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Lancaster University PhD

Doctoral Thesis

Ideological Dilemmas and Work-Related Musculoskeletal Disorders in Ultrasound Practice:

An Interpretive Phenomenological Analysis of the Lived Experiences of Sonographers

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Submitted to the Graduate School, University of Cumbria

This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor

of Philosophy

(December) 2022

i. Declaration

I declare that this is my own work and has not been submitted for the award of higher degree elsewhere. I confirm the word count for this thesis is 73,924 words (excluding acknowledgements, contents pages, reference list, and appendices).

Gareth C. Bolton (30/12/2022)

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iii. Abstract

Background: Since 2005, the UK government's Migration Advisory Committee has listed sonography as an official 'shortage specialty' (Migration Advisory Committee, 2019). Work-related musculoskeletal disorder (WRMSD), already widespread among sonographers, is increasing due to the additional physical stresses of working in understaffed environments (Harrison & Harris, 2015). While contemporary research has described the broad picture regarding WRMSD in ultrasound (Bolton & Cox, 2015), none has, to date, extensively explored its personal and professional impacts from a qualitative perspective.

Method: Extended semi-structured interviews with N=9 experienced sonographers working in the UK were conducted and analysed using a model of Interpretative Phenomenological Analysis (IPA) (Miller et al., 2017). Core thematic areas that emphasised personal and professional impacts of WRMSD were then further examined to highlight how participants specifically made sense of them.

Findings: The key ideological tensions evident in the findings pertained to those between individuality and collectivity, and freedom and necessity. Evidence indicated that the participants held a range of perspectives highlighted in the following themes: (1) 'WRMSD, Sonographer identity, attribution and context' which included acknowledgement, or denial, in terms of experiencing symptoms of WRMSD. (2) WRMSD and the cultural, professional, and environmental perspectives of sonographers. (3) Ideological dilemmas and WRMSD. The concept of Ideological dilemmas (Billig et al., 1988) provided the theoretical framework on which to build the final findings and analysis chapter.

Conclusions: Participants acknowledged their role as professionals, and also their own commitment to a broader altruistic model that reinforced their identities as good healthcare pro-

professionals. The concept 'ideological dilemmas' provided a useful analytic framework for understanding some of the everyday feelings of sonographers towards the phenomenon of WRMSD. Further exploration of the conceptual facility thereof is recommended in future studies.

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vi. Glossary of Terms

Agenda for Change Framework (AfC)	<i>National Health Service (NHS) grading and pay system for staff, excluding doctors, dentists, and some managers.</i>
Body Mass Index (BMI).	<i>A measure that uses height and weight to work out if an individual's body weight is healthy. The BMI calculation divides an adult's weight in kilograms by their height in metres squared. For example, A BMI of 25 means 25kg/m²</i>
British Medical Ultrasound Society (BMUS)	<i>A multi-disciplinary body that maintains standards of sonography practice, advance education and provide advice and information with regards to ultrasound.</i>
Chartered Society of Physiotherapists (CSP)	<i>Professional body, for physiotherapists</i>
Consortium for the Accreditation of Sonographic Education (CASE)	<i>An organisation which accredits ultrasound courses delivered within the UK. CASE is currently made up of 6 member organisations, BMUS, CSP, CoP, IPeM, SCoR & SVT: http://www.case-uk.org/</i>
Health and Care Professions Council (HCPC)	<i>an independent UK regulatory body responsible for setting and maintaining minimum</i>

	<i>standards of practice for health professionals, excluding doctors, nurses, and midwives.</i>
Health Education England (HEE)	<i>A Non-Departmental Public Body that supports the delivery of excellent healthcare by ensuring that the workforce has the correct numbers, skills and values and behaviours, in the right place at the right time to meet the needs of the public.</i>
Migratory Advisory committee (MAC)	<i>An independent, non-statutory, non-departmental public body that advises the government on professional migration issues.</i>
Centre for Workforce Intelligence (CfWI)	<i>The UK authority on workforce planning and development, providing advice and information to the health and social care system.</i>
Shortage Occupation List (SOL)	<i>A list which contains skilled worker jobs that the UK Government deems are in short supply within the UK labour market.</i>
Society and College of Radiographers (SCoR)	<i>Professional body and trade union for radiographers in the UK</i>
Society of Vascular Technologists of Great Britain and Ireland (SVT)	<i>Professional society for accredited vascular scientists in the UK and Ireland</i>

vii. Prologue

As a HCPC registered diagnostic radiographer, a qualified and experienced sonographer, and an academic working as an ultrasound programme leader, I wanted to gain a greater understanding of the experiences of sonographers working alongside the potential risk of acquiring a WRMSD. Having experienced some symptoms of WRMSD myself, as well as witnessing the significant and catastrophic effects this phenomenon has had on colleagues, I have felt inspired to want to learn more about what it is like for sonographers in the wider national field, across the UK.

The focus of my MSc dissertation in 2011 was around WRMSD and sonographer education, which resulted in the publication of Bolton and Cox, (2015). More recently I have worked with other programme leaders in developing an educational workshop on WRMSD, which I have delivered at 2 HEI's within the UK, which included my own ultrasound students. I have been actively involved in driving forward the reform of ultrasound education in the UK with involvements with meetings held by HEE, as well as sitting on the BMUS council and CASE committee. I have current first-hand clinical experience in medical ultrasound and continue to practice ultrasound in the NHS and therefore continue to have personal unique experience of WRMSD as well as the political, personal, and professional issues sonographers are facing in the current climate.

1 Introduction and Background to Study

1.1 Introduction to the Research and Rationale for the Study

This chapter aims to set out the foundations for this thesis, by discussing both its focus and purpose. The overall aims and objectives, ideas upon which this study builds, and the personal motivation of the author, were provided as a prologue outside the main structure of the thesis in the preceding section.

WRMSD is a worldwide public health problem (Arvidsson *et al.*, 2016). The UK had a prevalence rate of 530 cases of WRMSD per 100,000 people in 2014-15 with an estimated 9.5 million working days lost in the UK to WRMSD, which equates to 40% of workdays lost (Health & Safety Executive, 2015). More recently, the average prevalence of WRMSDs for workers in the health and social work sector was reportedly significantly higher than the average for all other relevant occupations, with 1,430 per 100,000 workers, averaged over the period 2018/2019-2020/2021 (Health and Safety Executive [HSE], 2022). Over the 2018/2019 financial year (pre-Covid-19 pandemic), cost estimates associated with self-reported workplace injuries within the UK were £18.8 billion, each year, for new injuries alone (HSE, 2020).

WRMSD is also specifically a significant problem within the sonographer population (Robson & Wolstenhulme, 2010; Sommerich *et al.*, 2019) with more than 80% of sonographers in the UK reporting WRMSD (Morton & Delf 2008, (Sommerich *et al.*, 2019). It is estimated that 20% may develop a career ending injury (Gibbs & Edwards, 2012; Sommerich *et al.*, 2019).

WRMSD is a complex, multifactorial condition that results from a combination of genetic, environmental, and behavioural factors ('Industry Standards for the Prevention of Work-Related Musculoskeletal Disorders in Sonography', 2017). Emerging research has attributed the growth in WRMSD to a vast and often diverse range of factors including repetitive tasks, in-

creased workload demands (Anderson *et al.*, 2019), lack of knowledge related to the phenomena (McDonald and Salisbury, 2019), irresponsible equipment manufacturers (Sommerich *et al.*, 2019), sedentary lifestyles, and reduced physical fitness (Evans, Kevin, Roll and Baker, 2009).

Several studies in the field of sonography have already emerged over the last decade outlining the nuanced problems that have increasingly been seen as an output of working with sonographers experiencing WRMSD, and the equally nuanced solutions that a practitioner may (or may not) find (Gibbs, and Young, 2009; Gibbs and Edwards, 2012; Gibbs, 2011; Gibbs, and Young, 2011; Bolton and Cox, 2015; Harrison and Harris, 2015; Harrison, Harris and Flinton, 2018; Harrison, 2015; Parker, and Harrison, 2015). Yet, very little further qualitative research of this order has to date emerged from within the radiological, or more specifically ultrasound, disciplines themselves, highlighting a significant gap in the current knowledgebase related to WRMSD and sonographers.

This study aims to provide an account of the unique perspectives of sonographers in terms of their experience and understanding of WRMSD and how these impact on their professional role and their lives in general. In particular, the study will explore the attitudes and experiences of sonographers towards WRMSD. Consequently, for this study an interpretive, qualitative approach is adopted with a view to opening further debates on this important issue within the ultrasound specialism, and specifically amongst sonographers, underscoring the complexity and nuances of the core issues, and highlighting some clear themes for future research.

1.2 Background to the Study

This section will outline the historical perspective which should contextualise this study in terms of how WRMSD has become a pertinent issue amongst sonographers and the wider ultrasound workforce in the UK.

1.2.1 The history of ‘Sonography’ developing as a ‘profession’ and the emergence of ‘Sonographer culture’

Before exploring the concept of WRMSD amongst sonographers it would seem prudent to provide a critical narrative of how sonography as a ‘clinical specialism’ or ‘profession’¹ has grown and developed over the past 50 years. It is important to recognise the specific nature of this development within the UK, to conceptualise the role of the sonographer in relation to the phenomenon of WRMSD.

At the end of World War 2, ultrasound began to develop roots in medical fields in the UK with the beginnings of commercial availability from the mid 1960’s (Lee & Paterson, 2004). In 1956, Ian Donald, University of Glasgow in Scotland, performed the first foetal head measurements and related the measurements to foetal age and weight, which was the beginnings of obstetric ultrasound in the UK (Baker, 2005).

The technological advances in the use of piezoelectric crystals led to developments of ‘real time’ grey scale ultrasound imaging which increased the rate of expansion of ultrasound as an imaging modality and in terms of widening the range of diagnostic applications (Gibbs, 2013). The developments have led to an increase in sophisticated ultrasound technology

¹ To date, ‘sonography’, ‘ultrasound practitioner’ ‘ultrasonographer’ or ‘sonographer’ are not regulated protected titles in the UK and consequently this specialism is not a ‘profession’ in its own right, although it is often anecdotally referred to as such.

which is able to make detailed assessments in pregnancy, evaluate moving structures (including blood flow and velocity measurements) and evaluate anatomy in 3 and 4 dimensions and assess stiffness of tissue which has led to ultrasound becoming a popular first line investigation for many anatomical regions of the body (Hoskins, Martin and Thrush, 2010).

Advancements in ultrasound technology, with rapidly improving diagnostic accuracy of ultrasound, have led to an exponential growth of the clinical specialism across a wide range of clinical applications including obstetrics, gynaecology, general medical, vascular, breast and musculoskeletal ultrasound to name but a few (Gibbs, 2013) which has concurrently led to a growing demand for ultrasound services nationally. Consequently, ultrasound has developed as a multi professional imaging modality owing to the heterogeneity of the clinical need nationally (Lee and Paterson, 2004). In turn, this has since led to a range of professionals using ultrasound, such as radiographers, midwives, physiotherapists, and vascular scientists across the UK.

Within the imaging field, medical ultrasound was initially predominantly carried out by radiologists, but since the 1980s radiographers have begun to take over much of the role, initially under the supervision of radiologists (Hart & Dixon, 2008) and by the 1980's radiographers performing most obstetric scans across the UK (Edwards, 2010). Being strongly under the auspices of radiography and radiology, sonography became a pioneer of role extension in the imaging field for radiographers as those performing ultrasound began initially to provide provisional comment on their images which was seen as progressive at the time (Gibbs, 2013).

The concept of sonographer reporting, or even commenting on the image, was initially contentious, with differing views between the ScoR (Society and College of Radiographers)

and the RCR (Royal College of Radiologists) (David, 2005). This debate was further challenged by the then regulatory body, Council for Professions Supplementary to Medicine, (CPSM). The requirements were such, at the time, that allied health professionals, including radiographers, would be in breach of their professional codes of conduct if they were to convey results of examinations or treatment to patients (Price, 2010). This was clearly problematic and would have prevented sonography becoming the clinical specialism it is today. Pressure increased, owing to clinical need, and at this point it was suggested that some employers were indeed allowing radiographers to 'exceed their professional constraints' which later resulted in the CPSM, now replaced by the HCPC (Health & Care Professions Council) removing the restriction from the professional standards (Gibbs, 2013).

In 1987 radiographers were eventually permitted to provide verbal and written comment on their scans and radiographs, which had previously been forbidden (Price, 2010). Consequently, this laid the foundations for further professional development and autonomy for radiographers and sonographers which is represented in current UK practice today. The (SCoR) have been pivotal, since the 1960's, in driving forward the sonography workforce to what it has become today, and particularly in terms of the development of clinical imaging reporting by non-medical professionals (Price, 2010).

Progression and development of the role has not been without its challenges and there were restrictions on practice whereby sonographers were initially heavily reliant on radiologists for professional support and supervision (Gibbs, 2013). Sonographers began initially by writing purely descriptive, rather than interpretive, clinical ultrasound reports based on scan findings. This later developed into reports of a gradually more interpretive nature, as the clinical specialism developed, which allowed these specialists to develop into autonomous practitioners (Hart & Dixon, 2008).

It is acknowledged that higher levels of autonomous practice continues to evolve, particularly at the time of writing this thesis, making significant improvement to patient diagnosis, and waiting times (Parker and Wolstenhulme, 2012; Mitchell, Nightingale and Reeves, 2019). Despite this progress, and the fact sonographers are now scanning in the region of 23% of all diagnostic imaging patients in the UK during the period 2021-22 (NHS England and NHS Improvement, 2022), sonography is still not a regulated profession. The main arguments against statutory regulation of sonographers are cost, tied in with the fact that many sonographers are already registered using a different professional title, e.g., radiographer, which means the bulk of the workforce are being 'taken' from other professions (SCoR, 2019). Consequently, other than via the new 'direct entry' routes, sonography has remained almost impossible to enter, as a specific career choice, for school and college leavers (SCoR, 2019), which has contributed to the national UK shortage of sonographers (Waring, Miller and Sloane, 2015).

The sonographer shortage has been the driving force behind many of the innovative moves by Health Education England (HEE) and some higher education institutions (HEIs) to tackle the issue and since 2016, there have been moves towards 'direct entry' routes into ultrasound, with two graduate entry masters routes opening at the University of Cumbria and the University of Derby and an undergraduate route at Birmingham City University (Waring, Miller and Sloane, 2015; Waring and Bolton, 2018). In March 2023, Sheffield Hallam University started its first undergraduate BSc (honours) apprenticeship route into sonography, the first of its kind to be CASE accredited (CASE, 2023).

Several recent commissioned projects have been completed which provide further evidence to the staffing crisis in sonography (Waring *et al.*, 2018; Miller *et al.*, 2018). Both studies arose from data collected from a HEE commissioned research project which explored the

need for 'direct entry' ultrasound education. Miller *et al.* (2018) examined how sonographers are potentially in a state of 'flux' in terms of moving from perceived 'stressful' roles in departments that are understaffed with a perceived high workload into either early retirement or less stressful roles in a related field, thus leaving a void of understaffing behind in many departments.

There is a disconnect between the challenges faced in staffing and the number of ultrasound examinations which need to be performed annually. The number of examinations performed by sonographers across the most recent 1-year period showed a significant increase ultrasound patients being scanned, when compared with 10 years earlier, and this has been summarised in Table 1 and Table 2 below:

	X-ray	Ultrasound	CT Scan	MRI	Fluoroscopy	Nuclear Medicine	PET-CT Scans	SPECT Scans	Medical Photography	% organisations included	Total
Mar	1,713,155	859,145	546,945	316,410	76,785	28,405	20,335	3,565	5,345	100.0%	3,570,085
Apr	1,751,420	817,485	536,790	298,130	74,705	25,680	18,605	3,300	5,115	99.4%	3,531,225
May	1,786,850	809,565	541,805	307,230	75,955	25,340	18,405	3,395	4,490	98.8%	3,573,035
Jun	1,931,755	882,385	560,400	322,065	84,300	29,010	20,590	3,980	4,845	99.4%	3,839,330
Jul	1,873,460	846,560	561,285	321,345	78,975	28,485	20,210	3,940	4,750	98.8%	3,739,010
Aug	1,747,035	788,190	545,950	313,100	72,505	26,345	18,450	3,705	4,270	98.8%	3,519,550
Sep	1,847,755	850,880	551,855	318,405	78,055	28,255	20,465	3,890	4,695	99.4%	3,704,255
Oct	1,828,325	831,030	562,055	330,650	74,755	27,855	21,155	3,530	4,760	98.2%	3,684,110
Nov	1,862,405	887,170	569,925	329,490	79,800	30,065	20,495	3,630	4,770	98.8%	3,787,745
Dec	1,681,300	794,485	550,685	303,555	70,550	25,900	18,440	3,315	4,805	98.8%	3,453,030
Jan	1,695,760	808,345	551,070	318,085	69,635	25,935	19,585	3,245	4,750	95.8%	3,496,410
Feb	1,603,365	763,775	512,155	297,280	67,910	24,515	19,450	3,025	4,505	93.9%	3,295,975
Mar	1,817,435	847,455	560,100	318,430	73,440	28,720	20,635	3,595	4,620	89.7%	3,674,430
Total	21,426,870	9,927,335	6,604,065	3,777,760	900,575	326,095	236,485	42,550	56,375	-	43,298,105

Table 1 Number of Imaging Examinations Performed in England within a 1 Year period From March 2021- March 2022²

(Taken from NHS England and NHS Improvement, 2022)

² 1. Activity not matched to a known organisation is omitted. 2. Data from April 2021 onwards remain provisional and subject to change. 3. Total row represents a rolling 12-month total and does not include activity from the earliest month in the table. Totals may not always equal the sum of the parts due to rounding (NHS England and NHS Improvement, 2022).

The data outlined in Table 1 (above) demonstrates the significant increase in workload for sonographers remained following the Covid-19 pandemic. Table 2 outlines the increase in ultrasound workload in the pre pandemic era, when the data collection for this study was completed. This therefore suggests an increase in overall relative workload pressure on sonographers, particularly in comparison to sonographer staffing resource currently available within the UK (SCoR, 2019).

	X-ray	Ultrasound	CT Scan	MRI	Fluoroscopy	Nuclear Medicine	PET-CT Scans	SPECT Scans	Medical Photography	% organisations included	Total ¹
2012/13²	21,174,005	7,687,850	3,346,840	2,349,160	1,018,620	437,155	71,080	11,390	6,085	93.6%	36,102,195
2013/14	21,832,985	8,140,175	3,780,405	2,614,865	1,028,735	446,365	75,255	16,350	10,530	97.8%	37,945,665
2014/15	22,576,785	8,566,470	4,199,515	2,890,310	1,018,100	439,655	89,165	21,850	16,180	99.2%	39,818,030
2015/16	22,570,870	8,916,225	4,461,650	3,084,815	1,040,560	432,755	97,990	25,900	23,945	99.6%	40,654,715
2016/17	22,913,795	9,368,335	4,815,200	3,358,515	1,052,750	423,860	132,760	35,420	31,225	99.7%	42,131,855
2017/18	22,908,795	9,507,560	5,146,475	3,464,010	1,025,330	417,460	154,270	40,015	37,550	100.0%	42,701,460
2018/19	23,467,930	10,161,965	5,665,930	3,743,995	1,034,025	421,650	177,330	45,365	52,875	99.8%	44,771,065
% Growth³	2.4%	6.9%	10%	8.1%	0.8%	1.0%	15%	13%	41%	-0.2%	4.8%

Table 2 Count of NHS imaging activity in England, 2012/13 to 2018/19

(Taken from NHS England and NHS Improvement, 2019)

The figures cited above provide comparable evidence of increased workload for UK sonographers over a specific timeframe, as well as the wider medical imaging workforce. There are however several restrictions to the current evidence, owing to several factors, in relation to the ultrasound workforce, missing from the current data, as outlined below:

The makeup, size, and age profile of the ultrasound practitioner workforce in England is not known because:
Sonography is not currently a regulated profession in the UK
There are multiple staff groups involved in ultrasound service provision
There are multiple national qualifications/certifications for ultrasound practitioners
Each staff group may have its own ultrasound practitioner qualification/certification
Organisations tend not to collect data on additional or specialist qualifications of its members
There is a lack of data detailing ultrasound activity by specialty/profession/staff group as organisations
There is a tendency not to collect data on ultrasound specific activity.

Figure 1 Limitations to the Data on the UK Sonographer Workforce

(Adapted from Professional Standards Authority, 2019)

Since 2005, the UK government’s Migration Advisory Committee has listed sonography as an official ‘shortage specialty’ (Migration Advisory Committee (MAC), 2019). Parker & Harrison (2015) also highlighted there are currently not enough sonographers in the UK to meet service need, again foregrounding the point that sonographers continue to be placed under increased workload pressures to keep up with caseload demand. The exponential rise in sonographer workload against the potential difficulty in growing the workforce remains a significant problem in terms of growth of the clinical specialism and increasing pressure on existing sonographers, and it is this sense of pressure which is inherent in sonographer culture (Mitchell & Nightingale, 2019).

The sharp increase in workload in ultrasound departments in the UK is a significant issue because, first there is clear evidence that sonographer numbers have not been monitored until the recent survey in 2017 (CfWI, 2017); second, the lack of a professional identify means that

sonographers are being sought primarily from the existing pool of diagnostic radiographers, which are also on the professional 'shortage' list (MAC, 2019). As a result, staff are being 'poached' from one shortage profession to potentially solve the staffing shortage in another, meaning there is no new source of sonographers from the graduate pool. Third, the significant shortage of sonographers would suggest that those remaining in ultrasound practice must manage the ever-increasing workload demands and cope with the resulting personal and professional pressure being placed upon them (Miller *et al.*, 2018).

Miller *et al.* (2018) found that sonographers are currently in a state of 'flux' in which experienced staff are tending to either move roles or retire relatively early leaving less experienced staff to carry the burden of increased workload and student training. It is acknowledged that this study was conducted with a relatively small sample size (n=20) and might not necessarily be representative of the entire sonographer population in the UK but all the same this provided an interesting concept, from a qualitative research perspective, for consideration against the wider national picture, particularly in the sense this study further supported the potential personal and professional impacts understaffing can have on the profession.

There are some slight improvements in the figures in the latest survey completed by the SCoR (2019), which demonstrated marginal increases in the number of sonographers under the age of 40, suggesting less short-term threat of losing sonographers to imminent retirement and a slightly lower vacancy rate of 12.4% since the previous survey in 2014. In addition, the current survey noted a higher percentage (47%) working full time, compared with only 35% in 2014 which could suggest a marginal improvement in staffing, albeit with more staff working more hours perhaps under more pressure. The researcher is also curious

whether the shortage of sonographers at a national level has become a catalyst for an increase in staff numbers working full time to meet workload demands. Interestingly only 5% reported WRMSD as a reason for sickness absence (SCoR, 2019).

In order to meet workload demands and patient expectations the NHS, since 2000, have been moving toward 7 days working (NHS Improvement, 2019). The SCoR provided guidance of ultrasound examination times, which included the assertion that sonographers themselves carry 'the professional responsibility' to ensure that the time allocated for each ultrasound examination is adequate to ensure safe practice (this includes performing the examination safely, accurately reporting the findings and competently dealing with any significant or urgent findings (Thomson, 2015)).

The role of the 'sonographer' in the UK has evolved over the past 40 years and within the area of clinical specialism, there are now a wide range of healthcare professionals providing ultrasound services nationally, although 'sonographer', 'ultrasonographer' or 'ultrasound practitioner' are still not protected, registerable, titles in the UK (Thomson & Paterson, 2014). The following definition of 'sonographer' is used in connection with the Public Voluntary Register of Sonographers, now transferred to the Register of Clinical Technologists (RCT). Sonographer has been defined as 'A healthcare professional who undertakes and reports diagnostic, screening, or interventional ultrasound examinations. They will hold qualifications equivalent to a Postgraduate Certificate or Diploma in Medical Ultrasound, BSc (Hons) clinical ultrasound or an honours degree apprenticeship that has been accredited by the Consortium for the Accreditation of Sonographic Education (CASE). They are either not medically qualified or hold medical qualifications but are not statutorily registered with the General Medical Council.' (Society and College of Radiographers, 2019).

Historically, ultrasound, or sonographer, 'training' was driven by clinical need at a local level (Parker & Wolstenhulme, 2012). This has since evolved over the years with many ultrasound departments continuing to train radiographers, already employed in the wider radiology department, to become sonographers, via the traditional postgraduate diploma or MSc ultrasound route (Waring, Miller and Sloane, 2015).

Demand for ultrasound services has increased exponentially over the last decade, and in direct response to this increasing demand in 1993 the Consortium for the Accreditation of Sonographic Education (CASE) was formed (Gibbs, 2013). CASE is made up from several independent professional organisations (see glossary). The role of CASE is to approve and accredit ultrasound education programmes and focused courses in the UK by working with higher education institutions (HEI) to ensure quality and benchmark standards of practice are being met (CASE, 2019). The development of CASE still continues to help by ensuring the robustness of the training programmes which are crucial in maintaining and growing the sonographer workforce in order to deal with the ever-growing demands.

According to Office for National Statistics (ONS), population numbers are set to rise, meaning there are predicted to be higher numbers of people aged over 65, by 2024, suggesting a greater demand for healthcare and consequently imaging services (ultrasound). There is consequently a growing pressure on the government and HEE to find strategies to solve the sonographer shortage given the UK sonographer workforce has been in a state of crisis for several years (Parker & Harrison, 2015; Mitchell & Nightingale, 2019). For the past six years several meetings have been held at a national level, across England, to develop a means to move forward. At the time of writing there has been a second attempt at lobbying for 'sonographer' to become a protected title, which to date has been unsuccessful and further

lobbying of parliament is expected in the years ahead (SCoR, 2019). In addition, approximately 60-70% of sonographers are registered radiographers, by professional background, and maintain HCPC registration using this professional title (PSA, 2019). As the title 'sonographer' remains unregulated there are an ever-increasing number of sonographers working in the UK without statutory regulation, often for a genuine reason such as eligibility being impossible. This has led to problems whereby a number of employers will not employ non-HCPC registered staff as 'sonographers'. This has created a 'chicken and egg' situation whereby universities offering 'direct entry' programmes in ultrasound must warn applicants, who are not already from a professional background, such as those with a science degree, that employment may not be possible in all situations which has led to some reluctance in clinical departments offering placements in the first place (Waring & Bolton, 2018). Conversely statutory regulation could open the floodgates to the rapid expansion of ultrasound training which at the present time continues to be moving forward cautiously (BMUS, 2022). It is estimated that there are now approximately 3,000 sonographers currently practicing in the UK, most of whom are employed by the NHS and private sector organisations (CfWI, 2017). However, this number is drawn from a range of clinical contexts such as radiology departments, community settings, agency/locum settings and self-employed/small business and because of the lack of data collection in this area figures remain debatable (Professional Standards Agency, 2019).

The ONS has predicted increasing population numbers in over 65's by 2024, which will reflect increasing demands on healthcare services (including ultrasound). In a report by the Health and Safety Executive (HSE) sonographers in the UK are reported to be completing between 12 and 20 scans per day, with most departments scheduling working in 15–20-minute slots (Monnington *et al.*, 2012), adding further pressures to already stretched ultrasound services.

The recommendations from a relatively recent Professional Standards Agency (2019) report acknowledged that although the risk of no regulation for sonographers is high, it suggested the risk is already mitigated through existing mechanisms e.g., existing regulation (radiographers, midwives, nurses etc.) who make up most existing sonographers across the UK. In addition, they referred to the fact that most working ultrasound departments are 'controlled environments' regulated by the CQC, which they suggested remains sufficient to provide adequate mitigation.

If there is to be an increase in the number of ultrasound graduates from 'direct entry' routes, then the report recommended that the government should consider the costs and benefits of statutory regulation of sonographers in the future. They did however express some caution, in terms of ensuring the flexibility of those already registered, as a different professional title may be required to ensure continued flexibility, and workability, of the sonographic workforce (PSA, 2019).

One of the challenges for professional societies and regulatory bodies is gathering the necessary evidence to continue to put pressure on the government to review the need for sonography regulation. One of the challenges is the makeup, and size, of the sonography workforce, which remains difficult to quantify, owing to the existence of multiple staff groups involved in ultrasound service provision, alongside multiple national qualifications/certifications for ultrasound practitioners. Organisations tend not to collect data on additional or specialist qualifications of its members or ultrasound activity by specialty/profession/staff group (CfWI, 2017).

At the time of writing there continues to be much debate regarding the future, particularly in terms of developing the sonography workforce, and how the challenges of understaffing and increasing workload are going to be met.

This section aimed to provide some background to 'sonography' as a clinical specialism, in terms of how it has emerged, and in doing so to conceptualise sonography as a career to better understand how WRMSD, as a phenomenon, is embedded within this workforce crisis.

1.3 Research Question:

The study aims to answer the following research question:

What are the key experiences of sonographers living with the associated risk of WRMSD?

1.3.1 Aim

The aim of this study was to gain a deeper understanding of the unique experiences and the personal perspectives of sonographers and WRMSD.

1.3.2 Objectives:

1. To perform a scoping, narrative (literature) review to outline the gaps in the current knowledge base.
2. To understand sonographers' individual and unique experiences of carrying out their current role alongside the inherent associated risk of WRMSD.
3. To evaluate sonographers' understanding of WRMSD and how this phenomenon impacts on their professional experiences, relationships, behaviour and thinking.
4. To further understand sonographers' personal experience of WRMSD considering what is currently understood about the phenomenon through their professional practice.
5. To gain an insight into sonographers' experience of WRMSD in terms of the potential impact this might have on themselves, their colleagues, the wider professional population, and any political implications.

2 Literature Review

2.1 Introduction to Literature Review

This chapter will provide a critical narrative of the current literature related to WRMSD through a critical evaluation of the relevant publications. In Section 2.1, an outline of the literature search strategy is provided, with additional detail available in the appendix section [Appendix 1]. The literature review follows a scoping and narrative review approach (Munn et al., 2018) with the aim of providing a contextual overview of the literature relating to the research question in order to highlight the relevant gaps in knowledge. Section 2.2 evaluates the literature relating to the anatomy, symptoms and effects of WRMSD and potential economic consequences of WRMSD in ultrasound. Section 2.3 discusses the potential causes of WRMSD. This section initially begins by exploring the phenomenon outside of the field of sonography and then later focuses specifically on sonography and practitioners within this field (sonographers). Section 2.4 to Section 2.9 also provide a synthesis of the literature pertinent to the research question and sonographers' experience of WRMSD. These focus on issues such as scan techniques, the influence of patient obesity, workload pressures, lifestyle considerations, psychological effects, and ergonomic concerns. Despite limited direct literature being available relating to the research question, this review includes insights from sonographers worldwide, along with those specifically from the UK. It also explores their perceived roles, viewpoints on the causes of WRMSD, and their reported experiences in identifying and managing WRMSD across diverse clinical ultrasound contexts. Furthermore, the review explores wider significant issues such as the training of sonographers. It also examines how the how the structure and functioning of healthcare services, both within the UK and overseas, impact their professional roles. The literature review also focuses specifically on the perspectives of sonographers, including potential measures to combat WRMSD such as muscle

strengthening exercises. It also incorporates additional literature on current clinical needs in ultrasound, expectations placed upon sonographers, and the views and experiences of sonographers regarding their current working environments. The summary in section 2.9 brings together the current salient points within the debate in relation to sonographers' experiences of WRMSD. It also underscores the gaps within the present understanding, which this study aims to fill. This review reaffirms the significance of the central research questions within this thesis.

A combination of a 'scoping review' and a 'narrative review' was deemed to be a useful methodological approach to the literature review, for this particular study, in order to examine emerging evidence in terms of what was already known to be an under researched area of ultrasound practice. Scoping reviews are advantageous where clarification around a concept or theory is required and where it is difficult to determine where one method ends and another begins, while still following a robust and systematic search strategy (Munn *et al.*, 2018). A narrative review provides a scholarly summary, alongside interpretation and critique, to establish what is already known about the subject, the nature of the knowledge-base, and how that informs clinical practice (Greenhalgh, Thorne and Malterud, 2018).

A thorough review of available evidence was completed to investigate the research question concerning sonographers' experiences of WRMSD. This review involved exploring pertinent databases and websites. The search process began in October 2013, coinciding with the start of the Doctorate, and has continued systematically until November 2022. The approach followed the methodology outlined by Booth, Sutton, and Papaionnou (2016). The key words in the search strategy included, "WRMSD", "Work-related injury", "msk", "experiences", "pain", "views", "sonographers", "ultrasound practitioners", "working practices", "ultrasound", "prevention", "identification", "treatment" and "management" which were entered

into the University of Cumbria's 'One Search', followed by focused searches using MEDLINE, Science Direct, CINAHL and Google Scholar (See Appendix 1 for further details on the key word search strategy employed).

The literature review was enhanced by access to reports and publications completed by the relevant UK professional bodies and societies, such as BMUS, CASE, SCoR, as well as government reports and standards, such as the Health and Safety Executive (HSE) and the Professional Standards Agency (PSA). Studies published in the English language between 1980 and 2022 were included and studies were in the main limited to those related to countries and regions with a high degree of applicability to the UK, including the USA, Canada, Western Europe, Australia and New Zealand. Some older publications were excluded where findings were no longer deemed relevant to current ultrasound practices or when they were unable to offer a relevant historical perspective.

A 'snowballing' effect was utilised to gather additional literature using the reference lists of studies found using the systematic processes, described above (and in Appendix 1).

2.2 Anatomy Symptoms and Effects of WRMSD

2.2.1 Introduction

This section provides a critical narrative review of WRMSD in relation to the anatomical regions the phenomenon potentially affects, the symptoms it produces and the fundamental effects it has on careers, as well as the potential impact it has on lives outside of the working environment, specifically focusing on sonographers.

It is useful to reflect on the fact that the term WRMSD has differing interpretations and syntax, for example the concept of 'discomfort' and 'disorder' are often confused or misinterpreted (Sommerich *et al.*, 2016). Earlier in the background section (1), it was acknowledged that WRMSDs are a complex phenomenon and highly under researched.

WRMSDs have therefore been described as a 'major public health problem' (Arvidsson *et al.*, 2016) supporting the need for urgent action to tackle this debilitating issue, which is compromising many professions, and more specifically and most pertinent to this study, songwriters. To better understand the phenomenon, it is first prudent to explore the anatomical regions, affected by WRMSD.

2.2.2 Anatomy

WRMSDs cause pain, affect joints, can alter body shape, and may result in reduced range of movement (Public Health England, 2019). There are a sizeable number of musculoskeletal conditions (up to 200) which may affect a range of anatomical regions including muscles, bone, soft tissues, joints, and spine (Jellad *et al.* 2013). Furthermore, WRMSD may also include all types of arthritis with Street *et al.* (2003) previously suggesting the main anatomical regions affected being the upper extremities, neck, shoulders and trunk.

In some cases, the precise anatomical region affected can be impossible to specifically identify. Vries *et al.*, (2013) discussed the term 'chronic non-specific musculoskeletal pain' (CMP), which is an umbrella term covering symptoms which do not necessarily pertain to a specific anatomical region. Earlier Malmgren-Olsson, Armelius and Armelius (2003) discussed the challenges of categorising pain-related musculoskeletal conditions such as myalgia and fibrositis. Consequently, WRMSDs are difficult to define and are challenging to diagnose which is

supported by all current studies to date (Scopel, Oliveira and Wehrmeister, 2012, Hogan, 2021, Evans, et al., 2022).

The most injured anatomical regions amongst sonographers tend to be the shoulder (84%), neck (83%), wrist (61%), back (58%) and hands (56%) (Coffin & Baker, 2007). Furthermore, the lower back, hands, wrists, forearms, elbows, shoulders and neck are especially significant problem areas (Eatough, Way and Chang 2012, Esmaeilzadeh, Ozcan and Capan, 2014).

WRMSDs are also dependent on the work or occupation being carried out (Fischer and Woodcock, 2012). WRMSD in sonographers, like in other occupations, affects a range of anatomy, leading to inflammatory and degenerative processes taking place, exasperated by small repetitive stresses to muscles and tendons that occur over time and include conditions such as carpal tunnel syndrome, tendonitis, bursitis and epicondylitis (Muir *et al* 2004, Hogan, 2021). This phenomenon is caused by repetition, sustained force, awkward postures and direct pressure (Dyrkacz, Mak and Hec, 2012). These injuries, which affect soft tissue, nerves, muscles, ligaments and tendons, consequently, lead to symptoms of pain and eventually incapacitation (McDonald & Salisbury, 2019; Simonsen *et al.*, 2018) resulting in micro-trauma.

WRMSDs include several inflammatory and degenerative disorders involving muscles, tendons, joints, nerves, and blood vessels which can result in prolonged pain and disability, (Aptel, Aublet-Cuvelier and Cnockaert, 2002). Sonographers may develop small muscular tears which occur due to the repetitive fine movements of the hand, wrist, elbow, and shoulder due to manipulation of the ultrasound transducer when performing an US scan and these small tears can worsen over time (Engen, 2010). WRMSD in sonography is not a new phenomenon, the term 'sonographer's shoulder' was coined by Craig as far back as 1985 (Scholl & Salisbury, 2017).

Table 3 outlines some of the figures from a series of published articles, outlining the respective anatomical regions affected by WRMSD, demonstrating the serious potential implications this phenomenon can have on sonographers.

The main anatomical areas affected by WRMSD, in terms of pain and discomfort, a comparison of the findings of three earlier studies				
Figures derived from:	Mazzola <i>et al</i> (2017) %	Miles (2005) %	Pike <i>et al</i> (1997) %	Necas (1996) %
Neck	74	66	73	76
Upper Back	(Back) 58	45	60	53
Middle Back		29	40	-
Lower Back		48	65	46
Shoulder	76	67	73	66
Upper Arm	-	34	38	-
Forearm	-	29	35	33
Wrist	59	47	65	61
Hands/Fingers	55	43	60	47
Elbow	-	32	-	33

Table 3 Anatomical Areas Affected by Pain and Discomfort

(Adapted and further updated from an original version within an earlier systematic literature review by Morton & Delf, 2008)

In terms of biomechanics, WRMSDs arise because of repetitive action of muscle groups which exceed their biological tolerance levels, leading to injury to the muscles or tendons which can result in shorter or longer-term pain, discomfort, and disability (Lanfranchi and Dubeau, 2008). Furthermore, biomechanical muscular stress, initiated by repetitive or awkward posture, eventually may lead to WRMSD (Eatough, Way and Chang, 2012). Static postures can also be problematic, potentially leading to nerve compression and pain (Omer *et al.*, 2004). WRMSD can also be a result of sudden or unexpected movements such as compression, contraction rotation (twisting) and shear forces (Trinkoff *et al.*, 2003) consequently affecting the respective anatomical regions highlighted in Table 3 above.

Anyone can develop muscle imbalance from sustained suboptimal postures, and imbalance between agonist and antagonist muscles of a joint, or imbalance between dormant and non-dormant muscles (handedness can be an example of this) (DeMont, 2004). Overall, the factors that can lead to WRMSD are all typical to a sonographer’s working environment.

Table 4 illustrates some of the anatomy affected by repetitive motion:

Repetitive Movements	Prevalence
Wrist/Hand Motion	
Repetitive	92%
Awkward Position or Bending	100%
Twisting	62%
Arms/Shoulders	
Repetitive	100%
General	
Sustained Positions	92%
Repeated Stretching/Reaching	84%

Repeated Pressing/Twisting	77%
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Table 4 Anatomical Regions Reported To Be Affected by Repetitive Motion

(Adapted from Christensen, 2001)

2.2.3 Symptoms

The symptoms of WRMSD remain as variable as the phenomenon itself (Barros-Gomes *et al.*, 2019). It is generally accepted that muscular discomfort and/or pain may be an early sign of WRMSD. Studies reporting short-term musculoskeletal discomfort, linked to an individual's occupation, confirm that this is a predictor of potential longer-term musculoskeletal pain as well as WRMSDs (Serranheira *et al.*, 2015). WRMSD includes a range of conditions such as tenosynovitis, bursitis, tendonitis, carpal tunnel syndrome and epicondylitis (Spence *et al.*, 1995) and consequently the associated symptoms are wide-ranging. What is common among sufferers of WRMSD is that they tend to experience symptoms of pain or tenderness following a period of intense repetitive work-based activity (Dong *et al.*, 2019).

Most studies agree that, because of the latter, individuals typically report symptoms such as muscle weakness, swelling, skin discolouration, painful skin to the touch, increased sensitivity to pain (hyperalgesia), burning or tingling sensation (paraesthesia) (Anderson, *et al.*, 2019). It is widely accepted that WRMSD do not always fall into specific medical diagnoses (Melaku Hailu Temesgen *et al.*, 2019) and consequently symptoms are often difficult to categorise, making the phenomenon difficult to diagnose.

Further studies report additional symptoms of WRMSD, which include loss of grip, pain, tingling and numbness in the fingers and numbness in the hand or forearm (Ripat *et al.*, 2010). Staal, de Bie & Hendriks (2006) earlier cited similar symptoms, which also included, stiffness, clumsiness, loss of co-ordination, loss of strength, skin changes and temperature differences

as significant predictors of WRMSD. Symptoms arising from WRMSD can initially begin as quite mild, sometimes presenting with a dull ache or a tingling sensation in the affected area, which may disappear after a rest period, but can later develop into irreversible more painful conditions (MacDonald & Scott 2013). In some cases, WRMSD may present as soft tissue pain, which can be made worse by work-related activity (Wooten, 2019).

In general, healthcare professionals affected by WRMSD reported experiencing symptoms of biomechanical strain from manual handling of objects and people, which contribute to the gradual development of WRMSD (Nilsson, Lindberg and Denison, 2010). WRMSD symptoms, reported in the sonographer workforce, also seemed to be representative of the latter (Gibbs and Young, 2011), with symptoms tending to be unique to individuals, and their respective role, which has significant heterogeneity among sonographers. Swinker & Randall (2007) noted that incidence of pain was proportional to increased length of scan time and suggested the type of scan and patient type were also influencing factors (Harrison, Harris and Flinton, 2018).

Furthermore, several studies reported sonographers were also experiencing generalised pain, both when performing ultrasound scans and in the evening following their working day (Al-Rammah *et al.*, 2017; Simonsen *et al.*, 2018). Earlier studies concurred, reporting that up to 89% of sonographers reported experiencing symptoms of pain as a direct consequence of their work (Swinker & Randall, 2007; Gibbs and Edwards, 2012).

A study by Ilce (2014) discussed this point further and argued that diagnoses such as myalgia or carpal tunnel syndrome can be defined as 'musculoskeletal disorders', while symptoms such as 'pain and aches' are classed as 'discomforts', which may be reversible. This highlighted a debate across several studies regarding which specific symptoms should be specifically classified as WRMSD. This may lead to misunderstanding and lack of clarity amongst the

general population and specifically amongst sonographers themselves. This lack of understanding of the phenomenon is a significant gap in the current knowledge base (Bolton and Cox, 2015) and will be explored further in this study.

The definition of the term 'WRMSD' and specifically, what this term means to sonographers, needs to be explored further to highlight potential gaps in sonographers' current understanding of the phenomenon. Table 5 is related to guidance produced by the Society and College of Radiographers (SCoR) and it has highlighted that symptoms of WRMSD are thought to occur in stages:

<p>STAGE 1 (MILD): The first symptoms are a dull pain or a tingling sensation in the affected area which gets better when rested. At this stage, the condition is reversible and is known as threatened over-use injury.</p>
<p>STAGE 2 (MODERATE): If the condition is left unchecked at the mild stage recurrent pain aching and tiredness will occur earlier in the working day and will persist at night possibly disturbing sleep. There may be a visible swelling. The condition may be reversible at this stage but only by complete rest from the task that has brought on the injury in the first place.</p>
<p>STAGE 3 (SEVERE): The pain along with weakness and fatigue can be felt even when resting completely. Sleep can be disturbed, and it may not be possible to carry out even the most mundane tasks at home or work. This stage may result in permanent disability.</p>

Table 5 Stages of WRMSD symptoms

(Adapted from SCoR, 2002 and SCoR, 2019)

2.2.4 Effects on Sonographers

The symptoms, highlighted in Table 5, may have a significant impact on sonographers, potentially reducing their ability to scan (ScoR, 2019). Evidence suggests the nature of the job

requires some 'non-ergonomic' positioning, which is virtually impossible to avoid (Sommerich *et al.* 2019). This fundamentally means that solutions for mitigating the effect of such actions, in terms of WRMSD, can be significantly more challenging for this specific workforce (Coffin, 2014).

Sonographers have an awareness of their part in contributing to their own increased risk of WRMSD (Mogan and Motamedi, 2019; Gibbs and Edwards, 2012). In spite of this, evidence suggests many sonographers continue to scan while experiencing symptoms of discomfort which is thought to be exacerbating the problem (Butwin *et al.* 2017). Consequently, this in part may be leading to increased incidence of WRMSD and subsequent longer term higher levels of sickness absence across the workforce (Burnett and Campbell-Kyureghyan, 2010). For example, an earlier study, which explored the frequency of wrist exertions related to associated discomfort (Khan, O'Sullivan and Gallwey, 2010), found that by assessing the impact of forearm and wrist flexion and extension, excessive pronation and supination of the wrist and forearm provoked discomfort when extended beyond the 60% range of movement mark. It is acknowledged that the findings of this study need to be viewed with some caution. Primarily, as all participants were male the inclusion of female participants may have potentially altered the overall findings. The study did highlight some of the challenges faced by those performing ultrasound examinations on a regular basis. In particular because of the nature of the range of movement required for the role, the challenges faced in avoiding such movements are apparent and in part seen as unavoidable.

The serious health risks, both physical and psychological, associated with WRMSD among sonographers are also becoming more recognised (Scholl & Salisbury, 2017). Furthermore, these risks are likely to have major implications for both sonographer health and wellbeing, and in terms of overall costs to employers (MacDonald and Scott, 2013). Table 6 illustrated

some of the anatomy and the prevalence of significant effects from repetitive movement, specifically related to echocardiographers.

Repetitive Movements	Prevalence
Wrist/Hand Motion	
Repetitive	92%
Awkward Position or Bending	100%
Twisting	62%
Arms/Shoulders	
Repetitive	100%
General	
Sustained Positions	92%
Repeated Stretching/Reaching	84%
Repeated Pressing/Twisting	77%

Table 6 Anatomical Regions Reported To Be Affected by Repetitive Motion

(Adapted from Christensen, 2001)

2.2.5 Summary

This section has outlined the anatomy affected, the symptoms of WRMSD (more broadly and specific to sonographers) and how these effects relate to WRMSDs and sonographers. A range of anatomical regions can be affected by WRMSD across many professions. There is still some degree of debate in terms of how WRMSDs are categorised, highlighting some of the nuances particularly related to WRMSD amongst sonographers, which need to be explored further. The literature has highlighted a general consensus that the symptoms of WRMSD are broad, and variable from individual to individual, and tend to be specific to the

role being undertaken. There is also broad agreement in the literature that the potential effects of WRMSD on individuals can be catastrophic, in some circumstances, resulting in a career ending injury highlighting the seriousness of the phenomenon.

The next section will discuss the underpinning causes which lead to WRMSD. Whilst the causal factors of WRMSD are complex, these will be explored in more detail.

2.3 Causes of WRMSD:

2.3.1 Introduction

The previous section discussed the anatomical regions affected by WRMSD. The aim of this section is to provide a critical narrative review on the causes of WRMSD evident in the current literature, which aims to highlight the gaps in knowledge, which this study aims to fill.

The challenges of identifying the precise causes of WRMSD are not a new concept in sonography and it is acknowledged that the causes are multifactorial (Gibbs & Young, 2011). Furthermore, these are linked to a broad range of conditions and situations which are often considered complex and inter-related (Simonsen *et al.*, 2018). The views held by Sonographers about the causes of WRMSD have been highlighted in only a small number of studies, for example (Gibbs and Edwards, 2012; Bolton and Cox, 2015; Simonsen *et al.*, 2018), but in the main, these confirm the complexity in determining the causes and acknowledge the wide range of factors which may lead to WRMSD, acknowledging the paucity of research in this field.

This chapter has gathered the current evidence into themes, which will be explored through a critical narrative review. Each section will explore some of the findings from wider professional fields before focusing on sonography specifically.

2.3.2 Generic Causes of WRMSD

Figure 2 (below) is a conceptual framework, developed as a tool for understanding WRMSDs, and this illustrates the fundamental elements of working conditions which may impact on workers' musculoskeletal health (Karsh, *et al.*, 2001). Central to this model is the individual, with the respective parts of the work which can influence the individual's risk of WRMSD on the left. The 'task' is fundamentally related to what the individual job role involves, and 'technology' relates to the technologies, which may be present to assist the individual in performing the relevant task. Combined, these two factors affect the job itself and the physical demands placed upon the individual. Finally, the working environment and the workplace organisation combine to ascertain the true nature of the job role, including the peculiarities of what that involves, and consequently how these impact on the individual, both in a physical and psychological sense. Disconnect between working environment and workplace organisation may therefore lead to additional strain on the individual (Karsh, Moro and Smith, 2001) consequently leading to WRMSD.

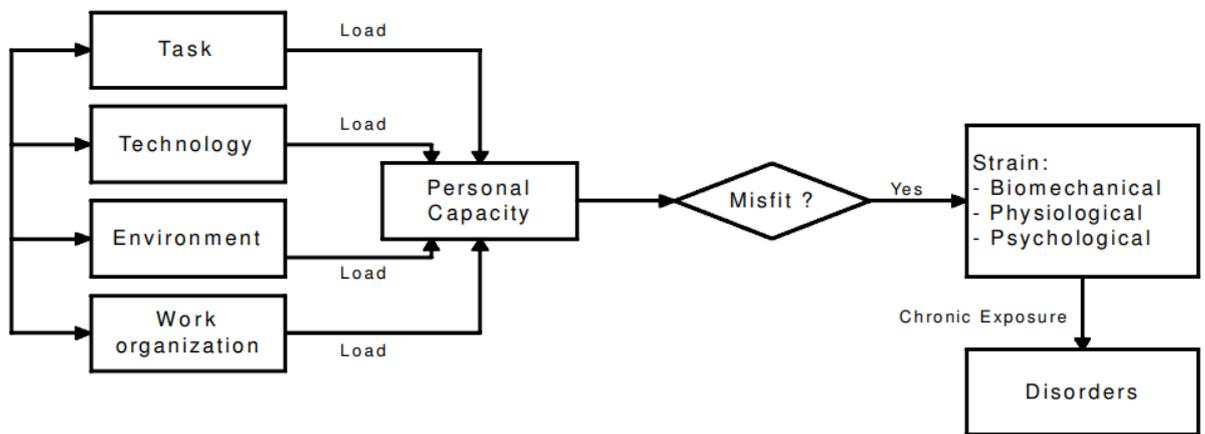


Figure 2 Conceptual Model of the Development of WRMSD

(Karsh *et al.*, 2001)

2.3.3 Causes of WRMSD in Sonographers

The next sub-sections will explore the relative biomechanical, physiological, and psychological causes of WRMSD amongst sonographers through a critical narrative.

2.3.3.1 Biomechanical Causes

Biomechanical causes are one ‘umbrella term’ for some of the main physical causes of WRMSD, and these include ultrasound scanning postures, excessive force used in performing a scan and poor workplace design (Coffin and Baker, 2007). A summary of the biomechanical causes of WRMSD can be found in Table 7 below.

Biomechanical Causes of WRMSD
Vibrations Overuse Excessive force/strain Forceful/awkward movements Poor posture/improper positioning Repetitive motion Sustained duration of pressure

Table 7 Biomechanical Causes of WRMSD

(Adapted from Baker and Coffin, 2013)

It is acknowledged that, except for ‘vibrations’, all of the causes in the table above are pertinent to sonographers (Morton and Delf, 2008; Coffin, 2014). Furthermore, few recent reviews, related to causes of biomechanical overload in healthcare, are evident in current literature (Simonsen *et al.*, 2018; Sommerich, 2018; Occhionero, *et al.*, 2014; Burnett and Campbell-Kyureghyan, 2008). Although the previous section discussed the anatomy affected by WRMSD, this section will further evaluate how this is related to the causes of WRMSD.

In terms of sonographers, Evans *et al.* (2010) outlined the biomechanical factors considered to be the main causal factors of WRMSD amongst sonographers which are highlighted in Table 8 below:

Causes of WRMSD amongst Sonographers
1. Fine transducer movements combined with gripping it tightly may lead to trauma of the minute muscle fibres of the fingers, hand and forearm.
2. Twisting and bending of the wrist to improve transducer contact with the tissue surface can lead to strain in the soft tissues of the wrist joint.
3. Sustained abduction of the shoulder with the elbow away from the body while scanning affects musculoskeletal changes throughout the shoulder and arm.
4. Sustained bending, twisting, and rotation of the torso and neck to complete examinations and interface with the equipment stresses multiple musculoskeletal components.
5. Compromised workspaces contribute to poor postures that must be maintained for prolonged periods during the patient examinations, straining joints and fatiguing muscles.
6. Innovation in computer and digital image acquisition has increased examination efficiency, thereby increasing productivity and workload requirements and decreasing rest periods between examinations.
7. Individual factors of height, age, and gender of the sonographer have an influence on the ability to withstand daily, repeated stress on the body.

Table 8 Summary of specific biomechanical factors, which may contribute to WRMSD

amongst sonographers(Adapted from Evans *et al.*, 2010)

As illustrated in the table above, the study by Evans *et al.* (2010) highlighted that, at the time of publication, documentary evidence surrounding the causes of the phenomenon were not

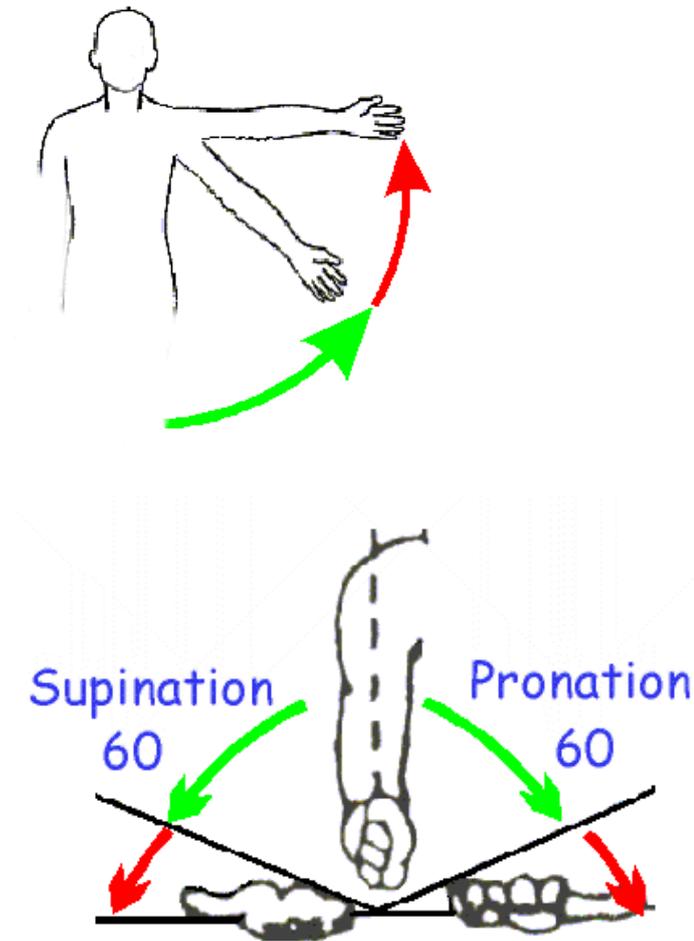
adequately supported by any underpinning research and consequently data was only anecdotal and focused mainly on biomechanical forces and did not consider any potential psychosocial causes (these will be discussed at the end of this section). Consequently, Evans *et al.* (2010) suggested an integrated approach is needed to capture the nuances surrounding this phenomenon to better understand the causes of WRMSD.

2.3.3.2 Posture

'Posture' has been a recurring term frequently used when referring to WRMSD in a variety of vocational roles ranging from office work to engineering, healthcare, factory work, musicians and even hairdressing (Coenen et al., 2016). The way humans 'physically' operate, particularly within their working lives, is attributed to the overall health and wellbeing they experience (Smyth et al., 2017) This section aims to explore the concept of posture, related to WRMSD in wider professional contexts, later focusing down to the role of the sonographer.

Posture, in terms of being a risk factor for WRMSD, relates to the position of a part of the human body relative to another adjacent part, measured by the angle of the joint connecting them (Butwin *et al.*, 2017). WRMSDs are commonly associated with poor posture (Butwin *et al.*, 2017; Armstrong *et al.*, 1993). Each joint in the human body has what is known as, a neutral range of movement. This is attributed to movement, which does not usually require a high muscular force, and does not cause discomfort to the individual (Butwin *et al.*, 2017). When the degree of strain, applied to relevant muscle groups, becomes frequent and unbalanced, WRMSD is more likely to occur (Wareluk and Jakubowski, 2017). Although posture can be said to have a 'safe' range, the point where this is exceeded, and the respective posture is considered to become a 'risk-factor', varies considerably between individuals. Furthermore, this is dependent on several personal factors including age, muscle strength and gender (Soares, Jacobs and Sharan, 2012).

Some pictorial examples, of various scanning postures, have been highlighted in Figure 3.



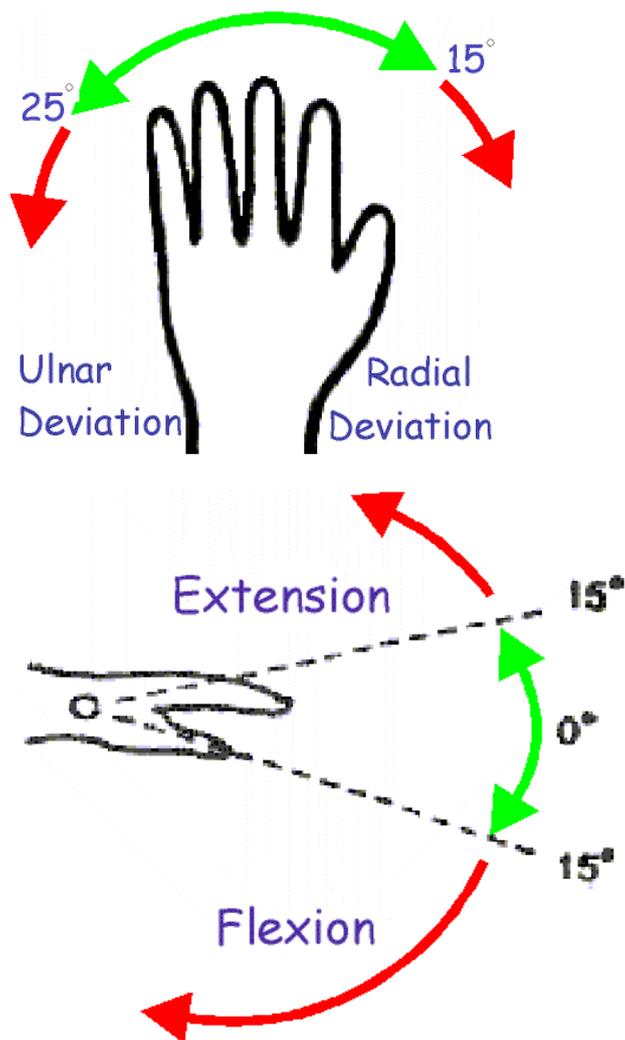


Figure 3 Safe and Unsafe Ranges of Movement for the Shoulder, Forearm and Hand

(Images taken from Dodgeon and Newton-Hughes, 2003)

The comfortable 'range', which is peculiar to the individual, is determined by the range of deviation that specific joint can usually accommodate (Lötters and Burdof, 2002; Sweeney *et al.*, 2022). Static posture has also been identified as a potential risk factor for WRMSD, in some cases, attributed to the accumulation of lactic acid, subsequently leading to muscular discomfort, fatigue and pain (Kilbom, 1990; Hogan, 2021). The effects of bending or twisting have also been identified among workers in several different occupations, for example, off-

shore workers, earth moving operators, carpenters, and office workers as well as sonographers (Riihimaki *et al.*, 1989; Sweeney *et al.*, 2022). As with task-repetition, poor posture increases WRMSD risk for an individual, when combined with applied force, which is a significant factor in many aspects of sonography work (Hogan, 2021).

The shoulder has also been identified as a particular 'problem' region across a range of professional and occupational fields. Village and Trask (2007) suggested that there are three main causes of shoulder injury: (1) compression of the supraspinatus tendon, (2) reduction in blood supply to the supraspinatus and infraspinatus muscles and tendons, when the arm is elevated, (3) prolonged static contractions leading to muscle fibre damage. Furthermore, they suggested sonographers continually elevating their arm beyond 30 degrees from their trunk is a leading cause of the above.

Similarly, wrist and forearm postures (continually extended from the neutral range) combined with sustained force, particularly at the fingertips, have been found to increase pressure within the carpal tunnel in a cumulative fashion. If such pressure is high or prolonged, this can cause irreversible damage (Viikari-Juntura & Silverstein, 1999; Melaku Hailu Temesgen *et al.*, 2019). In addition, the ability to perform other tasks (e.g., lifting or pushing) in awkward postures is also significant and this may lead to limitations with mobility, stability, and balance (Vink, Koningsveld and Molenbroek, 2006).

Within the ultrasound workforce, posture is also seen as a leading cause of WRMSD for sonographers who adopt a 'tense' posture, thought to be more susceptible to WRMSD (Gibbs and Edwards, 2012) than those who are more relaxed. The concept of a 'right' and 'wrong' posture is somewhat difficult to conceptualise amongst sonographers, as each sonographer is physically unique and the way in which each individual performs their work varies enor-

mously (Luttmann, Schmidt and Jager, 2010). There are also challenges in applying generalised ideas to different individuals resulting in conflicting perceptions on what the 'correct' posture should be. Across the literature reviewed, studies often focused their discussion on extreme examples of 'good' or 'bad' posture and suggested a potential range of debatable 'acceptable' compromises in between these extremes (Simonsen and Gard, 2016), which highlighted the need for further research to be carried out in this area. None of the studies reviewed have explored the subtleties of sonographer behaviour. More specifically, no studies have captured why certain physical working practices are adopted, such as 'poor posture', even when they are widely known to cause discomfort, and more importantly, increase the sonographer's risk of acquiring WRMSD.

Figures 4 and 5 are examples of perceived 'good' and 'bad' posture, which have been produced in a simulated environment, to contextualise some of the 'typical' scanning positions which may be observed amongst sonographers working in clinical ultrasound practice. One of the fundamental gaps in current evidence, which this study ultimately aims to fill, is to better understand why sonographers work in a particular manner and what perceptions exist between perceived 'good' and 'bad' practice.



Figure 4 Example of optimal posture, noting no greater than 30° right arm abduction, with the wrist and ultrasound cable supported.

(Image taken from www.medical.philips.com)



Figure 5 Example of suboptimal posture noting greater than 30-degree right arm abduction, with the wrist and ultrasound cable unsupported, with stretching of the left arm (adjusting the console controls) potentially adding additional strain on the sonographer's arm. In addition, note the twisting of the sonographer's neck.

There is evidence, from the last decade and beyond, that improvements in knowledge and awareness of WRMSD are developing in ultrasound departments across the UK (Morton & Delf 2008; Gibbs, 2011; Gibbs and Edwards, 2012). It is acknowledged, across much of the available literature, that there are many challenges to reaching a consensus, in relation to the exact causes of WRMSD. Many of the current studies are still concluding that further research is necessary in this field to draw reliable conclusions (Scholl and Salisbury, 2017). This therefore further foregrounds the present gap in the current knowledgebase.

Morton & Delf (2008) concluded, from their earlier systematic literature review, that poor posture is a main cause of WRMSD in sonography. Again, the authors suggested that further research is required to establish what the exact ergonomic issues are within the practice of ultrasound. However, the situation would seem to be far more complex than initially suggested, and more recently Tator and Truluck (2017), in their very limited systematic literature review of (n=2) literature sources, explained that sonographers are often working under significant time constraints. They concluded that consequently sonographers may take unconscious 'short-cuts' which may result in less favourable working postures being adopted, such as failing to re-adjust their working environment either between or during each ultrasound examination, which may be increasing their risk of acquiring WRMSD. The underlying reasons why sonographers may work in this manner remain under researched, and unknown, and will be explored later in the thesis. Furthermore, these issues have not yet been adequately explored through any recent studies to date, highlighting a significant gap in the current evidence. This has highlighted the need for further studies of a qualitative design which can explore the personal lived experiences of sonographers and WRMSD (Simonsen and Gard, 2016).

Despite the emerging gap in research within this field, it is acknowledged that several other observational type studies have been carried out, over the years, including Friesen *et al* (2006) who conducted an observational study using video recordings of sonographers undertaking ultrasound examinations. This study concluded that sonographers experienced the most pain and discomfort from gripping the transducer “with a firm grip, downward pressure, flexed wrist combined with shoulder abduction and forearm pronation or supination”. Although the study highlighted some potential WRMSD causes, because of the technical aspects of the role, it remained unclear as to why the sonographers in the study allowed themselves to experience this type of pain, and yet continued to scan patients (when in pain) without trying to address the underlying cause. This further highlighted the need for more qualitative studies, which may explore this phenomenon further.

When performing ultrasound examinations, there are a range of potentially damaging postures which sonographers routinely adopt, which may increase their risk of acquiring a WRMSD (Sommerich *et al.*, 2016). Some examples of potentially suboptimal postures adopted by sonographers have been demonstrated in the photographs below:



Figure 6 Demonstrates sonographer positioning for performing a lower limb venous examination. Note the extended position of the left arm to operate the machine controls on the console due to inadequate positioning of the ultrasound machine in relation to the sonographer.

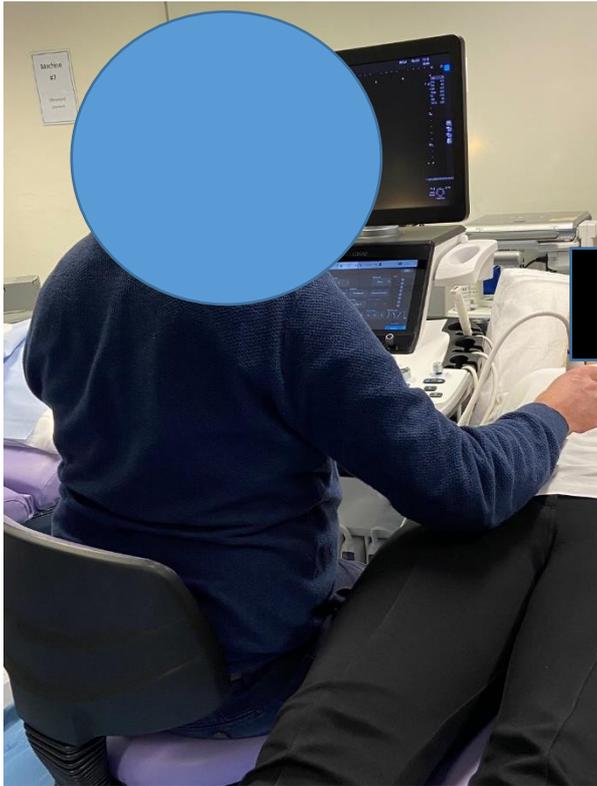


Figure 7 Demonstrates typical optimal sonographer and patient positioning for performing an abdominal ultrasound examination. Note the position of the right arm in relation to the sonographer (no more than a 30-degree abduction away from the body and note the resting of the elbow and forearm on the patient for support).

The concept of 'posture' itself remains complex and is not fully understood, primarily because this is often down to the individual and how they personally manage within the constraints of their respective role (Simonsen and Gard, 2016). This may be adding to the lack of clarity relating to the factors which continue to influence the potential causes of WRMSD (Levanon *et al.*, 2010) highlighting a further gap in the existing knowledge base.

The next section will explore how transducer design and ultrasound scan technique influence WRMSD in sonographers.

2.3.3.3 Transducer Design and Ultrasound Scan Technique

The previous section focused on how posture potentially causes WRMSD. This section will explore, through a critical narrative review, what impact scan technique and transducer design have on sonographers in terms of WRMSD.

The unique way in which ultrasound examinations are performed requires sonographers to utilise a particular type of 'muscular effort', and consequently they become prone to tiny muscle tears because of micro manipulation of the ultrasound transducer as they perform each scan (Staal, Bie and Hendriks, 2007; Engen *et al.*, 2010). Recent studies have already recognised that posture, force, and repetition used in performing ultrasound examinations remain contributory factors in leading to the acquisition of WRMSD (Wooten, 2019).

Typically, most sonographers perform an ultrasound scan using their right hand, for manipulating the transducer, irrespective of handedness. Previous studies such as Seto & Bicular (2008) have investigated whether sonographers could learn to scan with their usually 'non-dominant,' left hand as well, to balance the strain somewhat. This study involved direct observation of sonographers performing both left and right-handed scanning and then a later independent evaluation of the images produced to determine whether images produced with the non-dominant hand were adequately diagnostic. The study concluded that ambidextrous scanning may be a way forward in the reduction of WRMSD, however it is acknowledged that further research is necessary to acknowledge the practicalities of implementing this into the clinical setting (Gibbs and Edwards, 2012, Seto & Bicular, 2008).

The photograph below demonstrates a sonographer performing an ultrasound scan, which involves utilising a transducer.



Figure 8 Sonographer holding a typical ultrasound transducer used for abdominal ultrasound work.

A combination of persistent poor ergonomic activities such as gripping the transducer, twisting, or bending the wrist, while at the same time applying pressure with the transducer have potential to cause injury to the sonographer (Gibbs and Young, 2011). Furthermore, abducting the elbow away from the body at the shoulder for prolonged periods of time, adopting poor body posture during the scan and poor consideration by sonographers regarding the general ergonomics of the working environment are also thought to increase the likelihood of WRMSD (Bolton and Cox, 2015). This suggests that sonographers already have a degree of culpability and consequently share some of the responsibility in terms of ensuring their own personal safety as they carry out their professional role, and furthermore, in tackling and potentially reducing their risk of acquiring WRMSD.



Figure 9 Hand Tense (noting 'White knuckles')

It is just possible to see the skin on the sonographer's knuckles turning white, demonstrating the degree of 'tightness' in the grip required compared to Figure 10 (below).



Figure 10 Hand Relaxed. Demonstrating an example of sonographer positioning utilised for performing an abdominal ultrasound examination. Note the positioning of the right hand holding the ultrasound transducer.

A more recent study by Harrison, Harris and Flinton (2018) discussed 'white knuckles' and transducer grip forces as an indicator of WRMSD. These transducer 'grips' were found to induce muscle tension and, although the study only utilised a small sample size, (n=7), it does manage to provide a basis which may inform potential future larger and more wide-ranging research opportunities. The authors suggested that sonographers should be adopting a more relaxed transducer grip which will potentially reduce their risk of acquiring WRMSD in their hand. However, this study was performed in a simulated environment and focused on transducer grip and therefore did not consider the many other key elements of WRMSD, such as real specific clinical situations and wider causes of WRMSD. Although recent, the study further acknowledged the ongoing paucity of research in this field as well as the implicit desire of sonographer researchers to address the ongoing issues, related to WRMSD, which was clearly apparent in this study. This again provided evidence to support the view that further research is essential in this area, particularly as transducer technology evolves, and designs improve to assuage the impact of WRMSD.

Mazzola *et al* (2017) explored the ergonomic benefits of a series of ultrasound transducers, which included lighter and more ergonomically shaped designs. Although the study concluded that the designs were beneficial ergonomically, particularly for male users, the research was conducted under laboratory conditions, meaning no firm conclusions could be drawn in relation to the clinical environment, leaving a further gap in understanding here. Several studies have also chosen laboratory-based experiments (Village and Trask, 2007; Butwin *et al.*, 2017) to assess practical work-based intervention for tackling WRMSD. This would to some extent appear short-sighted given the purpose of such research is intended to influence real-life ultrasound practices.

Evidence suggests ultrasound transducer design has evolved over the years and many manufacturers have attempted to improve their transducers to make them more ergonomic for sonographers to use (Harrison, Harris and Flinton, 2018). Disappointingly, there have been no independent studies to date which have evaluated the benefits of different transducer designs on WRMSD prevention, highlighting a further gap in the knowledge. There is a significant lack of published independent research available, without having a bias in favour of manufacturers promoting their product, to evaluate how ergonomically designed transducers have benefitted current sonographers. In fact, it remains extremely difficult to ascertain exactly what is required in ergonomic terms, from a sonographer's perspective, to make sonography a safer specialism in which to work. This consequently highlights the need for further research in this area.

This section has discussed the impact of transducer design and scan technique on sonographers in terms of WRMSD and it has demonstrated that more research is required to better understand how sonographers are working with the ultrasound equipment available to them. Furthermore, this section has raised questions in terms of what benefits, so called 'ergonomic' transducer designs are having on their working practices. Finally, this section has also acknowledged the on-going complexity of WRMSD as a phenomenon and in particular the range of contributory factors which potentially affect how sonographers use the ultrasound transducer. Transducer design can only go so far in alleviating the challenges associated with WRMSD prevention and there are clearly other contributory factors to explore. The next section will review ultrasound equipment design in general.

2.3.3.4 Ultrasound System Design

Poor equipment design has historically played a significant part as one of the causes of WRMSD amongst sonographers (Baker, Evans and Roll, 2017). In the past, equipment manufacturers were accused of doing little to help sonographers, who were often blaming suboptimal accessory equipment such as a lack of ergonomically designed height adjustable tables/chairs/stools and poorly planned patient scheduling (Baker and Coffin, 2013). Over the years, many manufacturers have realised their part in the potential causes of WRMSD, and many now use ergonomic design as a 'selling strategy' (Baker, 2019). Ultrasound system design, which includes keyboards, screen height and position, equipment manoeuvrability, transducer grip, chairs, and examination couches, is a significant factor which has contributed to the causes of WRMSD for some practitioners in the past (Mazzola *et al.*, 2017). Unfortunately, it has taken a significant number of years, inhibited by cost, to persuade manufacturers to start to re-design equipment, and indeed for employers to purchase it. However, when balancing the cost of equipment against potential loss of employees, due to WRMSD, the overall price becomes negligible (Baker, 2017).

Furthermore, the basic set-up of an ultrasound examination could be fundamentally flawed and be a primary cause of WRMSD. Simonsen *et al.* (2018) explained that ergonomic flexibility is required to allow sonographers to have the scope to safely examine a wide range of ultrasound patients, not only by having an ergonomic ultrasound system, but also by the availability of adjustable examination couches and scanning chairs. Furthermore, they also suggested that more detailed and specific measurements are required to improve the ergonomics of related computer workstations (used for reporting ultrasound examinations after the scan) and the importance of ensuring such workstations are also evaluated carefully for each respective user (Roll *et al.*, 2012).

It is acknowledged that continuing efforts are being made by ultrasound equipment manufacturers to promote 'ergonomically' designed ultrasound machines and equipment (Platt and Baker, 2009). However, one of the fundamental challenges which remain is the lack of research in the field, particularly in terms of studies which directly quantify the forces being applied through the transducer during ultrasound examinations, and this is directly limiting any technical advances in terms of ergonomic ultrasound equipment design (Dhyani *et al.*, 2017). Although there is clear evidence that equipment manufacturers have made massive improvements in machine design, specifically in making them user friendly, the problem now would seem to be the disconnect between the equipment design and the sonographer operating the respective system correctly (Baker, Evans and Roll, 2017). No evidence was found to suggest in any definitive way, that ergonomic improvements have in fact reduced the incidence of WRMSD. Despite ergonomic equipment design, awkward postures, and positions to operate the equipment remain an issue (Dabholkar *et al.*, 2017) and from the current evidence, it is unclear whether the ergonomic designs are still ineffective, or whether sonographers are not operating the equipment adequately (or a combination of the above) (Sommerich, Lavender, Evans *et al.*, 2016). Radiology and ultrasound managers therefore need to involve sonographers in decisions regarding the purchasing of new ultrasound equipment, and concurrently, also do their part to help educate sonographers on WRMSD and provide ergonomically designed equipment to prevent WRMSD (Sommerich, 2018).

2.3.3.5 Equipment Factors

Since the Industry Standards for the Prevention of Work-Related Musculoskeletal Disorders in Sonography were published in 2003, ultrasound equipment has seen significant improvements in terms of ergonomic design (Murphey, 2017). Incorporating the necessary design features into ultrasound equipment manufacture may have a significant effect on limiting

the causes of WRMSD in sonographers. Despite the relative expense, manufacturers continue to use ergonomic designs as a marketing tool to sell their ultrasound systems although one of the significant gaps in the current literature is the lack of research in evaluating WRMSD through observational studies to establish the integration of improved equipment design and sonographer practice, and how this pertains to WRMSD.

The next section will explore how overall workstation ergonomics affect sonographers and influence the acquisition of WRMSD.

2.3.3.6 Reporting Workstations

The incorporation of digital systems into radiology departments (Brown & Baker, 2004) has accelerated the process of scanning and reporting in most ultrasound departments, and advances in ultrasound technology have increased demands on the service, which in turn has increased the number of scans performed per session as outlined in Chapter 1.

Computer work is inherent in the role of a sonographer, particularly in the past 15 years as digital systems have replaced older image archiving systems or film and thermal paper (Roll *et al.*, 2012). Those who spend significant amounts of time using computer keyboards and mouse work are significantly at higher risk of developing WRMSD (Korham and Mackie, 2010). This is significant for sonographers, more than ever before; for example, within a sonographer's role, in addition to scanning, they regularly must type reports and review images at a computer workstation (Morton & Delf, 2008; Eksioğlu, 2017). To limit the impact of visual display unit (VDU) use, employees have traditionally been advised to take advantage of incorporated rest breaks, which are thought to potentially help to limit the risk of WRMSD (Boro, Mwisukha and Onywera, 2012) but as previously discussed this opportunity to take regular breaks has been reported to be increasingly difficult due to increasing sonography workload (Hogan, 2021).

The next section will explore patient-related factors which are thought to influence WRMSD

2.3.3.7 Patient Factors

This sub-section will explore the relevant patient-related factors which are thought to contribute to WRMSD.

High patient BMI has been highlighted as a potential cause of WRMSD amongst sonographers from several studies (Pallotta and Roberts, 2016; Friesen *et al.*, 2007). Over the past 20 years levels of high BMI have risen in the UK population, as illustrated in Figure 11:

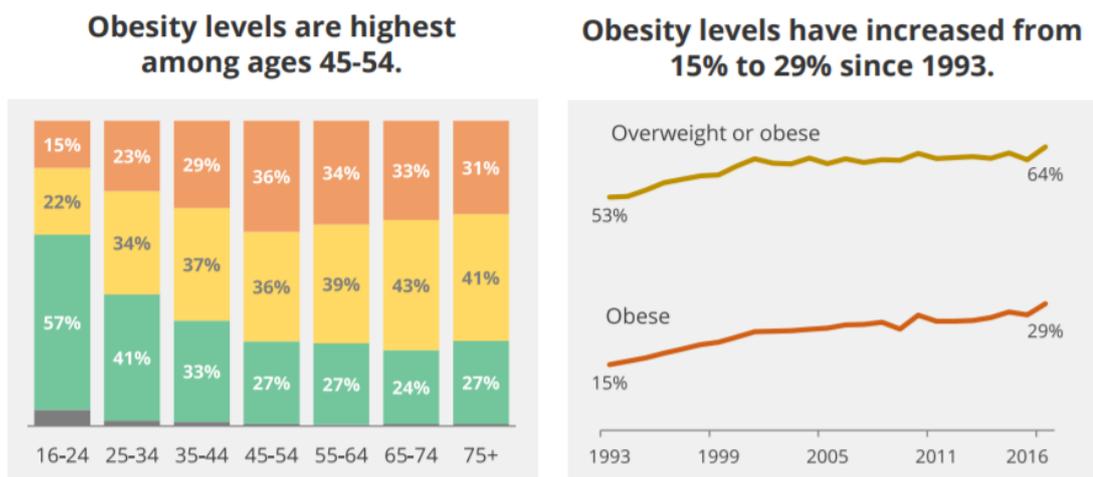


Figure 11 Graphical Illustration of Age Range of Obesity levels (Left) and Increasing Obesity Levels Across the UK Population over the past 20 years (Right)

(Taken From Baker, 2019)

The levels of high BMI, and the incidence of WRMSD, are thought to be interrelated, primarily because it is a technical challenge of the sonographers' role, in that high BMI patients require the sonographer to apply a firmer pressure with the transducer, to acquire adequate

diagnostic images (Harrison and Harris, 2015, Bolton and Cox, 2015). The main issues for sonographers when performing ultrasound scans on high BMI patients are the increase in applied force and increased risk of over-reaching (due to patient size and potential immobility) when obtaining the image. The use of additional force is necessary to reduce the fat layers and improve the potential image resolution obtainable. The consequence of this additional force is the increased risk of WRMSD, for the sonographer, when such circumstances persist over longer periods of time (Baker and Coffin, 2013).

It has already been mentioned that the application of a firmer transducer grip along with the increased pressure which the sonographer is required to apply when performing an ultrasound examination on a high BMI patient, has already been highlighted as causing 'white knuckles'. 'White knuckles' are a visual demonstration, a warning sign, of the strain sonographers are placing on to the muscles and tendons in their hand, which is potentially increasing their likelihood of developing WRMSD in the future (Friesen *et al.*, 2007; Harrison and Harris, 2015). Strategies have been suggested which may alleviate the issue of patient obesity on the challenges of performing an ultrasound examination: strategies such as asking the patient to lift the fat out of the way and scan underneath or rolling the patient halfway on one side/tilting their body to move the fat out of the way, have been given in some of the literature as ways to assuage the challenges faced by patient BMI (Woods, Miller and Sloane, 2016, Roll, Scholl and Salisbury, 2017). However, there seemed to be disconnect in terms of how training interrelated with sonographer working practices, particularly when performing ultrasound scans on an ever-increasing high BMI population.

There is evidence to suggest that, despite acknowledging the increased challenges of scanning high BMI patients, and in some cases this is known to cause pain and discomfort for the sonographer, many sonographers will continue to scan in pain. The current evidence base

however does not suggest any specific explanation in terms of what motivates sonographers to persist in scanning technically difficult patients. Consequently, this leads one to consider whether the challenges of managing the inherent risk of WRMSD related to patient obesity are potentially a training and development issue or whether there are other more complex factors which are yet to be unearthed regarding the phenomenon. The lack of clarity from existing studies advocates the need for further research in this field to better understand how sonographers see themselves in relation to WRMSD (Anderson *et al.*, 2019).

Furthermore, other attempts have been made to develop strategies to protect sonographers from WRMSD, specifically resulting from patient obesity. An example of this, in the UK, is the current Fetal Anomaly Screening Programme (FASP) protocol, which suggests that sonographers should only re-book patients once in cases where obesity has prevented adequate imaging of all, or part, of the required anatomy articulated within the recognised ultrasound scan protocol (FASP, 2020). Despite the development of such guidelines, it remains unclear from the current literature to what extent such guidelines are adhered to and in fact what underlying experiences sonographers report in terms of working in such circumstances, particularly in terms of WRMSD.

The British Medical Ultrasound Society (BMUS) have offered guidelines for performing and reporting ultrasound examinations on high BMI patients to help protect sonographers from potential litigation. Following guidelines to protect oneself from litigation is perhaps one perspective of the present situation, but little evidence exists as to how sonographers manage the challenge of scanning a high BMI patient. There is clearly a problem, because the existence of such guidelines acts as evidence that scanning high BMI patients is a potential problem. The level of engagement with such guidelines remains unclear in terms of how sonographers adhere to such guidelines, or not, and in fact the rationale for such actions that are

applied certainly lacks clarity. The disconnect between successfully carrying out their job, alongside protecting themselves from WRMSD, is apparent, because several recent studies acknowledged that some sonographers continue to scan in pain (Simonsen *et al.*, 2018; Fisher, 2015; MacDonald and Scott, 2013) but what these studies do not seem to conclude is why.

Consequently, the gap in the current knowledgebase is highlighted, alongside the scope for further qualitative studies within this field. Qualitative studies are required to better understand the role of the sonographer and the complexities of how their role is interrelated with WRMSD. This needs to be explored from current practicing sonographers' perspectives to unearth the complexities of the role and understand how sonographers justify their actions, despite potentially increasing their overall risk of WRMSD in some cases. Further studies are therefore needed to explore how sonographers manage their workload, given the risk of WRMSD, as well as seeking to understand the rationale for sonographers' current working practices. It remains unclear from the literature how WRMSD prevention guidelines, for patient obesity, are implemented or ignored, across the UK and the relationship between sonographers and WRMSD needs to be more clearly understood to progress forward.

2.3.3.8 Work organisation issues as a potential cause of WRMSD

In a guest editorial, Baker and Coffin (2019) discussed the current issues around WRMSD and made an interesting analogy about the causes of the phenomenon comparing this to the legs of a stool required to provide balance, explaining that without one leg, the stool, will topple over. This highlighted the nuanced intricacies, in terms of organisation of the working environment, which are needed to ensure sonographers are safe. They explained that it is not necessarily the number of examinations which are performed, that is causative of WRMSD, but the way in which they are carried out. It is impossible to put a 'safe' figure on how many

patients a sonographer can scan in one day, or indeed in one session. The authors suggested this is a frequently asked question from sonographers, and one which has no firm answer.

The following areas highlighted as potential causes of WRMSD among sonographers in a UK study are useful in summarising this section (Table 9).

Causes of WRMSD amongst sonographers	
1.	Lack of rest breaks during the working day
2.	Number of scans to staff ratio too high
3.	Management targets increasing pressure on workforce
4.	Inadequate time allocations for individual examination types
5.	Increasing numbers of patients with high Body Mass Index (BMI)
6.	Increasing number of TV scans, without adequate equipment/arm support
7.	Increasing number of nuchal translucency scans, requiring long periods of time, with micro-movement of the transducer
8.	Staff sickness (due to WRMSD) increasing pressure on remaining staff
9.	Rotational use of different scan rooms, meaning equipment needs to be re-adjusted for each sonographer (which frequently is not done due to time constraints)
10.	Lack of variety in scan types, meaning no variation in use of different muscle groups for sonographer

Table 9 Summary of the causes of WRMSD in sonographers

(Adapted from Gibbs & Young, 2011)

It is important to mention that in the aforementioned study, none of the participating sonographers attributed WRMSD causes to their own behaviour. Instead, all attributions focused on technical and biomechanical factors, indicating a significant gap in the existing evidence base. The purpose of this study is to address and evaluate this gap.

2.3.4 Summary

The causes of WRMSD are intricate and varied, as historically, they have been linked to numerous risk factors encompassing workplace exposures, personal, environmental, and socio-cultural elements (Armstrong et al., 1993; Cohen et al., 1997; Lemasters & Atterbury, 1996; WHO, 1985). It is widely acknowledged that WRMSD risk factors include job task factors that exert physical load (e.g., movement, posture, force), work organisational factors (e.g., decision latitude, social support), and physical environmental factors (e.g., vibration, noise) (Armstrong et al., 1993; Bernard, 1997; Lemasters & Atterbury, 1996). Additionally, external uncontrollable environmental factors (e.g., emergencies or unexpected situations) may also contribute to WRMSD occurrence (Cole et al., 2009).

Similarly, in ultrasound, the causes are equally complex and multifactorial, believed to arise from various factors, such as repetition, increased workload, posture, challenging patients (including high BMI), and equipment design (Gibbs and Edwards, 2012; Bolton and Cox, 2015).

Owing to the challenges in identifying definitive causes of WRMSD, similar challenges are subsequently faced in developing solutions to WRMSD. The next section will evaluate ergonomic interventions and WRMSD prevention.

2.4 Ergonomic Interventions/Prevention

2.4.1 Introduction

The aim of this section is to explore the concept of WRMSD prevention through the lens of 'ergonomic interventions' currently advocated for reducing the risks of WRMSD in several professional and workplace fields. This section will begin by briefly exploring wider, non-healthcare related fields, funnelling down into healthcare related fields, and finally focusing specifically on WRMSD prevention in sonographers.

As already discussed, in preceding chapters, WRMSDs remain one of the most common forms of work-related sickness in the UK (HSE, 2005). In the UK, WRMSDs are estimated to cause the loss of approximately 11.6 million working days each year (HSC, 2005), despite continued attempts to understand and control the management of this phenomenon. To place this in context, similar figures also exist in other industrially developed countries across the world with regards to WRMSD (Yu, *et al.*, 2012; Alshuwaer and Gilman, 2019). Consequently, there remains an urgent need to examine why the prevalence of WRMSDs remains so high and, furthermore, how attempts to alleviate associated risks can be made more effective. The complex and multifactorial nature in terms of the causes of WRMSDs (Long, Johnson and Bogossian, 2012), present a significant barrier toward the development of any potential prevention strategies. Asensio-Cuesta *et al.* (2012), presented a conceptual framework for understanding WRMSD describing the work environment, work organisation, technologies and overall 'job task' as factors which interact with individual personal capacity (biomechanical, physiological, and psychological) as contributory factors which eventually lead to WRMSD. Consequently, in beginning to understand the causes, one can eventually start to understand and develop potential solutions to the phenomenon in the form of ergonomic interventions and WRMSD prevention strategies (Sviland, Martinsen and Raheim, 2014).

There have been several approaches established, which have attempted to tackle the phenomenon and these interventions often need to be directed at various levels within a workplace. A framework for the management of WRMSD in the workplace is illustrated (below).

HSE (2002) proposed a seven staged management cycle:

1. *Understand the issues and commit to action*
2. *Create the right organisational environment*
3. *Assess the risk of WRMSDs in the workplace*
4. *Reduce the risks of WRMSD*
5. *Educate and inform the workforce*
6. *Manage any episodes of WRMSD*
7. *Conduct regular checks on programme effectiveness*

(Adapted from, HSE, 2002)

Over the past 10 years, the UK government has invested some financial investment into policies and services which have attempted to address the needs of those affected by WRMSD, although more work is required in developing a structured pathway to address WRMSD, from an interventional perspective (Coole, McBean and Drummond, 2015; Evans, *et al.*, 2022).

Caution must be taken when considering WRMSD prevention strategies, because many researchers have given the impression that successful prevention strategies automatically lead to a complete resolution to the problem, which often is not the case (Burton *et al.*, 2008; Sweeney *et al.*, 2022). Furthermore, one of the main difficulties in tackling WRMSD is the

complexity of the phenomenon and the fact it represents such a diverse range of cumulative disorders, making it challenging to understand and consequently difficult to prevent and treat (Woolf, Vos and March, 2010).

Earlier studies have already explored some novel ergonomic intervention strategies, for example Trujillo & Zeng (2006) developed a computer programme which reminded computer users at varying intervals to “stop and stretch” to minimise their risk of acquiring a WRMSD from their computer work. Their study concluded that approximately 63% of respondents found that the software improved their overall ability to do their job because they found the reminders a helpful distraction to a repetitive task. This suggests that the idea had some advantages in terms of reminding people to stop and think about what they are doing, which could have a positive outcome and reduce injury (Trujillo & Zeng, 2006).

Lysaught, Donnelly and Luong (2010) evaluated the best practices for the rehabilitation of WRMSD, through a systematic literature review. The review highlighted a range of ergonomic interventions aimed at combatting WRMSD, which are illustrated in Figure 12:

Ergonomic Intervention Evaluated
Physician Managed
Education
Education & Home Exercise (combined)
Clinical Based Physiotherapy
Clinical Based Multidisciplinary Team (MDT) Intervention
Workplace WRMSD Prevention Programme
Psychological Intervention

Figure 12 Range of ergonomic interventions aimed at combatting WRMSD

(Adapted from Lysaght, Donnelly and Luong, 2010)

From the themes illustrated in Figure 12 above, the review suggested several pertinent points, in relation to ergonomic intervention. (1) under the umbrella term ‘physician management’ it was suggested that, in most European studies reviewed, one of the perceived successful WRMSD prevention interventions is referral to a professional expert who can offer advice, in terms of acting as a ‘decision-maker’ for managing the phenomenon through prescribing medications or offering referrals to other services. It was also highlighted, from the studies reviewed, that this was perceived as a positive intervention of those experiencing WRMSD symptoms. (2) The review illustrated the perceived potential benefit of ‘clinic-based therapy’ such as physiotherapy, occupational therapy, provided in the workplace. The review of 18 studies concluded that there were mixed results in terms of perceived success of such ergonomic interventions. (3) ‘Work site’ ergonomic intervention was perceived in a positive

way, reflecting the potential scope for collaborative efforts such as a combination of physiotherapy both in the assigned workplace (so that it is conceptualised toward the specific role) with follow-up sessions within the clinic environment as well.

Johnson *et al.* (2013) advocated 'self-management' as a concept requiring workers to 'let go' of their previously established behaviour to encourage a change toward healthier behaviours to bring about better psychological well-being, reducing stress and anxiety. Although Choobineh *et al.* (2011) argued that individuals require a certain degree of guidance to develop these 'self-management skills' and furthermore education is required to know exactly what is required. This study concluded that management commitment to ergonomic interventions within the workplace, alongside active participation of the workforce, are the key requirements for the success of any such WRMSD prevention interventions.

The World Health Organisation (WHO) (2003) and the Health and Safety Executive (HSE) (2005) recommended that interventions to tackle WRMSDs combine ergonomic improvements and health improvement activities aimed at modifying behaviour. Although, resistance from employees to engage with ergonomic interventions has been identified as the main reason for the failure of organisational change initiatives set up for the prevention of WRMSD (Deloitte & Touche, 1996; Haslam *et al.*, 2002; Burgess-Limerick, 2018). Consequently, it could be argued that Prochaska and DiClemente's (1982) model of Participatory Ergonomics (PE), which used targeted interventions specific to the individuals involved, potentially produced successful outcomes in terms of participant engagement (Haslam *et al.*, 2002).

Stevenson (2014) explored, as a potential solution to reducing WRMSD, the option of only selecting workers deemed physically suitable for the role, which is a contentious approach, and, although the requirement was acknowledged for this to be a rolling process and involve

not only the selection stage but regular monitoring of the individuals throughout their career pathway, it was not entirely clear from the conclusion of the study how this may work in a more practical sense. Heiden *et al.* (2013) also discussed the 'healthy worker' effect in terms of 'weeding out the fittest', in relation to the nursing profession. The paper highlighted that most studies, which have explored the aging population of nurses, tended to be inconclusive owing to the migration of older nurses into less physically demanding roles, such as education and management or even leaving the profession entirely. Consequently, some professions arguably may have a natural 'migration' of workers who gradually move into less physically demanding roles as they age (Serranheira *et al.*, 2012; Serranheira, Sousa-Uva and Sousa-Uva, 2015).

2.4.2 Ergonomic Interventions for Sonographers

Baker (2019) explained that, without applying a multifaceted approach to WRMSD, which would include workload administration and design, the individual sonographer's willingness to engage in safer practices, as well as an appropriate design for the working environment, interventions to reduce the incidence of the phenomenon are unlikely to be successful. Furthermore, few studies exist which have proposed potential solutions to the problem of WRMSD overall. Although finding a strategy, in terms of incorporating improved ergonomics into ultrasound practice, may seem to be a prudent way forward, there is little evidence to support the overall benefit of such intervention (Fisher, 2015) particularly when these strategies have not been satisfactorily tested prior to being implemented.

Ergonomics is a concept intertwined with WRMSD prevention strategies, and is concerned with relating the work type to the person, by creating a best fit for the worker and their environment to limit discomfort and fatigue (Goyal and Rachapalli, 2009). It is not always clear as

to the extent to which ergonomic intervention has taken place in the field of sonography to date, however several studies have now explored the concept of WRMSD amongst sonographers further, including how potential methods to prevent the phenomenon may be developed in the future. One of the concepts, highlighted in recent studies, is the importance of continued ergonomic assessment of sonographers' working environments (Mazzola *et al.*, 2017). However, developing a strategy to combat the increasing level of WRMSD which is evident in the sonographer population remains challenging and the concept of 'ergonomics' itself is a complex and multifaceted phenomenon (Mazzola *et al.*, 2017). Understanding what ergonomic changes are required to a particular working environment remains challenging and consequently suggests why not enough changes have been implemented to date. Furthermore, ergonomics and sonographers remain under-researched, and seem absent from many of the current studies available, highlighting the need for further exploration of this area from a research perspective (Broberg, Andersen and Seim, 2011).

WRMSD interventions and prevention strategies in healthcare roles are therefore well documented as noted in the narrative above. A study by Arvidsson *et al* (2016) explored the cross-sectional association between occupational factors and musculoskeletal pain in women teachers, nurses, and sonographers. This was an unusual study in terms of the population sampled being quite heterogeneous, evaluating a range of quite different occupational groups under one project. Consequently, the results of the study were unsurprisingly varied, and differences exist between the occupational groups. The findings of the study reflected the diversity of the sample, and although suggestions were made in terms of potential ergonomic interventions, those specific to sonography were somewhat vague and suggested putting measures in place to limit the emotional demands and workload, although no suggestions were made for how this may be achieved. Furthermore, the study acknowledged the

need for further research in addressing the physical workload demands of being a sonographer, a concept which has already been alluded to in several studies.

A decade ago, Gibbs and Young (2011) discussed the need for sonographers in the UK to consider their own working practices carefully, to develop their own personal modifications to reform their practice. Their study was conducted through a university-based workshop which provided an opportunity for the attending sonographers to discuss examples of good practice to explore methods to troubleshoot their own associated issues surrounding WRMSD in the workplace. The researchers contacted participants involved in this study 12 weeks after the initial workshop to examine whether the participants had experienced any longer-term benefits from attending the workshop. The study outlined several factors, which were thought to have been beneficial for the workshop participants, which are outlined in Figure 4.

Benefits of WRMSD Workshop
Opportunities to share ideas with fellow sonographers and different ultrasound departments
Demonstration of WRMSD prevention by Physiotherapist
Introduction to Alexander Technique
Advice from Health and Safety Experts
Ambidextrous Scanning Techniques
Reassured/acknowledgement of a 'culture of denial'
Alternating sitting/standing scanning
Additional 'slave' Monitors
Voice Activated Controls

Figure 4 The Benefits of a WRMSD Prevention Workshop

(Adapted from Gibbs and Young, 2011)

Despite the recommendations for potential safer practices, improvements in WRMSD prevention techniques and development of educational WRMSD prevention workshops, the study failed to demonstrate why sonographers tended to reduce their adherence to safer working practices over time, despite appearing to accept the advice in the workshop initially, which was demonstrated in a 6-week post workshop assessment, and then later at a 12-week post workshop assessment. The study has helped in part to set the scene for the potential complexities surrounding WRMSD, acknowledging the multifactorial nature of the phenomenon. What the study does not explore is why the sonographers who took part in the study alluded to the benefit of the workshop, after 6 weeks, but less so after 12 weeks (Gibbs and Young, 2011), consequently supporting the need for further studies in this field.

Earlier studies were published at least a decade before the latter study. Jakes (2001) suggested a detailed list of measures which were believed to potentially bring about a reduction of WRMSD among sonographers, which included maintaining an upright posture, avoiding leaning over the patient, use of cushions for arm support where leaning is unavoidable and many of these ideas remain as examples of good practice today (Bolton & Cox 2015, Gibbs & Young 2011, Gibbs and Edwards 2009). Some of the ergonomic equipment design features are outlined in Figure 5.

Ergonomic Equipment Design Features in Sonography:
Height adjustable ultrasound machines
Height adjustable ultrasound machine (monitors)
Adequate length of transducer cords
Light weight transducers with good hand grips
Height adjustable scanning tables
Cable braces (holders)

Figure 5 Ergonomic Equipment Design Features in Sonography

(Adapted from Bagley *et al.*, 2017)

More recent studies suggest that WRMSD prevention is not only the responsibility of sonographers, but that also instead a multifaceted approach is necessary including contributions from equipment designers and employers who need to collaborate to find solutions to the problem of WRMSD (Bolton & Cox, 2015; Gibbs and Young 2011; Gibbs and Edwards, 2009).

A more recent study, by Sommerich *et al.* (2019), evaluated a range of potential WRMSD prevention strategies for sonographers. One such strategy explored how sonographers performing venous lower limb ultrasound scans can utilise ‘powered augmentation’, removing the need for the sonographer to physically augment the patient’s leg veins with their left hand, whilst performing the scan with their right hand simultaneously. In the study sonographers’ posture was evaluated by comparing power augmented scans to normal practice (manual augmentation). The study concluded that ‘powered augmentation’ resulted in better overall sonographer posture, when undertaking venous assessment of the lower limb, compared to manual augmentation (Sommerich *et al.*, 2019). It was noted, when posture was evaluated using Rapid Entire Body Assessment (REBA) scores, that even with powered augmentation, sonographer posture was not perfect, suggesting that further work is still re-

quired in order to improve the adapted 'safer' technique (see Figure 6). There is little evidence of such research coming to fruition, as novel techniques rarely seem to be rolled out in ultrasound departments nationally, with most experimental research of this nature being performed in laboratory or simulation-based environments rather than in the real patient-facing ultrasound department.

Scholl and Salisbury's (2017) study suggested most participants reported having access to ergonomic equipment in the ultrasound examination room. Several other recent studies (Bagley *et al.* 2017) also supported this concept. Furthermore, earlier Magnavita *et al.* (1999) and Evans, Roll and Baker (2009) respectively reported that approximately 80% of sonographers have access to adjustable scanning tables and height adjustable chairs, although it is acknowledged that the tables may not have electronic controls and that the chairs may not be adequate enough to accommodate or encourage ergonomic scanning postures, although little evidence was found to suggest what improvements may have been made in terms of ergonomic couches and chairs. Few studies report the use of a cable brace while scanning,

and Bagley *et al.* (2017) reported that the overall relationship between the use of a cable brace and scanning in pain has not been well evaluated.

Work posture	Manual Augmentation	Powered Augmentation
Sitting	 <p>(a) REBA score 8</p>	 <p>(b) REBA score 4</p>
Standing	 <p>(c) REBA score 7</p>	 <p>(d) REBA score 5</p>
Sit/lean	 <p>(e) REBA score 11</p>	 <p>(f) REBA score 5</p>
<p>REBA score interpretation: 1=negligible risk, 2=low risk, 4-7 medium risk, 8-10 high risk, >10 very high risk</p>		

Figure 6 Images demonstrating a comparison of scanning postures using manual venous augmentation (left) and powered augmentation (right).

(Taken from Sommerich *et al.*, 2019)

However, Scholl and Salisbury (2017) focused their evaluation on potential access to ergonomic equipment, rather than the frequency of adjusting the equipment already supplied,

which is a limitation. Having access to ergonomic equipment is the first step, but it remains the responsibility of the individual sonographer to use the available ergonomic features of any ultrasound system. Although several authors confirmed that participants in their study indicated they made regular adjustments to their available equipment, larger and more wide-ranging studies are needed to explore this issue further (Lilley, 2018; Suzuki *et al.*, 2015; Bolton and Cox, 2015; Yu *et al.*, 2012).

None of the studies reviewed used covert observation of sonographer practices, or explored sonographers' lived experiences which suggested another significant limitation in the current research base, given that when sonographers are overtly being observed, their awareness of this may positively affect their practice during that period.

There have also been several studies employing a variety of experimental designs and novel research ideas over the previous decade, which to date do not seem to have flourished into the wider ultrasound field, or professional application, in most cases (Engen *et al.*, 2010). In an earlier study, van Galen, Liesker and de Haan (2007) examined the use of a vertical keyboard design on typing performance, user discomfort and muscle tension, concluding that participants in this small study found it to be easier to use than a standard design, with a lower mean muscle activation. Despite its marginal success, some participants found their workload was slower and more frustrating, because of the ergonomic intervention, meaning the related task took longer to perform because they had to learn how to use the new design effectively. This is one factor which may suggest why this design has not appeared again in any recent studies.

Coffin (2012) devised another novel technique, a vertical arm support mechanism, which was found to allow sonographer arm muscles to 'relax' more during the scanning procedure by reducing 'muscle firing'. The study concluded that all participants felt more comfortable

whilst scanning although there was a significant limitation to the study, in that it was only undertaken in a laboratory-based environment and not a real-life clinical environment. Consequently, it would seem prudent that such a design would need further exploration and modification before it could legitimately be used in the clinical setting, where real patients are being scanned.

Engen *et al.* (2010) undertook a study on the effect of chair massage and stretching exercises on muscular discomfort amongst cardiac sonographers. It was again acknowledged that the study was relatively small, and it had only been intended as a pilot study for a potential future larger study, which to date has not been published. However, their overall conclusion suggested that some improvements were seen amongst the participatory group sampled, although the lack of any follow up study having been carried since to quantify this is a significant limitation.

It would seem reasonable to conclude that supplying ergonomic equipment alone is not sufficient and by bringing in a good educational programme for sonographers, from the beginning of their ultrasound education, could bring together the whole issue of ergonomics to create an “ideal system” (Jones & Kumar 2001). Any “ideal system” must have acknowledged and addressed any barriers to engagement to be successful in combatting the problem of WRMSD. Ensuring sonographers know how to protect themselves from injury through adopting safer postures, and learning from each other through educated discussion and debate, (Bolton and Cox, 2015), is clearly needed. The role of education and WRMSD will be explored in the next section of this literature review.

2.4.3 Summary

Despite the growing body of evidence regarding WRMSDs and the risk factors associated with these problems in addition to the ongoing changes in work activity, the problem of WRMSD remains the most common cause of occupational ill-health in the UK. Several studies have demonstrated that, despite the development of ergonomic interventions, the reduction of WRMSD is still progressing very slowly and more research is needed to evaluate, support, and build upon the existing theoretical frameworks available and consequently develop safer working practices (Evans, et al., 2022).

Evidence has suggested that much more work still needs to be done in terms of developing adequate ergonomic interventions for the prevention of WRMSD, across a wide range of profession roles and occupations. Furthermore, one of the main challenges which has been repeatedly documented regarding designing such interventions is the multifactorial nature of the phenomenon itself (Gibbs and Young, 2011) which is a significant limitation and adds to the complexity of the situation and in particular makes planning interventions difficult. Despite more research emerging which explores ergonomic intervention in heavy industry, comparatively speaking, in healthcare fields and sonography, few studies are evident.

A commonality which has been found across various professional roles relates to the context of worker behaviour and the challenges with compliance and engagement, to any such interventions implemented and further studies are needed to explore this concept further (Lönnqvist, 2009; Mccrystal *et al.*, 2011; Koppelaar *et al.*, 2013).

From the studies evaluated, at the time of writing, it would seem many sonographers may benefit from preventative measures which address the physical workload required within their role, such as lifting, adopting constrained postures and in reducing wrist and forearm

pressures being applied (Lilley, 2018; Suzuki *et al.*, 2015; Bolton and Cox, 2015; Yu *et al.*, 2012). Although there is also clear evidence that manufacturers are developing more novel designs in terms of ultrasound equipment, it seems clear that more work is required in terms of developing equipment design, and particularly in addressing how sonographers are trained to use new equipment safely and ergonomically (Chapman, 2020; Chefec, 2008; Shuai *et al.*, 2014). Gibbs and Edwards, (2012) suggested sonographers should experiment with a range of ergonomic approaches to find the ones which works best for them personally. Workload and workflow are also significant contributory factors, and more research is needed to establish safer working practices in the prevention of WRMSD, both in wider professional fields and in sonography (Chapman, 2020; Chefec, 2008; Shuai *et al.*, 2014). One of the fundamental issues which seems apparent with any such interventions is the lack of engagement and the unwillingness to change practice or technique despite current advice advocating the need to do so (Lönqvist, 2009; Mccrystal *et al.*, 2011; Maunder, 1997; Koppelaar *et al.*, 2013; Haslam, 2002).

Due to the substantial costs associated with WRMSD, it is crucial that interventions to tackle this phenomenon become more effective (Simonsen and Gard, 2016; Esmailzadeh, Ozcan and Capan, 2014; Horkey and King, 2004). However, there remains limited evidence in terms of robust evaluation of ergonomic interventions, particularly in the field of sonography, and consequently, to date, this has only infrequently been undertaken (Harrison, Harris and Flinton, 2018; Karsh, Moro and Smith, 2001; Euler and Meadows, 2012). Furthermore, research which has explored the efficacy of WRMSD prevention interventions is ever more important, particularly as there is a critical shortage of sonographers in the UK, therefore reducing the loss of individual work hours from the 'profession' and reducing the likelihood of long-term career reduction is a significant priority for this professional group. Evaluation of

any such interventions also seems to be lacking, and from the limited research, which has already evaluated ergonomic interventions, most studies report varying degrees of success (Evans, *et al.*, 2022; Sweeney *et al.*, 2022).

One of the primary difficulties encountered in planning any intervention to reduce WRMSD is the intricate nature of the phenomenon, coupled with the various factors linked to its occurrence. These factors encompass physical aspects like force, repetition, and posture, as well as psychosocial elements such as perceived control, social/supervisory support, and unique role characteristics (Karsh, Moro and Smith, 2001; Petterson and Arnetz, 1998; Keller, Corbett and Nichols, 1998). Despite several recent studies (Dong *et al.*, 2019; Feng *et al.*, 2016; Kozak *et al.*, 2014) highlighting the connection between WRMSD and psychosocial factors, there have been limited efforts to address these challenges effectively in practical applications.

Furthermore, despite the well documented complexities surrounding WRMSD, interventions to tackle the phenomenon tend to be focussed at tackling the practical and physical workplace factors, rather than taking a more holistic view of the wider professional job role (Santos *et al.*, 2011; Paparella, 2007; Iwatsubo, 2000). It is therefore unsurprising that WRMSDs remain common and inadequate implementation of any such ergonomic interventions have often been blamed for the ineffectiveness of such interventions (Kemp *et al.*, 2002; Suzuki *et al.*, 2015; Lincoln *et al.*, 2000; Baker and Coffin, 2013).

Consequently, to reduce WRMSD, interventions need to be properly designed to tackle both the physical and psychosocial factors associated with the phenomenon (Hogan, 2021). Furthermore, ergonomic interventions need to be more overtly embedded in to occupational and workplace processes to gain employee commitment, educate colleagues about the risks

of WRMSD, and encourage continual evaluation of any such ergonomic interventions to maintain currency and effectiveness (HSE, 2022; ScoR, 2019).

Finally, it is unfortunate, but not necessarily unexpected, given the evidence in the literature that current recommended ergonomic (WRMSD) prevention strategies do not appear to have been widely adopted in ultrasound practice. This may be due to a failure in convincing colleagues of the associated benefits, the challenges faced in terms of implementation or perhaps the lack of resources or skills to facilitate such interventions. Consequently, further evaluation of the process of implementing ergonomic interventions to tackle WRMSD is needed to clarify such points, and to identify potential ways of improving their efficacy (Burgess-Limerick, 2018).

2.5 WRMSD Prevention Education

This section will consider WRMSD prevention education starting from a broad occupational context, funnelling down to a healthcare context and finally, and most specifically, a sonography context.

There has been much debate about the role of education in terms of tackling the serious issue of WRMSD in many professional fields. This section will explore such interventions through a critical narrative firstly by evaluating WRMSD educational programmes from wider professional fields, second by evaluating WRMSD educational programmes related to healthcare professions and finally by evaluating WRMSD educational programmes related to sonographers specifically. It is certainly important to fully appreciate what education is, to apply the concept to the prevention of WRMSD. Education is a process which facilitates learning through several established methods, such as teaching, training, discussion, directed

research and scholarly activity (Bolton and Cox, 2015). Through learning, individuals may acquire the relevant knowledge, skills, values, morals, beliefs, behaviours, and habits to assuage the impact of WRMSD.

2.5.1 The Broader Context to WRMSD Prevention Education

The World Health Organisation (WHO) suggest an individual's behaviour is an important contributor to many widespread diseases and health problems, including obesity, coronary heart disease, and various types of cancer (WHO, 1988). It could therefore be assumed action is needed from employers to implement risk-limiting practices within their respective workplace (e.g., changes to the workplace layout, equipment, or training). Employers also need to understand what prevents employees from adapting their behaviour to reduce risk. Furthermore, it is suggested that such changes then also need to be adopted by employees and integrated into their routine ways of working for them to become effective, advocating the need for educational interventions (Harrison, Harris and Flinton, 2018). Educational interventions need to be able to tackle both the physical and psychological causes of the phenomenon, to promote any required changes to practices, as well as the maintenance of such changes among employees, to reduce WRMSDs among individuals across all levels within a workplace (Shuai *et al.*, 2014).

Several authors have discussed a concept known as 'the stage of change' (Haslam, 2002; Burgess-Limerick, 2018). This concept originates from the Transtheoretical Model (TTM), (Prochaska & DiClemente, 1982; Jeunet *et al.*, 2018) and it is one theoretical framework which has resonance with developing educational approaches to WRMSD prevention, as it centres around the change process itself, and acknowledges the fluidity of change (Haslam, 2002).

This framework is of particular significance to occupational health and safety issues, because of the continually evolving nature of many types of work this relates to, combined with the challenges of tackling workplace risk and the need to continually adopt risk limiting strategies. This approach has been used extensively in relation to certain health related behaviours such as drinking, smoking, and exercise (Haslam, 2002). The stages are outlined below, and the concept assumes that any behavioural changes involve transition through a series of distinct stages:

- i) Pre-contemplation (resistance to recognising or modifying problem behaviour),**
- ii) Contemplation (recognition of the problem, thinking about changing, but not ready to act),**
- iii) Preparation (intending to change in the next 30 days, and/or having made specific plans to do so),**
- iv) Action (having engaged in behaviour change, no longer than 6 months ago), and**
- v) Maintenance (initiated changes over 6 months ago, working to consolidate gains made) or relapse.**

Figure 7 The Stages of Change

(Taken from Haslam, 2002)

The diagram below demonstrates how Haslam's five stages of change inter-relate:

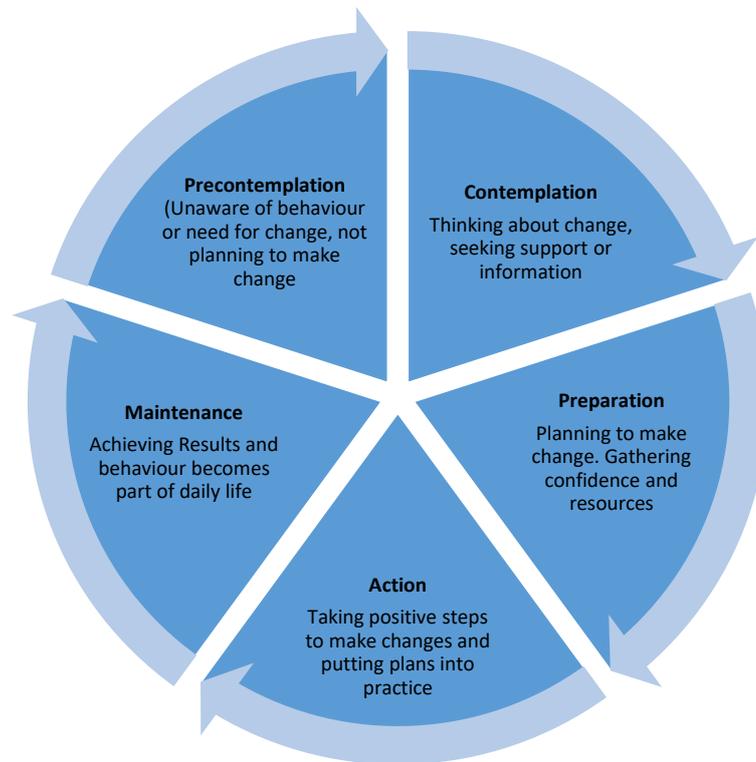


Figure 8 Haslam's Stages of Change

(Adapted from Haslam, 2002)

The stage at which an individual is placed within the cycle above is determined by their personal knowledge, attitudes, and beliefs regarding a particular phenomenon (Haslam, 2002). Due to the fluctuating prevalence of these ideas throughout time, an individual's readiness to embrace strategies geared towards fostering behavioural change is contingent on their personal stage of change (Lönnqvist, 2009). Because of the latter, it becomes apparent why adopting a 'one-fits all' approach to interventions aimed at reducing WRMSD may not be as effective as they might be. Several studies which have used the TTM approach have shown that stage specific interventions may increase the likelihood that individuals will engage accordingly (Prochaska *et al.*, 1993; Rakowski *et al.*, 1998). Furthermore, as part of learning

new skills, educational programmes therefore should be geared toward reinforcing motivation to change by raising awareness which would align with 'coaching' approaches to behavioural change (Fowler, 2008).

Educational programmes have been widely advocated in several fields, for health and safety, mandatory training (Health & Safety Statistics, 2015) and are also currently used as one platform to aid in the reduction of WRMSD (Public Health England, 2019) for computer users (Kallenberg, Hermens and Vollenbroek-Hutten, 2006) and several other professions affected by the phenomenon. This may be in the form of educational brochures that advise the user of the dangers associated with computer work in terms of repetitive strain injury (Esmaeilzadeh, Ozcan and Capan, 2014). What remains challenging in the use of education as a WRMSD prevention method, is that such methods may be quickly forgotten and then later ignored completely, potentially having little or no effect over the longer term (Gibbs, 2011).

It would seem the concept of education and encouraging changes to working practices are intertwined and to bring about workstyle change (Nieuwenhuijsen, 2004) in many occupational fields. Several studies have explored the concept of 'self-efficacy', which is a person's belief that they can sustain a particular required behaviour. In relation to this study, adopting 'healthy behaviours', which are associated with preventing WRMSD are of particular interest (Miller and Newton, 2006a; Miller and Newton, 2006b; Vries *et al.*, 2013; Roll *et al.*, 2017). The studies agreed that by motivating the workers to adopt more ergonomic, and subsequently safer working practices, positive changes can develop overtime. Such changes are thought to occur because by making people aware of the factors that increase their likelihood of acquiring a WRMSD, such as stress and poor ergonomics, the individual is more

likely to make the required adjustments to their actions in order to limit their risk of acquiring a WRMSD (Nieuwenhuijsen 2004; Miller and Newton, 2006a; Miller and Newton, 2006b; Vries *et al.*, 2013; Roll *et al.*, 2017).

This concept is also supported by several more recent studies which suggest that colleagues need to work together to learn about workplace ergonomics to better understand the risks and how to avoid them (Choobineh *et al.*, 2011). Furthermore, active approaches to developing and implementing WRMSD prevention strategies, and consequently WRMSD educational approaches, need to reflect this and move from passive learning towards more engaging methods of learning which are directly linked to respective workplace activity (Choobineh, *et al.*, 2011).

Acknowledging the inherent paucity in research in this field is not a new concept, an earlier study by Cole *et al.*, (2009) also concluded that much still needs to be done in terms of developing educational programmes for WRMSD prevention. Although it was acknowledged that the study was helpful in gaining valuable lessons in developing WRMSD prevention training. Cole considers that the 'lack of change' mentality in a range of workplace settings presented a series of challenges for any prevention programme designers to work with and proposed that many of these challenges were a consequence of the gap in the current evidence available (Nieuwenhuijsen, 2004). Many studies acknowledge that better collaboration is needed between practitioners, researchers, and quality makers to better inform future WRMSD interventions (Sommerich *et al.*, 2019).

Therefore, more research is needed to develop a broader understanding of the complexities of WRMSD, as a phenomenon, in terms of how behavioural changes and ergonomic intervention can be better utilised in preventing WRMSD (Monnington *et al.*, 2012). However, several reasons are apparent in terms of why individuals may not engage with educational

strategies to avoid WRMSD. Haslam (2002) explained that a lack of knowledge or understanding of the phenomenon or conflict between production and safety can be a significant influencing factor toward non engagement. Furthermore, they go on to discuss the influence of sickness absence leading to a cycle of dilemma and potential conflict between job requirements (such as productivity) and safety implications which may result in non-compliance of WRMSD prevention strategies, despite training having been provided.

Creating a holistic approach is therefore acknowledged; in the context of providing education to employees, in the reduction of WRMSD, by encouraging them to look at themselves, not only in their working lives, but in general as individuals (Burton *et al.*, 2008) is clearly hugely important. What seems to be lacking in the current evidence-base is how such mechanisms can work in the longer term, and this ideally needs to be explored in more detail through further research. Furthermore, such approaches need to be implemented to coincide with the readiness of the organisation, and the individual workers within, to allow a balance, or compromises, to be gained between convincing those in management roles that WRMSD exists and dealing with the tangible problems as they arise. The Prochaska and DiClemente's (1982) state of change model offers a potential framework on which to base the development of an intervention which matches the institutional characteristics, and those of the workers involved, to lead to demonstrable improvements in WRMSD prevention (Haslam, 2002).

Nieuwenhuijsen (2004), and more recently Burgess-Limerick, (2018), acknowledged that a combination of education given through brochures, posters, group discussions and ergonomic interventions can be a major step in bringing about the reduction of WRMSD, however as already explained earlier in this section not all participants in a prevention programme will alter their behaviour accordingly. The rationale for this can be explained from

the trans-theoretical model, which suggested that not all people are ready for change at the same time. Transcending these barriers is therefore necessary in bringing about further change and increasing the efficacy of any educational methods employed.

Although there is evidence that education plays a role, as one of the preventative measures used in tackling WRMSD, measuring its success is difficult due to a lack of good quality research in this field, but if carefully adapted and developed to meet its purpose it is likely to be of benefit in the prevention of WRMSD in the future (Burton *et al.*, 2008) especially when more robust studies have been completed to evidence this.

There are examples from several studies where education has been successful. More recently, Zeidi, Morshedi and Zeidi, (2011) evaluated the effect of interventions based on trans theoretical modelling (TTM) on computer operators' postural habits concluding that TTM can improve postural risk factors related to WRMSD among employees. There were acknowledged limitations to the validity of this study including contradictory evidence regarding seating posture and computer-based activity, advocating further research in this area, confirming the under-researched nature of the subject. Furthermore, although the study was undertaken in a work-based setting which usefully highlights the issues of comparability with the 'real life' scenario, the study was highly quantitative and did not explore the personal and professional impacts of the training on the participants. As the study was performed overseas, there may be cultural differences between the study participants and the transfer of their experiences in the UK.

There are also several earlier studies such as Cole *et al.* (2002) that advocated educating employees through team learning, in that, by allowing the employees to get together to discuss and problem solve issues around workflow and sharing out the most demanding aspects of

the workload it might give rise to a more diverse mix of tasks for each employee to perform in their daily duties.

Although evidence suggests education is potentially a valuable tool in wider professional fields in terms of WRMSD prevention, there is no doubt it remains a complicated issue, which warrants more research to better understand the associated experiences it presents. The next section will explore how prevention education has been used in preventing WRMSDs in wider healthcare related fields and also explore some of the pertinent studies over the last 20 years.

2.5.2 Educational Interventions related to WRMSD (Healthcare)

The previous section introduced how education can potentially contribute to WRMSD prevention programmes in wider occupational fields; this next section will therefore explore, from a more focused perspective, how educational interventions have been employed in wider health care fields, in relation to WRMSD prevention.

Healthcare workers are faced with various physical risks in the conduct of their work (Ilce, 2014). From the literature available, it is evident that several positive interventions and outcomes have arisen, in terms of avoiding WRMSD. These include teaching employees how to undertake their role in an ergonomically safer manner in the healthcare related fields. An extensive literature search has already highlighted how education has been used to assuage issues associated with WRMSD which have been documented in a wide range of professional backgrounds. This section will focus on healthcare professionals including nurses, surgeons, dentists, occupational therapists (OT) and physiotherapists.

One overarching theme amongst healthcare workers is the reports of those new to their profession tending to be more at risk from WRMSD, than more experienced colleagues, despite

evidence of exposure to educational interventions embedded in their professional training (Dyrkacz *et al.*, 2012). An earlier study, related to WRMSD amongst chartered physiotherapists in the UK, concluded that despite an in-depth professional knowledge of WRMSD, physiotherapists continue to become injured themselves from the phenomenon, particularly in their first few years of practice, suggesting newly qualified staff are not adequately putting their theoretical professional knowledge of WRMSD prevention into practice in the context of how they conduct their clinical workload (Glover *et al.*, 2005). This is perhaps surprising, as physiotherapists tend to have extensive anatomical knowledge, which is frequently used to treat others with WRMSD injury, and yet they are alleged to adopt practices whilst undertaking their professional work that put them at risk of WRMSD. Furthermore, Glover *et al.* (2005) concluded that inadequate training was *not* the cause of WRMSD amongst the newly qualified physiotherapists in their study sample. Understanding the reasoning behind this highlights again the complex and multifactorial nature of the phenomenon as no clear answers emerge from the current evidence base. A significant gap is therefore highlighted in the current research in terms of WRMSD 'safe' practice and how this may be applied to specific job roles. This has challenged the importance of education as a tool for the prevention of WRMSD in the healthcare setting to some extent, although one cannot help but consider whether such issues have arisen amongst newly qualified physiotherapists because they are focused on consolidating their practice, as newly qualified practitioners, and are consequently behaving in an altruistic manner, focusing on their patients rather than themselves (Gibbs, 2011). This highlights the need for further studies in this field to better understand how education is helpful in the prevention of WRMSD and where improvements or changes are required, particularly in terms of challenging and changing behaviours.

Several studies discussed 'professional culture' within various health care occupations, and educational interventions need to be able to 'break through' these specific cultural barriers

to become successful (Campo and Darragh, 2010). In another study, by Augusto *et al.* (2008), which also explored physiotherapists' experiences of WRMSD, one of the participants talked of the value of education in preventing WRMSD, particularly in terms of the ergonomics of their workplace, the schedule of work and the inclusion of exercise regimes.

With reference to the dental profession, Sakzewski and Naser-ud-Din (2014) completed a systematic literature review which examined the issues of WRMSD amongst dentistry professionals. The review concluded that much of the research in this field focused on causes, rather than prevention, of WRMSD and consequently the authors suggest that further research is needed to increase understanding of the phenomenon, particularly in terms of developing educational programmes, to better understand the effect of any prevention strategy. Furthermore, they suggest that, through improved understanding of the phenomenon, comprehensive educational programmes can be developed and rolled out at a national level to sustain improved WRMSD prevention practices.

Consequently, evidence suggests that educational programmes are widely advocated within healthcare professions as part of the prevention of WRMSD (Bolton, Booth and Miller, 2018; Bolton and Cox, 2015). Any educational programme, related to WRMSD, needs to be carefully planned because, as evidence suggests, simple 'knowledge transfer' alone is not sufficient in bringing about the required change in behaviour (Sakzewski and Naser-ud-Din, 2014) and consequently any WRMSD prevention programme also relies significantly up on the employees being willing to take on board any new techniques and skills that are deemed necessary to reduce the incidence of WRMSD (Evans, Roll and Baker, 2009; Fisher, Brodzinski-Andrae and Zook, 2009; Bade & Eckert 2008) so a good level of compliance is needed for suc-

successful outcomes in terms of moving forward. Further work is therefore needed around professional culture and conformism, to better underpin the foundations of any educational programmes for the purpose of WRMSD prevention in the healthcare setting.

When exploring the range of different healthcare professions' perspectives on WRMSD prevention education, Dyrkacz, Mak and Heck (2012) examined WRMSD in Occupational Therapy (OT) and they explained that, from an OT perspective, education on WRMSD has mainly focused on the physical injuries themselves and not on potential injuries which can occur in the wider OT field. They also went on to explain that any proposed educational programmes are not necessarily tailored to the unique healthcare environment local to them (Canada), which reinforced the requirement for any WRMSD prevention education to be audience specific in terms of the professional group affected by the phenomenon so that solutions can be targeted accordingly.

Other authors have considered WRMSD prevention and OTs, but from a different perspective, and suggested OTs could be valuable in playing a part in educating staff in the prevention of WRMSD, because of their professional expertise in creating structured programmes to rehabilitate those who have acquired an injury, making OTs well placed to be able to grade and adapt physical strengthening exercises to specific job activities (Gibbs and Young, 2011; Bade & Eckert 2008). Furthermore, OT may be useful in providing work place assessments such as analysing specific aspects of a job role, in relation to ergonomics, and reviewing employees' physical fitness or ability and overall general work behaviour in order to develop person-centred preventative strategies in reducing the risks of WRMSD (Larson & Miller, 2005) which would fit with the point raised earlier in this review, in the previous section, which suggests that any WRMSD intervention needs to be 'person-centred' toward the individual concerned. Fisher, Brodzinski-Andrea and Zook (2009) explored the role of OTs in

WRMSD prevention using a retrospective non-experimental design. There were limitations to this study, in that it only sampled one localised departmental work area and consequently the study findings could not be generalised beyond that scope. Furthermore, the study concluded that further research was needed to better understand how to change employee behaviour, a recurring theme for developing the education for WRMSD prevention. It was however acknowledged that the study did raise greater awareness of the phenomenon, among the team sampled, and some improvements in terms of health and safety awareness were achieved overall, which is encouraging as new educational strategies are developed.

Jarus & Ratzon (2005), who examined the impact of motor learning principles in reducing the incidence of WRMSD in the workplace, add a contradictory argument to the discussion, suggesting that, despite many prevention programmes having been shown initially to have some positive benefits in reducing WRMSD, when followed up after twelve months, there seemed to have been little or no change in overall behaviour and working practices, thus challenging the potential benefits of WRMSD prevention education. However, as previously advocated, several other studies argue that more frequent reminder sessions could assuage this issue of potential non-engagement and help to maintain the momentum in terms of WRMSD prevention (Schmidt *et al.*, 2017).

The way in which prevention programmes are planned and implemented remains significant (Fisher, Brodzinski-Andreae and Zook, 2009; Bejarano, 2014; Coutu *et al.*, 2011). If a workable model of education for WRMSD prevention is designed this could be implemented on a larger scale, and replicated more widely, to bring about greater understanding of the problem and associated methods of prevention to predict injury risk and ways to reduce this risk (Morrell, Loan-Clarke and Wilkinson, 2004; Branch, 2010). The design of any such programme must arise from an evidence-based approach, incorporating reflective learning, and

using methods which have worked well from earlier educational interventions and in addition they need to meet the requirements of the audience and professional field (Vicary, Young and Hicks, 2017). Such interventions may be wide-ranging and should include a multifactorial approach, as previously suggested, which may include support from managers, colleagues, physiotherapists and other experts in the creation of a WRMSD prevention team (Bade & Eckert, 2008).

Furthermore, Daraiseh *et al.* (2010) conducted a study which explored WRMSD in the nursing profession, and they explained that colleagues first need a thorough understanding of the bio-physical mechanisms which lead to pain and WRMSD to act accordingly in terms of adopting counter-balancing behaviours. This suggests there is a potential benefit to a foundation programme of education, which may provide the underpinning knowledge for all workers, exposed to the risks of WRMSD, followed up by personal and role specific education (Burton, Lloyd and Griffiths, 2011).

The conflicting debates, related to the educational approaches to combat WRMSD in healthcare related fields, tend to emerge because of the heterogeneous way in which WRMSD education has evolved, owing to the multifactorial nature of the phenomenon and the fact differences exist within every occupational role, and individual affected. The phenomenon is also further complicated by the nuanced way in which individuals working in healthcare see themselves in relation to their own health and well-being (Roll *et al.*, 2017).

Although one could argue these are not directly classed as 'education' per se, several conditions are now managed by 'self-management' strategies, e.g., conditions like diabetes, asthma, and cardio-pulmonary diseases (Smyth *et al.*, 2017). Earlier, Johnston *et al.*, (2013) explored the use of this method as a strategy for combatting WRMSD, advocating that be-

cause working is seen as 'being a positive health behaviour' it necessitates the need for strategies within that specific role to be used to develop a means to prevent WRMSD. Consequently, this study advocated direction from within the injured worker themselves to find workable solutions to their problem from within their workplace. Although one must approach such a suggestion with some caution, as this method has not yet been established with sufficient material evidence to sustain its validity, this poses an interesting concept that would lead one to question whether enough is yet known about sonographers' attitudes toward self-management which would highlight the need for further research in this area.

This section has explored how educational strategies to address the WRMSD have been employed in healthcare related occupations. It has considered several nuanced ideas which surround the development of any educational WRMSD prevention programme specific to healthcare related occupations. There is agreement amongst the authors that the phenomenon remains complex and under-researched, which consequently leads to disparity in educational approaches offered. Furthermore, there is also agreement that educational interventions need to be specific to the individual and the job or related role. The complexities in tackling WRMSD transcend into the development of any educational prevention programmes, and one of the main challenges is making any intervention effective in challenging and changing the respective behaviours, to reduce the incidence of WRMSD. The complexities surrounding professional cultures and changing behaviour remain complex and under-researched highlighting a significant gap in the knowledge base. The next section will focus specifically on WRMSD prevention education in sonographers.

2.5.3 Educational Programmes related to WRMSD (Sonographers)

The previous section explored educational programmes as a WRMSD prevention tool in relation to broader healthcare professionals. The next section will evaluate the same concepts, specifically in relation to sonographers.

Within sonography there are already several agreed strategies for the prevention of WRMSD, which have been discussed in a previous section of this review. In fact, even back in 2001 it was suggested that sonography students needed to be taught of the dangers of WRMSD, from the very beginning of their ultrasound training, and in doing so this could bring the fundamental issues related to this phenomenon to the forefront, to create an “ideal system” (Jones & Kumar, 2001). This “ideal system” could be successful in addressing the main causes of WRMSD by ensuring sonographers know how to protect themselves from injury through adopting safer postures and growing opportunities for peer learning, through educated discussion and debate (Bolton and Cox, 2015; Harrison & Harris 2015; Gibbs and Edwards 2009).

A more recent study by Bolton and Cox (2015) explored the range of WRMSD prevention strategies that were being implemented across the UK using a dual method of data collection. The study employed a focus group locally, followed up by a questionnaire sent out to the wider sonographer population across the UK. The study suggested that there were some positive steps towards WRMSD prevention being addressed through education nationally, although a number of points were raised in terms of how participants felt this could be improved in the future, including the benefits of face-to-face lectures aimed at trainee sonographers in the university setting, incorporating the Alexander technique into practice and

seeking the expertise of physiotherapists to advise on posture and ergonomics in ultrasound departments.

This study highlighted the potential challenges of changing existing behaviours and one study participant suggested that many sonographers are already aware of a range of strategies which may be employed to limit their risk of acquiring WRMSD. However, the study did highlight a level of uncertainty amongst sonographers in relation to WRMSD prevention and demonstrated a lack of knowledge as the main underpinning reason as to why sonographers do not necessarily fully engage with such prevention strategies.

There were some limitations to the Bolton and Cox (2015) study. Firstly, although the study captured the views of a local sample of sonographers, through the initial focus group, only final year trainee sonographers were invited to complete the questionnaire, which meant the sample potentially excluded valuable data from more experienced sonographers. Secondly, the study did not follow-up on the questionnaire survey through interviews which may have allowed the study to have explored in greater depth the potential reasons why sonographers may not engage in educational interventions over a longer timeframe.

As already discussed, in a previous section of this literature review, implicit evidence does suggest there continue to be issues, concerning a lack of engagement with relevant WRMSD prevention education. Consequently, one of the fundamental gaps which this research seeks to explore and understand is why sonographers fail to engage in WRMSD prevention, despite being educated about the potential benefits. As Bolton and Cox (2015) highlighted, a lack of a working knowledge of some of the established WRMSD prevention strategies remains a barrier for adhering to WRMSD prevention education in many cases and this is explored further in section 2.8 of this literature review.

Moreover, this study's results acknowledged positive perspectives regarding the education

for preventing WRMSD among sonographers. Many questionnaire respondents offered constructive suggestions to enhance the education of sonographers on WRMSD prevention. A significant emphasis was placed on regular short group-training sessions to foster the development and reinforcement of techniques and skills, as well as to promote peer support and idea sharing. The findings of the study also supported the idea of a combined educational approach involving both universities and clinical educators. Such an approach holds promise for enhancing the overall education of sonographers in WRMSD prevention. However, it is worth noting that limited research has been conducted in related fields, leaving a gap in the current evidence base regarding this phenomenon (Bolton and Cox, 2015; Sommerich *et al.*, 2016; McDonald and Salisbury, 2019; Wareluk, Jakubowski, and Wareluk, 2017).

Bolton and Cox (2015) went on to explain that sonographers who took part in their focus group, spoke of posters in their department which were used for demonstrating a range of muscle-strengthening exercises, thought to help minimise the risk and/or impact of WRMSD. This would suggest that information, education, and training continue to be cascaded to sonographers. The fundamental emerging challenge is in devising suitable WRMSD prevention education to the individual. The complexities of the phenomenon, already documented earlier in this review, which arise from a combination of numerous causative factors, result in no single defined method of prevention. As several studies have highlighted, the multifactorial nature of WRMSD in terms of cause and prevention remains a dilemma and despite attempts at educational prevention methods being evident, evidence of engagement with the latter seems to be lacking (Bolton. and Cox, 2015; Sommerich, *et al.*, 2016; Mcdonald and Salisbury, 2019; Wareluk, Jakubowski and Wareluk, 2017).

Some of the main issues, related to WRMSD prevention education in the UK, were also highlighted in earlier studies (Gibbs and Young, 2011; Gibbs and Edwards, 2012; Gibbs and

Young, 2009). As already discussed, evidence emerging from the literature studied, advocates that there are already a number of suggested ways in which improvements can be made in the field of sonography, with a growing body of evidence that highlights sensible strategies which are emerging in terms of the training and education available to sonographers, intended to reduce the longer-term incidence of the phenomenon (Bolton and Cox, 2015; Gibbs and Young 2011; Gibbs and Edwards, 2009). There seems to be general agreement between the available studies related to sonography and all seem to illustrate similar points and suggestions. All highlighted the benefits of education and the challenges in long term participant engagement. In relation to the latter, Bolton and Cox (2015) argued for more emphasis to be placed on accessory equipment (e.g., support cushions), administrative support (in terms of better patient scheduling), textured examination gloves (for better transducer grip) and muscle-strengthening exercises (for better sonographer health and strength).

Differences in opinion do occur where evidence of new or novel educational prevention strategies have been attempted. An example is an earlier study by Brown & Baker, (2004), who suggested that Electromyography (EMG) devices are described as an “excellent” way to study the onset of muscle tension with the limb abducted to varying degrees from the body. This technique potentially illustrated to the person the time it takes for muscle fatigue to happen. In their study Brown & Baker (2004) discussed how this technique might be used to educate sonographers; when the upper limb is abducted by 120 degrees, muscle fatigue will take place within five minutes, compared to 20 minutes when the arm is at 60 degrees and 60 minutes when held at just 30 degrees. This scientific method of assessing the likelihood of WRMSD occurring, by indicating a warning when certain postures are adopted, could potentially be developed as a strategy to support the education of sonographers in how to reduce

the incidence of WRMSD, and as a reminder to adopting a safer posture while scanning (Murphey and Milkowski, 2006; Brown & Baker 2004).

There is an apparent lack of follow-up from any such studies, leading one to assume 1. Recommendations from the study have been found to have been of little long-term benefit, 2. Sonographers have not been able or willing to engage, or 3. Barriers exist which inhibit developing such strategies further (such as financial, or practical). Unanimously, across all of the studies evaluated, consensus of agreement was apparent in that the development of WRMSD education remained fundamental in helping to bring about WRMSD reduction, particularly if this is delivered through a programme that could potentially inform managers, and sonographers, about the risks of WRMSD in the workplace and how to limit these risks (Fisher, Brodzinski-Andreae and Zook, 2009). Furthermore, training programmes could usefully illustrate several health and safety issues for sonographers, including the safe use of equipment and specific peculiarities of the role such as safer scan technique and posture (Morton & Delf 2008).

There is evidence to suggest a multifaceted approach to WRMSD prevention education, with the responsibility for improving the working practices of sonographers being shared and developed between the sonographers, departmental managers, universities, and equipment manufacturers (Morton & Delf 2008; Bolton & Cox, 2015) to see these improvements come to fruition. Robust methods for developing such changes in practice are lacking from the current research base. Furthermore, before such educational approaches are developed, greater understanding of how the phenomenon of WRMSD is perceived by sonographers is needed to find solutions to mitigate its impact (Sommerich *et al.*, 2016).

The concept of a group approach seemed to resonate among several studies. Simonsen *et al.* (2018) suggested that sonographers need to work together, through focus groups, to share

expert knowledge and experiences of WRMSD prevention, to improve working conditions. Furthermore, Harrison, Harris and Flinton (2018) explored the benefits of educating a small group of student sonographers on the optimum ways to hold the ultrasound transducer, concluding that there were small differences (for the better) following instruction on best practices. The authors of this study acknowledge its limitations and further, more generalisable research is still advocated to provide results which resonate at a national level. No studies of this nature have been conducted in real-life situations over a long enough period to allow quantifiable results to emerge and it would be useful to consider how such ideas may work in clinical situations.

Harrison & Harris (2015) in an earlier study discussed the need for sonographers to have a good awareness of the risks of WRMSD and they suggest that through engaging with 'a range of stakeholders such as senior managers, ultrasound managers, ultrasound practitioners, students, educators, occupational health departments and equipment manufacturers', improvements can be made in terms of reducing the risk of WRMSD. Raising awareness of the phenomenon is advocated unanimously in the literature and the Society and College of Radiographers (SCoR) issued guidance in 2006, and later in 2019, related to WRMSD and sonographers, highlighted in Figure 9:

Recommended 'best practice' that sonographers should follow to reduce the risk of developing WRMSD.

Preventing or minimising awkward postures, alternate sitting and standing and vary scanning techniques and transducers grips.

Adjust all equipment to suit users' size and have accessories on hand before beginning to scan.

Use measures to reduce arm abduction and forward and backward reach to include instructing the patient to move as close to the user as possible, adjust the table and chair, and use arm supports.

Relax muscles periodically throughout the day:

Stretch hand, wrist, shoulder muscles and spine

Take mini breaks during the procedure

Take meal breaks separate from work-related tasks

Re-focus eyes onto distant object

Vary procedures tasks and skill as much as reasonably possible.

Use correct manual handling techniques when moving patients, wheelchairs, beds, stretchers and ultrasound equipment.

Report and document any persistent pain to employer and safety representative.

Maintain a good level of physical fitness to perform the demanding work tasks required.

Work together with employers on staffing solutions that allow sufficient time away from work.

Participate in education and training to reduce the risk of developing musculoskeletal disorders:

Attend employer sponsored training

Attend seminars, lectures, workshops, or conferences offered by professional organisations or manufacturers

Access to journals, textbooks online resources etc.

Attend a formal sonography programme that includes work related musculoskeletal disorders prevention in the curriculum.

Figure 9 Guidance for Sonographers on WRMSD Prevention 'Best Practice'

(Taken from SCoR, 2006; SCoR 2019)

One of the guidelines above was for sonographers to attend education and training on WRMSD prevention, which should be provided by the employer. Teaching sonographers to consider their risk of injury throughout their career and the ways in which these risks can be minimised is also advocated in current and future ultrasound education and training programmes (Bolton & Cox, 2015; Burnage 2007). It is however acknowledged that such interventions, for the avoidance of WRMSD, have remained in the developmental stages for approximately 20 years and consequently consideration is needed in terms of whether the WRMSD prevention education interventions are adequate to tackle the overarching issues as well as the strategies used to encourage their implementation.

Furthermore, uptake of such intervention has been tentative (which is consistent with studies from wider healthcare and other professional fields) (Xiao and Watson, 2019). In a relatively recent study, Fisher (2015) examined the success of education on the prevention of WRMSD amongst a small group of radiographers and sonographers, (n=24) participants. The study highlighted the gap in the current evidence base in terms of the success rates of such intervention, suggesting a need for larger cohort studies in this area. A quantitative design was utilised which provided some evidence that the sonographers in the study were aware of the general ergonomic, WRMSD prevention techniques available, although uptake seemed to be mixed for the participants sampled. This implicitly suggests that further research, in particular qualitative studies, are needed to explore first-hand why sonographers work in the way they do, which would help to develop a deeper level of understanding of the phenomenon to potentially allow improvements to the education interventions moving forward.

Several studies have tried to look at participant engagement in WRMSD methods which are currently being taught, for example, refresher training is advocated every 4-6 months

(Fisher, 2015) as follow-up training has been found to increase uptake and engagement in several studies (Demerouti, Mostert and Bakker, 2010). Increasing engagement in terms of adhering to educational guidance of WRMSD prevention remains challenging and this underpins the position of sonographers perfectly as little evidence exists in terms of how this challenge has been addressed in any field, and specifically to this study. To make any WRMSD prevention intervention successful, in persuading workers to adopt a safer working practice, studies need to consider what is going to persuade an individual to apply the content of the theory to their practice and indeed whether education alone is going to be a success in bringing about the change (Butwin, Evans and Klatt, 2017).

Although current studies accepted that increasing understanding, through education, is a positive step forwards in terms of raising awareness and reducing WRMSD (Simonsen and Gard, 2016; Bolton and Cox, 2015; Gibbs and Edwards, 2011) so much remains unknown about the actual benefits of these interventions and how to maintain participant engagement. Furthermore, there is much still to learn from the strategies used in other “at risk” occupations, where further studies have been carried out on WRMSD prevention.

There have been a number of debates regarding the use of education and WRMSD prevention, for example some argue for education for students at the beginning of their training (Sommerich, 2018, Bolton & Cox, 2015). Several authors, as previously mentioned, have discussed the benefits of reinforcing the training throughout the sonographer career (Fisher, 2015) in a very similar manner to annual mandatory training currently completed by most allied healthcare professionals in the UK to ensure frequent reminders take place.

Consequently, injury prevention educational programmes have been advocated in ultrasound departments for teaching sonographers how to work more safely, to reduce their risk of acquiring a WRMSD, and to ensure departments are made ergonomically safer (Dabholkar

et al., 2017). The Consortium for the Accreditation for Sonographic Education (CASE) also now include WRMSD prevention in their criteria for being included in any programme they accredit (CASE, 2021). Furthermore, there does appear to be several factors where improvements can be made to bring about a reduction in WRMSD among sonographers. How these changes are applied remains challenging in many cases, for a range of complex and under researched factors, and unfortunately many of the current evidence-based solutions do not seem to have been evaluated in real-life situations (Bolton & Cox, 2015; Coffin, 2014; Morton & Delf 2008) which leads one to question the credibility and reliability of such studies, when considering any future education or training based on them. It remains unclear how sonographers relate to such strategies from a 'real-life' perspective and, from a practical sense in terms of working as a sonographer, highlighting the need for further research to underpin this (Soares, Jacobs and Jose, 2012; Jeunet *et al.*, 2018).

Challenging the status-quo is clearly important, and it cannot be denied that educational programmes remain crucial in potentially reducing the incidence of WRMSD because awareness is crucial to act as a catalyst for change (Danielsson and Rosberg, 2015). The heterogeneity of individuals in the workplace, and in fact how different individuals perceive situations and consequently respond to them, seemed to be a key factor which has been overlooked by the current evidence base in sonography, consequently highlighting a further gap in the current knowledge on WRMSD prevention (Skjaerven, Kristoffersen and Gard, 2010; Feng *et al.*, 2016).

2.5.4 Summary

This section has highlighted that there is emerging evidence that education is advocated in the prevention of WRMSD among sonographers. Like in other occupations, there is some de-

bate related to the efficacy of educational methods, primarily associated with participant engagement (Fisher, Brodzinski-Andreae and Zook, 2009). All the studies reviewed acknowledged the complexities surrounding WRMSD, as a phenomenon, and how this has affected the educational strategies needed to challenge the present situation. There were limited studies which have captured the benefits of real life WRMSD prevention educational approaches, as many studies have been conducted in simulated environments, which is a clear limitation (Harrison, Harris and Flinton, 2018).

A combination of only limited research having been completed in this area, and the heterogeneity of the sonographer population, which to date has not been considered in other related studies, means not enough is yet known about WRMSD prevention education in sonographers to make significant changes (Harrison, Harris and Flinton, 2018). One of the fundamental issues is challenging professional culture and changing behaviours, which seemed to resonate in wider affected occupational groups.

2.6 WRMSD Prevention, Health and Wellbeing

The aim of this section of the narrative literature review is to explore how WRMSD prevention and employee health and wellbeing are interrelated, given the heterogeneity of the sonographic workforce. It will explore how a sonographer's personal health and wellbeing may impact on their vulnerability to, and experiences of, WRMSD.

2.6.1 WRMSD Prevention

Preventing WRMSD is already well established as a significant public issue in many countries (Tucker *et al.*, 2014). NICE (2020) advocated the public to adopt a healthier lifestyle, which includes physical activity, as a measure to reduce the incidence of WRMSD. As outlined earlier there are several studies which have already explored the impact of WRMSD on various

areas of the body, with often little suggestion of what specifically can be done to alleviate or prevent this from happening (Horkey and King, 2004; Harcombe *et al.*, 2009; Choobineh *et al.*, 2011; Campo and Darragh, 2010); however, several authors have advocated muscle strength as being a useful barrier to WRMSD (Croisier, 2004; McDonald and Salisbury, 2019; Caruso, 2016; McDonnell, Hume and Nolte, 2011). Although, Mansfield, Thacker and Smith (2017) conducted a systematic literature review which explored physical activity and its association with work-related upper quadrant disorders (WRUQD) and found inconsistencies in the findings of the studies reviewed which highlighted a gap in the current evidence base, owing to the limited number of studies published in this area of research.

Increased muscle strength has been attributed as being a contributing factor in resisting the pressures of workload, to a much greater extent than weaker muscles (Jose, 2012; Bravo, Coffin and Murphey, 2005). Inadequate muscle strength may therefore be a predictor in the development of WRMSD. This is of importance to older sonographers particularly, who are more susceptible to WRMSD due to the ageing process as muscle mass becomes decreased (Jose, 2012). Incorporation of muscle strengthening exercises into a WRMSD prevention programme for sonographers, and careful occupational health screening and clearance for all staff proposing to train as a sonographer, may therefore be prudent moving forward. Unfortunately, although muscle strengthening has been mentioned in several studies, no research has been conducted which assesses the benefit of muscle strengthening exercises in direct relation to the work of sonographers, nor that which explores a sonographer's perception of their own fitness and the impact this might have on the physical aspects of their role. Nevertheless, there is concurrence within the current WRMSD prevention guidance which advocated that sonographers consider their own personal health and exercise, including muscle stretching, to minimise their risk of WRMSD (McDonald and Salisbury, 2019).

Over the past decade research in this field has grown and there are now numerous recommendations relating to how sonographers can establish safer working practices in terms of WRMSD prevention (Paparella, 2007; Rousseau *et al.*, 2013; Lilley, 2018; Bolton. and Cox, 2015; Morton & Delf 2008). Recommendations suggested that increasing individual upper body strength, by completing specific muscle strengthening exercises, could be beneficial in reducing WRMSD (Alaniz and Veale, 2013), although this is yet to be proven. However, McDonald and Salisbury (2019) more recently acknowledged that these recommendations needed to be taken with some caution because most ergonomic research in sonography had been confined purely to the workplace. They suggested that informed choice is important to increase adherence to exercise regimes as even moderate exercise and stretching may help to reduce WRMSD, according to some studies (Alaniz and Veale, 2013). It is acknowledged that the available research is both limited and dated.

In some situations, too much exercise, or indeed if the exercise regime was not appropriate for the individual, or indeed if exercises were completed incorrectly, has the potential to aggravate an existing injury. Consequently, this has highlighted a degree of uncertainty in the current debate and the need for sonographers to exercise caution when performing any muscle strengthening exercises (Mc Donald and Salisbury, 2019). Furthermore, there is no current evidence that sonographers who do exercise regularly do in fact have a lower risk of acquiring WRMSD (Bolton and Cox, 2015; Loras et al., 2015).

The broader benefits of such exercises are cited by several authors (Mcdonald and Salisbury, 2019; Alaniz and Veale, 2013; Omer *et al.*, 2003; Melaku *et al.*, 2019). However, it is less clear from the evidence available whether sonographers seem to overwhelmingly engage with these exercises, to potentially limit the impact or acquisition of WRMSD (Karsh, Moro and

Smith, 2001, Chefec, 2008, Jose, 2012, Alaniz and Veale, 2013). Incorporating stretching exercises, for some sonographers, into the working day has led to demonstrable benefit when these are performed regularly (McDonald and Salisbury, 2019). However, all authors highlighted the need for further large-scale studies in this field acknowledging the gap in the current evidence based, reflecting the present lack of understanding of the phenomenon (Butwen *et al* 2017; Alaniz and Veale, 2013; Gibbs and Young, 2011; Baker, Roll and Evans, 2009; Muir *et al.*, 2004; Pike *et al.*, 1997).

There are arguments to suggest that by capturing the general feeling of sonographers, and by making allowances for the variation and differences between sonographers, including physical, emotional, and professional differences, further improvements can be made in terms of WRMSD prevention and sonographer health and wellbeing (Alaniz and Veale, 2013; McDonald and Salisbury, 2019), meaning a 'one-size fits all' strategy, would not seem appropriate. Encouraging sonographers on how to increase muscle strength through performing strengthening exercises and how to consider their posture and the ergonomics of their surroundings may contribute to developing a self-empowered workforce, where individuals adopt better work habits that suit their needs and reduce the incidence of WRMSD in the longer term (Loras *et al.*, 2015, 2020).

It has already been acknowledged that recommended improvements for the prevention of WRMSD include the distribution of exercises instruction posters, within some departments. These posters aim to encourage and teach sonographers how to perform a range of muscle strengthening exercises during their working day (Felton *et al.*, 2022). They also include information to inform departments how to vary specific examination types on the relevant ul-

trasound scan patient work lists to allow different muscle groups to rest and to educate sonographers, managers, and appointments staff on safer more ergonomic prevention strategies to reduce the incidence of WRMSD (Morton & Delf, 2008).

Several recent studies also explored how individual employee physical fitness (overall) potentially affects the likelihood of acquiring WRMSD, and indeed how lifestyle activities in general potentially affect a sonographer's professional health and wellbeing (Felton *et al.*, 2022; Childs *et al.*, 2021). The recent study by Childs *et al.* (2021) also specifically explored sonographer wellbeing and the impacts of the Covid-19 pandemic, clearly an additional burden on sonographers, which was unfortunately not considered in this study owing to the data collection occurring pre-pandemic. The pandemic has very likely compounded the problem of WRMSD further because evidence suggests workload has increased since (Mazal *et al.*, 2021).

2.6.2 Lifestyle of Sonographers

Lifestyle activities outside of the working environment are also thought to be contributory to WRMSD, particularly when domestic workload follows the standard working day, limiting the opportunity for muscle recovery. Physical fitness of the individual sonographer is still thought to have some significance, in terms of WRMSD prevention, and exercise is advocated in the sense it can provide improved muscle capability and efficiency because this improves muscle strength, enhances balance and posture to limit WRMSD (Knapik, 2015; Alaniz and Veale, 2013; Zhang and Huang, 2017; Casemiro *et al.*, 2017). McDonald and Salisbury (2019) found the larger number of respondents in their study performed walking or hiking, as their only form of physical exercise, compared to a lesser number who performed muscle strengthening activities such as weightlifting, yoga and Pilates. Furthermore, several other studies have found that muscular discomfort is lower in those individuals who performed

strength training involving multiple muscle groups, which mimic everyday activity such as yoga and Pilates (Cassemiro *et al.*, 2017).

What fails to be fully illuminated within the current research in this field, is what it is like for sonographers working 'at the coal face' to better understand the true challenges they face, which may then allow for further explanation as to the difficulties in adhering to WRMSD prevention strategies which have already been recommended for several years. No in-depth studies have to date explore the true benefit of how sonographer health and fitness impact on their resilience to WRMSD.

2.6.3 Summary

This section has highlighted that there is certainly a corpus of evidence to suggest that improved physical fitness, alongside regular engagement in meaningful individualised exercise activity, may certainly be helpful in limiting both the effects and reducing the onset of WRMSD. However, there is still not enough evidence available to fully demonstrate the impact individualised exercise and lifestyle activity specifically have on an individual's chances of acquiring WRMSD, so population-based studies are required to strengthen the evidence base. It is acknowledged that many ultrasound departments already have 'exercise instruction posters' displayed, but the engagement of sonographers with such regimes, or in fact their overall lifestyle activity, remains unknown. The next section will evaluate the methods to monitor and report symptoms of WRMSD as and when they arise.

2.7 Monitoring and Evaluation of WRMSD and Sonographers

The aim of this section is to discuss the current strategies for monitoring WRMSD in sonographers and the concept of 'body mapping'. This section will explore how WRMSDs may be identified and monitored using established body mapping processes, recommended by the

Society and College of Radiographers, hereafter SCoR. This section will also evaluate, through a critical narrative review, the guidelines currently in place, including those from SCoR, with respect to sonographer practices of reporting symptoms of WRMSD.

2.7.1 Body Mapping

Firstly, it is prudent to establish what ‘body mapping’ is, particularly as this method has been applied to several occupations affected by WRMSD. The process of body mapping is supported by the Health and Safety Executive and Trade Union Council (TUC) (CSP, 2010). Furthermore, this has already been validated by, and published in, several peer reviewed journals initially based on the Nordic Musculoskeletal Questionnaire (Kuorinka *et al.*, 1987). This was historically a useful tool for facilitating discussion with employees about the effects of their work on their individual health. The process also assists health and safety representatives, employers, and employees through the sharing of experiences of a particular physical issue or a specific pain in a region of the body, related to their occupational role, consequently allowing a dialogue to take place which may assist in developing an understanding of the potential cause of an employee’s WRMSD (SCoR, 2019). Furthermore, by marking out the respective sites of potential pain or discomfort, on a body map, the process also provides evidence for the respective sonographer and the health and safety representative to present to those in higher management when trying to drive forward potential workable solutions to an individual’s personal occupational circumstances (Thomas, Hare and Cameron, 2018).

Utilising body mapping has the potential to raise awareness among colleagues, allowing them to openly share their experiences of WRMSD and to discuss the importance of submit-

ting incident/accident report forms, if they are experiencing symptoms (CSP, 2010). Consequently, this may help toward the development of support networks locally by bringing about discussion, related to WRMSD, and a reduction in feelings of isolation amongst employees (Dickson *et al.*, 2011).

The Chartered Society of Physiotherapists explained that, under Regulation 4 of the Safety Representatives and Safety Committee Regulations, 1977, accredited safety representatives can investigate potential hazards within the respective workplaces, complaints raised by employees, and causes of accidents and ill health associated with the specific occupation. Conducting a body mapping exercise has been used previously as a form of 'inspection', as described under these regulations, and union representatives may legitimately negotiate paid 'facility' time to meet members for advice and support, and to encourage colleagues to carry out a body mapping exercise, where relevant (CSP, 2010).

Specific to sonographers, the SCoR guidelines, for their members, include a method which allows sonographers to self-monitor their physical health and wellbeing in terms of mapping and recording potential symptoms of WRMSD as outlined below [see Figure 10].

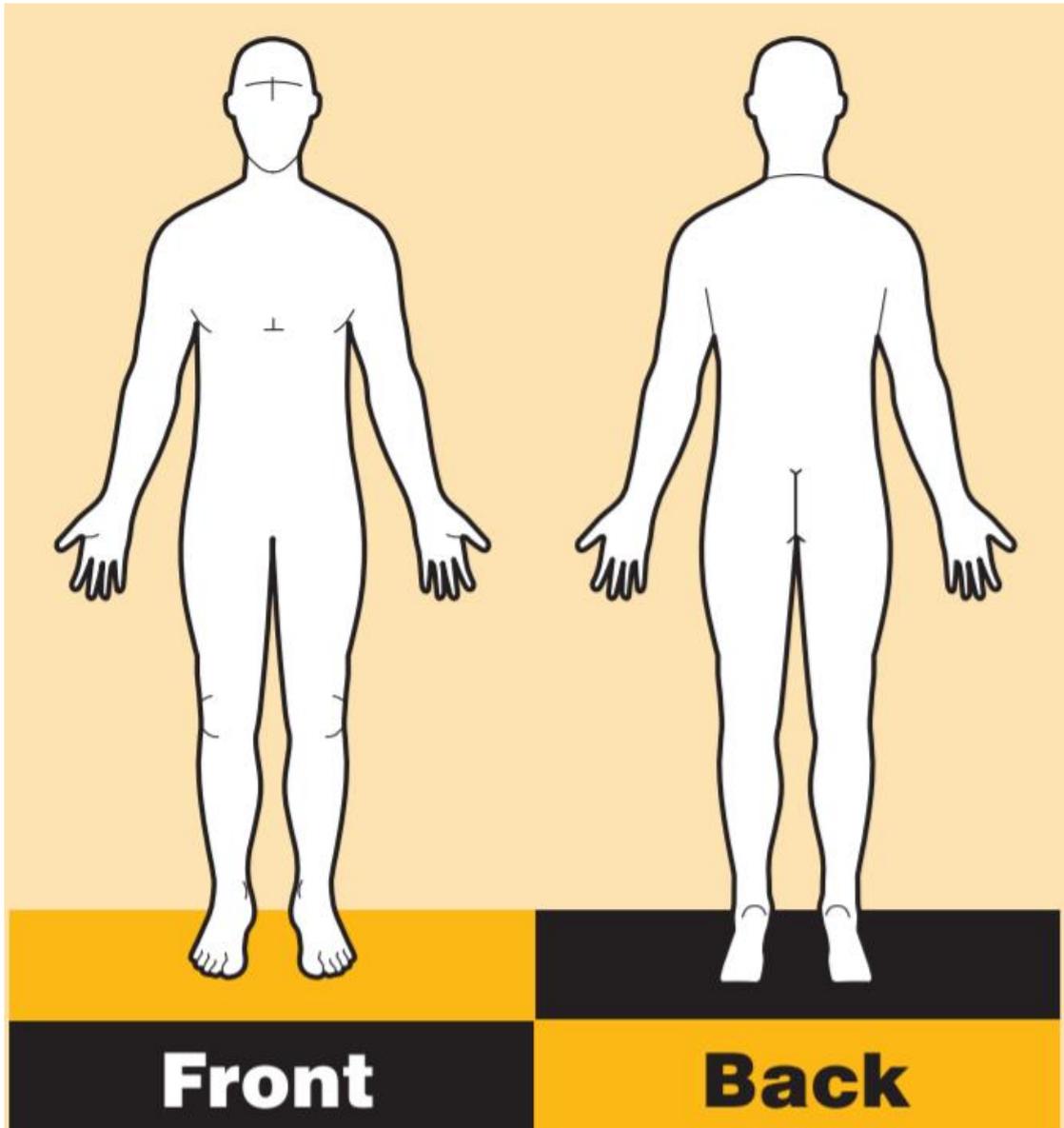


Figure 10 WRMSD Body Mapping For Sonographers

(Taken from SCoR, 2007)

Using the chart above, sonographers are invited to 'code' their symptoms as per Figure 11:

- *Orange for aches and pains (not debilitating and usually gone a few hours after the shift)* • *Green for symptoms of pins and needles and numbness*
- *Blue for shooting pains*
- *Red for continuous muscle pains (i.e., pain that doesn't go away even when away from work for a day or two)*

Figure 11 Body Mapping: Coding of WRMSD Symptoms

(Taken from SCoR, 2007)

Body mapping has been a useful method, for some, and has provided sonographers with an opportunity to develop an understanding of the multifaceted risk factors associated with WRMSD; it provides anonymity in reporting symptoms, as well as allowing the ultrasound workforce a voice. Consequently, this may also be helpful in the facilitation of developing further practical solutions in combating WRMSD (SCoR, 2019).

Earlier, the SCoR (2007) highlighted that body mapping cannot be done as an alternative to formal incident or injury reporting, rather in tandem with such established processes, and therefore they suggest that Health and Safety Representatives must continue to encourage sonographers, with suspected WRMSD, to complete incident reporting forms following accidents or incidents of pain or during exposure to a specific workplace activity.

Part of the rationale for developing the 'body mapping' back in 2007 was because of a generalised perception that SCoR members were seen as reluctant to report symptoms of WRMSD for several reasons, such as a perception that they are the only ones experiencing symptoms

of WRMSD and may not want to be identified or singled out by management (SCoR, 2007) and consequently this was seen as an initiative to encourage sonographers to report symptoms of WRMSD.

Further guidance was issued by the SCoR (2019) and these guidelines outlined evidence embedded in employment law, including that employers have a legal duty to conduct a risk assessment before any changes in work practice are made. For sonographers, changes may include the adjustment of scanning times, upgrades to equipment, alterations to work schedules or out-of-hours cover and extending the working day. Furthermore, the guidelines suggested that when any accident or injury is reported, a risk assessment needs to be reviewed, and risks acted upon. A summary of the guidelines can be found in Figure 12:

Society and College of Radiographers Guidelines on Recording Problems Associated with WRMSD
All ultrasound rooms and procedures should be subject to a regular and ongoing risk assessment process.
If sonographers are suffering from a WRMSD they should ask their local health and safety representative or industrial relations representative to look at the risk assessment in place, and check whether any risks were noted on a previous assessment, and what preventative measures were taken.
It is important that concerns about WRMSDs are put in writing to management
If an injury has been sustained during employment, the sonographer should report this to their manager, complete an incident report and seek advice from occupational health.
Many departments have open access for sonographers to physiotherapy or back care specialists.

Figure 12 Guidelines on Recording Issues Associated with WRMSD

(Adapted from SCoR, 2019c)

The SCoR (2007), (2019) advocated that it is each sonographer's professional duty to inform their manager, preferably in writing, if their working conditions (workload, high patient BMI, inadequate equipment etc) are either causing or exasperating symptoms of WRMSD. Body mapping is also advocated to provide tangible evidence of each sonographer's physical well-being or otherwise to both the employer and employee. Unfortunately, it is apparent from the literature that self-reporting of WRMSD is significantly lacking by those experiencing pain (Bolton and Cox, 2015; Sakzewsky and Naser-ud-Din, 2014), although none of the current literature provides an explanation of precisely why this is the case, highlighting another gap in the current evidence-base which this study aims to fill.

The guidelines above provide evidence that, although there is support from the SCoR for sonographers who are members of this organisation, it remains unclear as to what extent respective individuals are following such guidelines. More interventions clearly need to take place with the aim of encouraging sonographers to openly discuss these issues to bring about improvements (Morton & Delf, 2008). The current study is well placed to determine what sonographers' views are in relation to the guidelines available.

2.7.2 Summary

This section has illustrated that there is evidence that relevant professional bodies have been trying to support members in recording and reporting concerns related to WRMSD. It has also highlighted that very little has been done in terms of research related to how such guidelines are followed in practice.

2.8 Barriers to Reporting WRMSD

The aim of this section is to explore the barriers to reporting symptoms of WRMSD from an employee perspective. This section aims to provide a critical narrative of current research

studies and will begin exploring barriers to reporting WRMSD in a broad context of wider occupational fields, narrowing down into healthcare specialists and finally focusing on sonography.

2.8.1 Barriers to reporting WRMSD in wider occupational fields

Through examining the research from wider professional fields, it is evident that, despite guidelines for safer practices being available and support networks being recommended and developed for those experiencing symptoms of WRMSD, barriers exist among those experiencing symptoms of WRMSD to report them (Berner and Jacobs, 2002; Childs *et al.*, 2021; Lee and Paterson 2004; David, 2005; Parker, 2012; Dembe *et al.*, 2005).

In a study related to computer workstation users Berner and Jacobs, (2002) acknowledged that budget, time, and staffing are all limitations to WRMSD prevention. The latter reasons outlined, may therefore also act as a barrier to reporting WRMSD given time and staffing constraints increase pressure on employees, in terms of workload, and time limitations for reporting such issues. Barriers to reporting is not a new concept, in fact several studies discuss this concept in the context of WRMSD (Roll, Scholl and Salisbury, 2017; David, 2005; Roll *et al.*, 2017). A study by Coutu *et al.* (2011) used a qualitative methodology to explore the experiences of 16 participants, using a sample of convenience. The study highlighted some potential dilemmas which seem to exist amongst the participants in terms of reporting symptoms of WRMSD. Participants in the study emphasised a sense of stigma, when declaring any type of WRMSD during the process. On labelling themselves as having WRMSD, participants reported feelings of weakness. The participants felt the need to place themselves into a box, and if they did not have WRMSD they were 'healthy' and could enjoy lifestyle activities such as sports, leisure. Participants in the study defined admitting to having a WRMSD as a weakness, with statements such as 'feeling weak' 'having no endurance'. The study showed

WRMSD has resonance with fears of isolation from colleagues, loss of independence and experiencing limitations. The study highlighted an overarching fear of being perceived as 'disabled'. The study concluded by warning of the dangers of such attitudes, particularly if they become a barrier for raising concerns about WRMSD, hindering potential rehabilitation. The study did have several limitations, a small sample size being one, inferring that the results are not necessarily generalisable across a larger cohort. Furthermore, the study highlighted some debate over whether those with recurrent WRMSD may already have had pre-determined experiences which could have altered the generalisability of the findings to those experiencing WRMSD for the first time.

More recently, Stock *et al.*, (2014) reported potential 'fear of reprisals' and issues surrounding potential litigation claims as a barrier to reporting symptoms of WRMSD. Furthermore, they identified the following barriers:

Level of education of employees in terms of employment law/rights

Fear of reprisals for reporting WRMSD

Employer appeals against WRMSD litigation claims

Those with higher income, less likely to report

Shorter periods of work absence from WRMSD, less likely to report

Membership of a trade union (those who are members more likely to report)

(Adapted from Stock *et al.*, 2014)

Interestingly, this study suggested that those who are more informed about WRMSD are considered more likely to report associated symptoms. Fear of repercussion was thought to

be a significant barrier for reporting symptoms which may also be associated with an individual's financial circumstances, and fears over job loss and loss of income.

Furthermore, an earlier study by Cole *et al.* (2009) suggested that the changes required to adopt new working routines take effort and time which can often be frustrating to employees as this can affect productivity, highlighting another barrier to reporting symptoms of WRMSD as doing so may decrease productivity which may have additional consequences.

2.8.2 Barriers to reporting WRMSD in related/healthcare occupational fields

These additional consequences related to productivity are perhaps explained within other allied healthcare related fields. The Chartered Society of Physiotherapists (CSP) (2010) suggested several factors which might explain the non-reporting of symptoms from its members. Figure 13 outlines the main barriers reported by members of the CSP:

The Chartered Society of Physiotherapists (CSP) Members' Barriers to Reporting Symptoms of WRMSD
Blame symptoms on getting older or being unfit without realising that others are being affected as well.
Accept the symptoms as 'part of the job'.
A common behavioural trait displayed by physiotherapists, is that of a 'can-do' attitude, which implies a 'good physio' just gets on with it.
Physiotherapists believe that their knowledge and skills should protect them from such injuries and therefore it is their own fault if they get hurt.
New graduates (are the most vulnerable to injury) tend to be keen and eager to impress & may lack the confidence to speak up if they are exposed to poor practices.
The 'patient first' culture in the profession which puts pressure to conform to the way things are done even if it is at personal risk to the physiotherapist

Figure 13 Barriers to Reporting Symptoms of WRMSD

(Adapted from CSP, 2010)

The barriers reported above were also echoed in a study related to Occupational Therapists (OT) and Physiotherapists in the United States of America (USA), where Campo and Darragh (2010) discussed the dilemma faced by colleagues who were experiencing symptoms of WRMSD. The study concluded that, despite experiencing pain as part of their professional role, most OT and Physiotherapists continue to work, supporting the assertions made by the CSP in Figure 13. The study found that professional identity and pride were fundamental to the non-reporting of personal pain and injury; the patient usually came first. Reducing productivity would certainly impact on this. A recommendation from this study was further research to explore the relationship between professionalism and caring for patients (when dealing with personal experience of WRMSD). To date, no further research has emerged from this study, highlighting another gap in understanding here.

An earlier study by Augusto *et al.*, (2008) did conclude that a person's own feelings, experiences and history must be considered in the planning of WRMSD prevention and treatment, otherwise they may feel inhibited to express their views openly. Person-centred interventions are therefore needed, which actively encourage the reporting of WRMSD symptoms.

2.8.3 Barriers to reporting WRMSD in sonographers

As several studies have already shown absence of reporting WRMSD as being of significance, the next section will explore the barriers which exist in terms of preventing sonographers reporting symptoms of WRMSD.

In a study conducted by Scholl and Salisbury (2017), similar findings were observed compared to previous research regarding the percentage of sonographers (n=85%) who experience pain during scanning. Although this study showed a slight decrease in the number of

sonographers reporting pain, over the course of 20 years since Pike et al.'s study in 1997, the percentage has remained consistently significant.

Despite various studies on WRMSD in wider healthcare professions, there is a need to further investigate why sonographers are hesitant to report their pain. While research from other occupations has addressed this concern, there is limited reliable evidence specifically related to the barriers that prevent sonographers from reporting WRMSD symptoms.

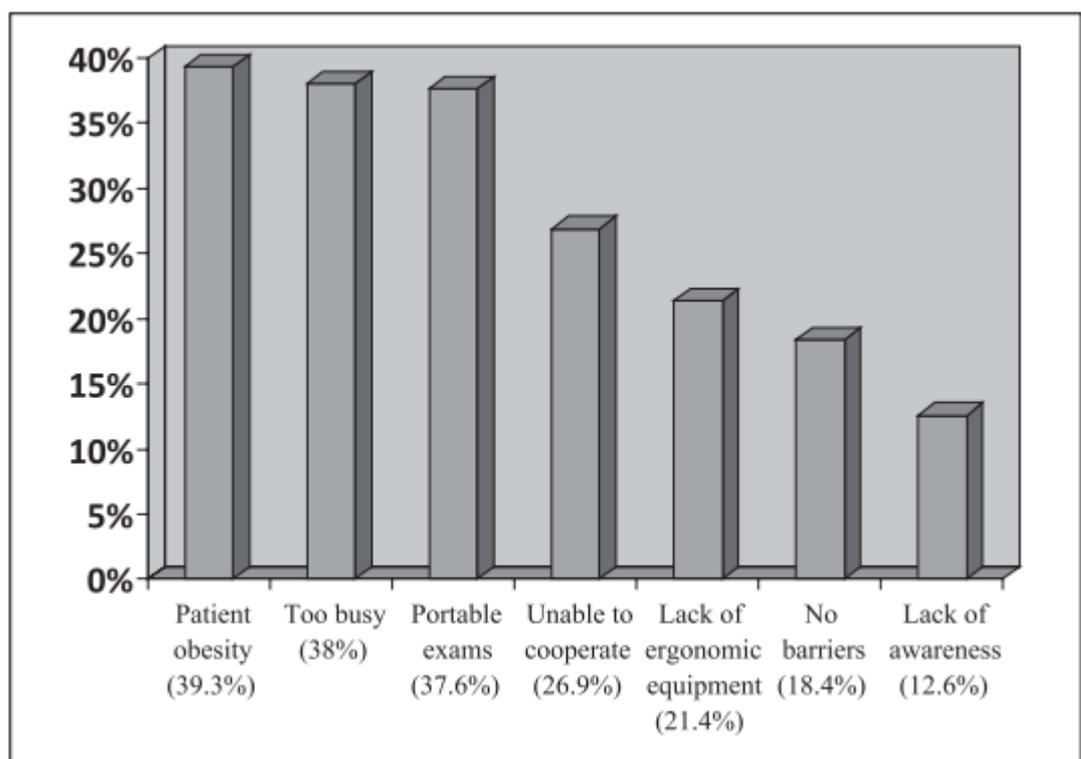


Figure 14 The percentage of respondents who reported barriers to practicing ergonomic sonographic scanning techniques

(Taken from Scholl and Salisbury, 2017)

The above study presented new insights into the primary challenges faced by sonographers when trying to incorporate ergonomic practices in the clinical environment, instead of merely reporting symptoms, which may be interconnected. The study examined four barriers

that potentially hinder sonographers from adopting recommended ergonomic scanning techniques. These barriers included a busy schedule, the need to conduct portable examinations, insufficient access to ergonomic equipment within their department, and a general lack of awareness regarding ergonomic techniques. The issue of being pre-occupied with other work-related tasks is thought to lead to inadequate time to rest muscles and properly manipulate and position sonographic equipment (Scholl and Salisbury, 2017).

Workload increases have been suggested by several authors as the underpinning reason behind the barrier of 'being too busy' to make equipment adjustments or rest muscles in between patients. Most participants (n=85%), in a study by Scholl and Salisbury's (2017), indicated overwhelmingly that they were aware of current suggested ergonomic practices, in contrast to several other studies which reported a lack of awareness of ergonomic scanning techniques as a significant reason that sonographers are at risk of WRMSD (Roll et al., 2012; Scholl and Salisbury, 2017).

In addition to the four barriers previously mentioned, this study identified two additional obstacles that need consideration: patients with a high body mass index (BMI) and patients who are uncooperative. Patients with a high BMI often require excessive pressure during an ultrasound scan, which can lead to strain on the sonographer's upper extremity. On the other hand, patients who are unable to cooperate due to immobility may require the sonographer to assume awkward postures to obtain the necessary images. While high BMI was discussed earlier in the causes of WRMSD section, there is still some reluctance from sonographers surrounding openly reporting 'high BMI' as a limitation in ultrasound imaging, especially when considering the possibility of sharing these limitations in patient-facing ultrasound reports.

Figure 15 illustrates some emerging themes from a UK study, on sonographers reporting to be 'unaffected' by WRMSD, based on what the participants felt has prevented them from acquiring a WRMSD.

Posture/Technique	Physical Fitness and Personal Health-Well-being	Problem Scans	Stress Avoid-ance/Workload strategies	The Unknown/Fate
Standing-up while scanning	Drink plenty of water	Avoiding 'Nuchal Scans'	Remain Relaxed at all times	'Just Lucky'
Avoid Over-stretching	Maintain personal physical fitness	Avoid Obstetric Scanning	Avoid tension/keep stress levels low	
Avoid leaning over patient	Playing squash	Avoid carotid Scanning	Mini Breaks	
Remain Relaxed at all times	Being male and having better upper body strength than female colleagues		Management of workload/sense of control	
Keeping the couch as low as possible to keep upper arm as vertical as possible	Height/reach			
Patient positioning to avoid leaning/stretching				
Using the same scan room for a whole session				
Ergonomic advice related to posture/positioning				
Avoid saddle chairs				
Avoid pressing hard with transducer				
Adjust position as minor symptoms of discomfort arise				
Good posture and body strength				

Figure 15 Sonographers Unaffected by WRMSD

(Adapted from Gibbs and Edwards, 2012)

Gibbs and Edwards (2012) completed the study which explored the experiences of sonographers reporting to be unaffected by WRMSD. The relatively small study examined (n=22)

participants to establish some potential reasons why they perceived themselves to be 'unaffected' by symptoms of WRMSD. One of the key findings from the sample was a sense that sonographers needed to take responsibility for their own safety to assuage the potential impact of WRMSD. Consequently, this study highlighted an implicit sense of stoicism, suggesting sonographers may feel that they have 'failed' if they fail in avoiding WRMSD, which one could assume to be a barrier to sonographers reporting symptoms of WRMSD. Furthermore, the findings of this study also suggest to some extent that sonographers are actively aware of the risks associated with WRMSD in their role and would suggest that some sonographers consider themselves to be proactive in terms of tackling the issues related to WRMSD in their role by explaining how they personally avoid WRMSD. This study has offered some implicit evidence to suggest barriers to sonographers reporting symptoms of WRMSD. This is also consistent with the other study outside of ultrasound mentioned earlier in the review.

The themes taken from the study above demonstrated some conflicting views, even within the small sample employed, demonstrating a range of different barriers to reporting symptoms of WRMSD. The study does not appear to consider why the differences exist and consequently further studies involving those with, and those without, WRMSD symptoms are advocated in the recommendations. It cannot be denied however that the study was useful in terms of highlighting the multifactorial nature of WRMSD and individuality amongst sonographers and furthermore it illustrated the complexities surrounding the barriers to sonographers reporting personal injury or symptoms of WRMSD.

Several earlier studies have also proved useful in contextualising why employees may experience barriers to reporting symptoms of WRMSD. For example, Augusto *et al.*, (2008), and much earlier, Jakes (2001) advocated encouraging sonographers to start to consider their work posture, on a regular basis, both during the scan and at the computer work stations,

and through encouraging sonographers not to be afraid to report injuries and problems so that early action may be taken to limit the problem to alleviate barriers for reporting WRMSD.

In 2003, the Society of Diagnostic Medical Sonography in the USA established industry standards to prevent work-related musculoskeletal disorders (WRMSD) in sonographers. Based on these standards, Baker and Coffin (2013) proposed some optimal practices for the exam room that should be reasonable for sonographers to manage as part of their daily role. The key adjustments they should make are as follows: (1) modifying the height of the exam table and chair to minimise excessive shoulder abduction and overreaching, (2) adjusting the examination table and chair to reduce trunk twisting and bending, and (3) positioning the ultrasound monitor directly in front of them to avoid straining the neck through unnecessary flexion, extension, or twisting.

Unfortunately, the study found that several common obstacles hinder sonographers from implementing ergonomic scanning techniques, many of which are beyond their personal control. For instance, challenges related to patient size and physical condition can persist despite appropriate equipment adjustments. Additionally, factors such as limited influence over department budgets and scheduling services, suggesting a lack of administrative support, can be additional barriers (Baker and Coffin, 2013).

It would therefore seem apparent that there may be several reasons which are restricting the reporting of WRMSD, which have not been highlighted in the current research in the field. Consequently, this would highlight a further gap in the evidence base. Despite all the current efforts, which remain inadequate, there appear to be fundamental issues which remain under researched, particularly in relation to sonographers and WRMSD.

The culture of 'being a sonographer' in terms of what it is like to work in that specific role, and what real world issues sonographers are experiencing which fundamentally underpin their professional behaviour, in particular with regards to the phenomenon of WRMSD, are what remain unknown from the current literature. Behavioural Change seemed to be a key barrier to successful WRMSD prevention, across all the studies explored in this review (Mccrystal *et al.*, 2011; Maunder, 1997; Koppelaar *et al.*, 2013; Haslam, 2002). No current studies, either related to sonography or other professional fields, have established exactly how potentially 'unhealthy' behaviours can be changed in the longer term. Consequently, there is a fundamental gap in the knowledgebase which needs to be addressed, through further studies, to establish more successful strategies and challenge the serious issue of WRMSD in sonographers.

The difficulty in implementing best ergonomic scanning techniques is influenced by several barriers. While some of these barriers are beyond the control of sonographers themselves, others appear to be more manageable (Depalma and Weisse, 1997). Therefore, it is crucial to focus on addressing the barriers that are adjustable, to ensure a safer work environment overall. Despite an increase in awareness of ergonomic scanning techniques and access to adjustable equipment, research indicates that many sonographers still experience discomfort while scanning (Scholl and Salisbury, 2017). This suggests that there has been little improvement since the initial reports of WRMSD in sonographers over 30 years ago. To reduce the risk and prevalence of WRMSD, sonographers need to empower themselves by recognising the significance of proper ergonomic posture and personal self-care (Bolton and Cox, 2015). However, the challenge of addressing barriers that prevent sonographers from reporting WRMSD symptoms remains unresolved.

The reason behind sonographers' reluctance to report symptoms of WRMSD is still not entirely clear, from the current literature. Through examining this phenomenon in other professions, some pertinent links may be established to suggest potential reasons for the reluctance, which may allow for better solutions to be developed in the future. Developing a greater understanding of why sonographers are reluctant to report symptoms of WRMSD may be helpful in developing a strategy to prevent or limit WRMSD for sonographers in the future.

2.8.4 Summary

This section has discussed the barriers to reporting symptoms of WRMSD in wider professional fields, then narrowed down the discussion to focus on the same issues in healthcare related fields, before finally focusing on sonographers. It would seem prudent to assume that some of the other barriers to reporting symptoms of WRMSD, emerging from wider professional fields, particularly healthcare, will have some resonance with the situation among sonographers and it is hoped that the findings from this study will help to provide further clarity on the barriers that exist amongst sonographers, particularly in terms of their reticence in reporting symptoms of WRMSD. Further research is certainly needed to better understand how specific attitudes amongst healthcare professionals, and indeed sonographers, towards WRMSD prevention, could be removed as a potential obstacle, to bridge the 'gap' in understanding related to sonographer behaviour in relation to the phenomenon and to reduce the incidence and impact of WRMSD (Coutu *et al.* 2011).

The final section of this literature review will summarise the key issues that have emerged from the literature about sonographers, and WRMSD.

2.9 A Contextual Summary of the Salient Issues Relating to Sonographers and WRMSD

This section is intended to act as an overall contextual summary of the literature review and the key issues related to WRMSD for sonographers, funnelling down into the literature review final summary and then the subsequent methodology section.

2.9.1 The Peculiarities of WRMSD and Sonographers

WRMSD prevention programmes generally need to consider several nuanced factors, including the biomechanical and psychological causes, to be successful (Cole *et al.*, 2009). Furthermore, there needs to be a readiness for change among radiology departmental management and sonographers, where knowledge is openly discussed and shared, to bring about positive changes in any WRMSD prevention programme (Cole *et al.*, 2009).

One of the barriers identified is lack of self-efficacy amongst sonographers which Cole *et al.*, (2009) suggested could be brought about through adequate WRMSD prevention education although identified flaws in the survey strategy were acknowledged with suggested amendments to potential questioning of participants in future studies. Their study concluded by identifying the challenges in bringing about behavioural changes and individual challenges experienced as being potential barriers for sonographers to engage with WRMSD prevention strategies in their working practices highlighting the need for further studies in this area.

Nieuwenhuijsen (2004) earlier acknowledged that a combination of education given through brochures, posters, group discussions and ergonomic interventions can be a major step in bringing about the reduction of WRMSD; however, it is understood that not all participants in a prevention programme are going to alter their behaviour simply because they are told to. Furthermore, Cole *et al.*, (2009) support their reasoning for this assertion using the trans-theoretical model perspective, which explains that not everybody is ready to embrace

change at the same time and consequently multiple different approaches to developing cultural and practical changes within any workforce are required.

The attitude of the employees is also very important in the success of a WRMSD prevention programme and one way in which workers can be persuaded to co-operate is to create an ergonomic team. In doing this, each worker has the opportunity to become directly involved with a successful continual educational programme, that becomes a mandatory part of the health and safety scheme in the workplace (Bade & Eckert, 2008).

The success of such an intervention needs to be viewed with some caution; for example, with prevention strategies employed in the ultrasound department setting, from a human nature point of view, some people are bound to ignore such warnings and carry on as they had previously done in the past, in order to simply get their work finished more quickly, which is a problem when attempting to bring about behavioural change of any kind (Cole *et al.*, 2009). Bringing about behavioural change within a workforce remains difficult to fully understand, and very little relevant literature was found on this subject related to sonography. However, it is widely acknowledged that changing behaviours is a difficult process and much more research in this area is advocated (Nieuwenhuijsen, 2004) to make any such interventions more successful.

Sonographers spend a significant proportion of their time lone working making it difficult to always see the metaphorical 'wider picture'. It remains important for sonographers to learn from each other, particularly as practices are continually changing. The fundamental importance in terms of keeping sonographers up to date on current best practices by creating a communication network for sonographers to openly discuss and share ideas to reduce WRMSD (Bolton and Cox, 2015) is highlighted.

This issue was earlier considered by Friesen *et al.* (2006) who found that the sonographers who participated in their study, based in various rural locations in Canada, lacked a professional network of support because of working alone, which ultimately became problematic in terms of having capacity to implement positive departmental changes and learn from peers. Consequently, respondents found it difficult to raise concerns or complain about the challenges of their role, particularly issues related to workload and WRMSD. Furthermore, the study strongly advocated the need for sonographers to openly discuss their work-related problems and put forward ideas related to potential change specifically related to making their role potentially safer for sonographers in terms of reducing the incidence and effects of WRMSD. This was just one example of how sonographers, who felt isolated, experienced feelings of being 'left behind', in terms of the previous example being a consequence of a rural location.

In their more recent study Bagley *et al.* (2017) found that the sonographers sampled had an ever-increasing level of exposure to ergonomically designed equipment, but the authors questioned whether the fundamental issue is sonographer isolation and because of this they have not always kept themselves sufficiently aware of the latest design features of their ultrasound systems to adequately implement the benefits of the design in terms of WRMSD prevention. This demonstrated how an underpinning sense of isolation can occur from the day-to-day practicalities of the role, which may lead to sonographers feeling out of date with current equipment technology (ergonomically) or even their overall role in general.

Having to take time away from work can also have a detrimental effect on the person themselves, their team, and the service they work for (Cole *et al.*, 2009; Schonstein, 2006; Coutu *et al.*, 2011). As outlined in Chapter 1, there is a national shortage of sonographers in the UK meaning ultrasound departments are already operating with a disproportionate number of sonographers relative to the workload placed upon them (Miller *et al.*, 2018). Consequently,

staff sickness can have an enormous effect on patient waiting times, adding further pressure on remaining sonographers to scan additional urgent caseloads (Waring, Miller and Sloane, 2015). Furthermore, this raises the likelihood of WRMSD to those remaining staff, who are tackling an increased workload, creating a dangerous cycle of injury risk along with feelings of isolation for colleagues taking sickness leave away from their role (Sommerich, *et al.*, 2016).

Those sonographers who take sickness leave may experience feelings of guilt and then subsequent paranoia because they are conscious of the additional workload their absence will create for their colleagues. Gerwurtz, Premji and Holness (2018) examined how stigma affects workers who return to work following a period of sickness absence for WRMSD, finding that participants in their study experienced feelings of isolation, fearing reprisals or financial difficulty, leading one to wonder whether similar feelings are likely to be experienced amongst UK sonographers. Furthermore, an earlier study by Campo and Darragh (2010) explored the effects of WRMSD on occupational therapists and physiotherapists concluding that without future proofing their role, participants in this qualitative study feared the possibility of career longevity and considered the daunting possibility of having to look for a less 'physically demanding' role in the future to maintain financial security. Ignoring the problem could also be making matters worse because sonographers are, in general, waiting too long before admitting they are having symptoms of WRMSD, perhaps due to concerns over losing their job (Augusto, 2008; Chadwell, 2009).

In order to bring about positive change for sonographers Nieuwenhuijsen (2004) explored the concept of 'self-efficacy', which is a person's belief that they can sustain healthy behaviours. They associated this with preventing WRMSD by motivating employees to adopt more ergonomically and safe practices. Aust *et al* (2007) explored the psychosocial work environ-

ment for hospital workers in Denmark. They used 'The Copenhagen psychosocial questionnaire' to measure the psychosocial working environment of hospital staff to tailor interventions appropriately to the needs of specific occupational roles. This is perhaps something which needs to be explored further in the UK, in relation to WRMSD and sonographers. Heiden, *et al* (2013) highlighted the challenges of assessing objectivity, when evaluating WRMSD including the complexities of the phenomenon, and the fact there may be inter-related issues which is true of any research study where participants may complain of numerous symptoms, without tangible evidence of cause, whether WRMSD or other.

2.9.2 Summary

The contextual summary of the salient issues relating to sonographers and WRMSD, which emerged from the scoping review of the literature, highlighted the complex and nuanced nature of the phenomenon. The gaps in knowledge, focused on the barriers to WRMSD prevention caused by the isolation of the role and the inability of sonographers to engage with fellow professionals for most of the working day, to allow sharing of knowledge and experience related to WRMSD.

Furthermore, there are clear gaps in knowledge surrounding sonographers and their own 'self-efficacy' in terms of changing behaviours to influence or reduce WRMSD prevention, for themselves and others. There is evidence to suggest sonographers are 'burying their heads in the sand', from the literature, but further research is needed to better understand this from a lived experience perspective.

2.10 Final Summary of the Literature Review

The literature review has yielded valuable insights into factors which have contributed to the formulation of the overarching research question for this study. Furthermore, it has laid the foundation for an in-depth exploration of the unique experiences of sonographers in relation to WRMSD.

The literature has confirmed the complex and multifactorial nature of WRMSD in sonography and the wider political, social, and psychological impacts. At the time of writing, a very limited research foundation exists within the UK regarding the phenomenon, although a larger number of studies have been done in the USA and Canada. What also emerges is the distinct lack of qualitative studies in the field, particularly specific to UK sonographers with little knowledge as to exactly what it is like being a sonographer in modern day healthcare in the UK. Many of the studies evaluated are quantitative, with many being conducted in a 'laboratory based' environment, not necessarily truly representing the pressures of the real clinical environment. It is acknowledged that, from an ethical clearance perspective, real-life practical experience is difficult to capture through a research methodological perspective owing to the permissions required to clear such observation-based studies where real patient examinations are being performed.

There are known differences in ultrasound practices between the UK and overseas, fundamentally in terms of the role of the sonographer being more autonomous in the UK, with sonographers performing the scan, interpreting the live image, and reporting the findings, as opposed to many overseas countries where sonographers largely work under semi supervision of a radiologist or obstetrician. Most of the studies carried out have either been mixed method/quantitative or quantitative, with only a few studies being purely qualitative (Simonsen and Gard, 2016) highlighting a significant gap. Simonsen and Gard (2016) used semi-

structured interviews to explore a sample of Swedish sonographers' perceptions of their role in relation to WRMSD. Although some methodological similarities to this study exist, the following differences are immediately apparent. First, the analysis of the data, although to a degree interpretive, was not particularly phenomenological or analytical and tended to focus on the technical rather than the experiential or the personal and professional impacts on the sonographer. Second, several of the studies were primarily focused on sonographers who perform echocardiography and vascular ultrasound, rather than what could be described as 'bread and butter' sonography in the UK, which would include obstetric, gynaecological, musculoskeletal, general abdominal, small parts, vascular, wards and head and neck ultrasound. Third, many of the studies tended to follow a lab-based experimental approach to WRMSD and sonographers rather than looking holistically or from an experiential perspective. The literature review has overall highlighted a gap in the knowledgebase in terms of how sonographers see themselves taking an active part in WRMSD prevention, which has not to date been explored. Most of the studies to date focus on the political, physical, technical, ergonomic, and psychological impact of WRMSD through large survey-based studies and no study seems to have fully explored in detail the personal and professional impacts of WRMSD from a 'lived experience' perspective of the sonographer, and within the UK climate, thus highlighting a gap for this study to attempt to fill.

The next chapter will identify how the findings of the literature, as well as key limitations, have been addressed through the methodological framework, analytical process and research design employed in this study.

3 Methodology and Research Design

3.1 Methodological Framework

Given the concerns articulated in the literature review, interpretive phenomenological analysis (IPA) was selected as the most philosophically and practically robust approach to explore the research question 'to understand the unique experience and the personal perspectives of sonographers and WRMSD'. This approach was selected to allow the researcher, a sonographer by clinical background, to embed themselves into the research process to obtain a detailed understanding of the 'lived experience' of sonographers working with WRMSD (Gray, 2022).

Smith (1996) initially proposed this methodological approach where he argued for the need of an experiential methodological approach to qualitative research. IPA was initially to be used in psychology and then later used in several other professions including healthcare, owing to the structured approach it offers (Tuffour, 2017). In essence, the process of IPA is about unearthing meaning (Finley, 2014). This is essentially in the context of the interpreter unearthing meaning from the participant making sense of a particular phenomenon (Smith, Flowers and Larkin, 2009, p.4). IPA's roots emerged from the philosophy of Husserl who suggested a phenomenological approach was fundamentally about unearthing hidden meaning (Ashworth, 2015).

IPA is concerned with hermeneutics, and the researcher's role in making this apparent, through their own interpretation of what the participant has said (Smith, Flowers & Larkin, 2009). The design for this study has been influenced by the work of Loaring *et al.* (2015) who suggested a study becomes phenomenological in the sense it seeks to understand how the participants relate to their experience.

Smith, Flowers & Larkin (2009) advocated the existence of a double hermeneutic, through which the researcher aimed to make sense of the participant, in turn making sense of a particular phenomenon. Consequently, in a sense, the researcher has a dual role by attempting to make sense of both entities. IPA's main philosophical theoretical underpinning has arisen from phenomenology, hermeneutics and idiography (Tuffour, 2017). Furthermore, according to Smith, Flowers & Larkin (2009), IPA follows Heidegger's view that phenomenological inquiry is an interpretive process, and one in which researchers are said to develop their own interpretations of what the participants said about their experiences of the phenomenon, which on some occasions may be fundamentally based on what is not said, rather than what is. Consequently, during the analysis of the participant interviews, not only the spoken words but also non-verbal cues, fillers tone, missing words, avoidance of question, use of metaphor, use of humour, laughter, use of tenses, self in the context of time, current self to past self will also be explored in detail [further narrative regarding the interview analysis will be provided in section 3.9 of this chapter].

IPA is not however without its critics, and Hefferon and Gil-Rodriguez (2011) discussed the implications in the emergence of IPA, as a research methodology, and suggested in some instances, when used incorrectly, IPA can result in broadly descriptive outcomes, with little distinction from standard thematic analysis. Furthermore Giorgi (2010) expressed concerns about the lack of science in IPA methodologies, in the sense that the researcher would seem to have free reign to direct the analysis how they see fit, without following an established approach. However, Smith (2010) argued, in direct response to Giorgi (2010)'s critique, that doing quality IPA requires a set of complex skills, interviewing, analysis, interpretation and writing which can all influence the quality of the research, more than simply the following of prescriptive procedures.

Originating from the philosophical underpinnings of phenomenology, IPA is based largely on human lived experience, and this methodological approach allows participant experiences to be expressed and interpreted without predefined boundaries or the restriction of categorisation (Smith, Flowers & Larkin, 2009) unlike grounded theory.

Consequently, this methodological approach was chosen to allow the researcher the opportunity to explore the individual and experiential perspectives of the participants, without being restricted by a set of pre-defined categories, it was chosen to better understand the participants' detailed personal accounts of how they made sense of their experiences, of WRMSD, in terms of their role as sonographers and as human beings (Smith, Flowers & Larkin, 2009). This concept was further supported by Shaw (2011) who highlighted the importance of experiential qualitative research in revealing the struggles of everyday life as being crucial to understanding human behaviour.

Several other methodological approaches were considered and later discounted: grounded theory (GT), ethnography and discourse analysis (DA). GT was considered as an alternative to IPA, however this methodology focuses on how an individual makes sense of the world and because of this the researcher must construct a theory, from concepts grounded in the data (Starks & Brown-Trinidad, 2007).

Reflexivity

Choosing the most appropriate research methodological approach created a sense of dilemma initially. I felt lost in terms of making the 'right' choice. GT seemed like a possibility but was later discounted given the focus of my research was participant experience.

Grounded Theory (GT) was considered as the primary potential alternative methodology in this research. Smith Flowers and Larkin (2009) themselves also define this approach as one of the main alternatives to IPA. GT as a concept emerged from the work of sociologists Glaser and Strauss (1965, 1967) (Charmaz, 2015, p55).

This study did not tend to view the participants in this way and rather viewed each one as an individual, who was engaged in making sense of their experience, which is then in turn made sense of by the researcher who aimed to explore personal experiences; whereas GT tends to explain social processes (Willig, 2001). Although this study also included 'social processes' in terms of the role sonographers play, which could perhaps suggest grounded theory is a suitable alternative methodology, IPA remained the methodological approach of choice because the aim of the research focused on interpretation of participants' personal lived experiences (Smith, Flowers and Larkin, 2022, p.35).

One of the fundamental differences between the two approaches is the opportunity for researcher creativity when employing IPA, compared to GT (Willig, 2001, p.69). It is acknowledged that GT focuses, like IPA, on the individual, although with GT, the focus tends to be related to how the individual constructs and makes sense of their lived world, or their reality, and consequently a theory is developed by the researcher, as it arises from the data. This study does not necessarily view the research participants in the same way, and instead they were viewed as an individual engaged in making sense of their experiences which was then made sense of by the researcher (objectively), which is much more in keeping with an IPA perspective. The aim of this study was therefore to explore the personal and professional experiences of the research participants (sonographers). GT on the other hand seeks to explain social processes (Willig, 2001) through an exploration of how social structures influence how achievements are made through a given set of social interactions (Charmaz, 2015, p76).

Additionally, there are practical reasons that contributed to the exclusion of Grounded Theory (GT) in this study. Firstly, the proposed sample type and size would have presented significant challenges had GT been adopted. Both approaches, GT and the chosen methodology (IPA), employ purposive sampling to select participants. However, GT goes a step further by employing theoretical sampling, as described by Bryant and Charmaz (2019, p. 231).

Second, additional participants may need to have been added to the existing sample to further explore any new theories emerging from the data, until such a point as data saturation is achieved. It is acknowledged that there is some degree of ambiguity in pertaining when such a point has been reached, although sample sizes do tend to be larger in GT when compared to IPA based studies (Bryant and Charmaz, 2019 p.234).

GT, as a methodological approach, allows researchers to create theory from the data which is then constantly compared with more cycles of future data collection, and subsequent analysis. This could involve making the research process potentially span a much longer period than an IPA based study (Gray, 2018, p. 695). When using GT, it is proposed that the theory is discovered by exploring ideas 'grounded in the data' (Starks and Trinidad, 2007, p. 1373) and the subsequent theories created are then open to researcher generalisation. Furthermore, there can on occasion be an element of participant observation in some GT studies, which may also have presented ethical issues for this thesis (Starks & Brown-Trinidad, 2007).

For this thesis it was not considered practical for the researcher to engage in such a reiterative data collection method, and process of data analysis, because of the practicalities of accessing the interview participants, who were all working sonographers managing busy workloads and furthermore the constraints of employment commitments for the researcher running alongside of the research process would have made this approach ever more challenging. DA was also considered as an analytical method, but discounted owing to the restrictions laid down by the need for 'coding' with the emphasis on the participants' use of

language (Willig, 2017) which would have changed the opportunity for the individuals' lived experience to fully emerge. As a result, this methodological approach was also discounted.

The researcher has a shared understanding of WRMSD and ultrasound practice which can affect the framework of the interviews through verbal and nonverbal input which may also alter the content of the discussion (Yardley, 2014, Yardley, 2017). IPA was ultimately selected as the most appropriate methodological approach for the analysis of the data because the fundamental aim of the study is to understand the lived experiences of sonographers and WRMSD. The study seeks to allow the researcher to make sense of, and interpret, the hidden meaning behind the participants' own understanding of the phenomenon (Smith, Flowers & Larkin, 2009).

There are other psychological and human science branches of phenomenology, which all have similarities with IPA, and certain differences. A notable example is the phenomenological psychology of Giorgi & Giorgi (2008) which is much more closely linked to the philosophy of Husserl and his theory of consciousness and 'phenomenological reduction' or 'bracketing' (p.33), which is a process involving putting to one side one's initial preconceptions of a phenomenon to interpret more open-mindedly what is being seen. This method is further explained by Smith, Flowers & Larkin (2009) who suggest Giorgi's method is more likely to lead to a descriptive narrative of events rather than an idiopathic interpretive commentary arising from the interview participants' accounts, which should result from a good quality IPA analysis.

Reflexive Point

Choosing an appropriate methodological approach for this study was not without its challenges. I was particularly keen to understand sonographer experiences and how they made sense of WRMSD as a phenomenon, and therefore IPA seemed the most appropriate choice. The reasons behind this were multifaceted. This approach has allowed me to gain an in-depth exploration of sonographer experience, through a lengthy analysis process. It has also allowed me to immerse myself in the participants' meaning, and thereafter make sense of my own interpretation of their meaning.

3.2 Philosophical Underpinning

To address the overall aim of this study, which was to explore the lived experiences of sonographers and WRMSD, several methodological, epistemological, practical choices were made in terms of the study design. This section of the chapter will explain how this study is aligned with the interpretive, phenomenological, and hermeneutic principles of IPA (Smith, Flowers & Larkin, 2009, p. 107, Smith, Flowers & Larkin, 2022, p.7). Section 3.1 began by justifying the research method selected as well as potential alternate methods which may have been employed. IPA is described by its founders as a study of experience which is guided by three theoretical influences: phenomenology, hermeneutics, and idiography (Shinebourne, 2011, Smith, 2004, 2007; Smith, Flowers and Larkin, 2009, 2022).

3.3 Ontological and epistemological positioning

Committed to the examination of how people make sense of major-life experiences (Smith, Flowers and Larkin, 2009, p.1), IPA adopts an interpretive ontological stance and consequently attempts to unearth meaning and therefore unearth the reality of the participants' experiences in the social, political and professional world. IPA is not simply a methodological

approach which seeks to gather facts or define the truth. As in many types of research, it just does not propose a singular, self-identical and objective truth; instead this method aimed to understand individual experience, the meaning which the individual appears to make of their experience and, most importantly, the interpretation which the researcher provides of the participant's meaning (Smith, Flowers and Larkin, 2009, p.58). IPA's epistemological stance rests on the participants' subjective account of their own experience (Gray, 2018, p.26).

Those who developed IPA as a research approach use the term "double hermeneutic" to describe the process of the researcher interpreting the participants' interpretation of their experiences (Smith and Osborn, 2003). When employing IPA, researchers consider the concept of the "double hermeneutic" to be crucial in generating knowledge (Dickson, Knussen, and Flowers, 2007). Knowledge emerges from a two-fold process of empathy and questioning on the part of the researcher. This dual approach to understanding constitutes the second aspect of the "double hermeneutic" (Vicary, 2016).

The primary goal of IPA is to comprehend the lived experiences of participants and the significance they attach to those experiences. It is acknowledged that there is no one "correct" method of conducting IPA analysis, but it should be robust, reproducible, and transparent, resulting in a coherent narrative of how the researcher perceives the participants' thoughts (Smith, Flowers, and Larkin, 2009, p.80). IPA has emerged from debates among social psychologists about which model best fits specific research objectives (Smith, 1996, 2004), and as a consequence, it continues to be a subject of debate among academics.

3.4 IPA & Phenomenology

As previously discussed, IPA is a qualitative research method concerned with exploring how participants make sense of a particular experience (Smith, Flowers and Larkin, 2009), however it is based on historical philosophical perspectives. Husserl talked of 'going back to the things themselves'. The concept of experience is important in IPA in a sense that being immersed in something without being explicitly aware of what is directly happening can have a fundamental effect on how a situation is perceived (Murray and Holmes, 2014). In IPA based studies it is the very essence of this experience which affects other emerging preconceived ideas; in fact some ideas can take on entirely different meanings. Being aware of what is happening is the beginnings of being able to acknowledge what can be described as an experience, as opposed to 'the experience' itself (Smith, Flowers, Larkin, 2009, p.2).

"Whatever presents itself as a unit in the flow of time because it has a unitary meaning, is the smallest unit which can be called an experience. Any more comprehensive unit which is made up of parts of a life, linked by common meaning, is also called an experience, even when the parts are separated by interrupting events" (Dilthey, 1976, p.210).

Therefore, the engagement by people in terms of their respective experiences of something considered 'major' or 'significant' in their life in terms of how they begin to reflect upon it and its significance or impact on themselves, is key to what an IPA type study aims to engage with.

3.5 Phenomenology as a philosophy

Edmond Husserl (1859-1938) was a pioneer in the phenomenological movement and his philosophy of phenomenology evolved over time. This concept centred around the idea of evaluating an experience by reaching its core without any preconceived assumptions (Cohen, 1987). The following quotation illustrates the basis of phenomenology:

"...phenomenology is the systematic attempt to uncover and describe the

structures, the internal meaning structures, of lived experience”

(van Manen, 1990, p. 10).

Husserl believed that in order to gain an understanding of the deeper meaning of any phenomenon, it is imperative for an individual to rid themselves of all preconceived perspectives and ideas (Creswell, 2007). The use of bracketing is one suggested method to identify and remove these potential preconceptions or established knowledge of the researcher (Lopez & Willis, 2004).

More pertinent to this study, it is acknowledged that the possibility remains that any researcher may hold biases or preconceived notions regarding the phenomenon which has the potential to alter, influence or add bias to the research data and consequently needs to be considered. The acknowledgment or “bracketing off” of any potential preconceived notions is seen as imperative in achieving reliable data. ‘Bracketing’ is something which can be done at any stage of the research process, and should be encouraged throughout the journey, and this may be achieved by keeping a research journal with subsequent reflection and reflexivity on the whole process (Speziale & Carpenter, 2007).

Husserl talked of ‘lebens-Welt’ or “life world” in terms of what individuals experience pre-reflectively, without interpretations. He suggested that experience is immediate, pre-reflective consciousness of life, and to understand a phenomenon (or the essential features of it) one must be as free as possible from cultural context. The idea being that no explanations are added before the phenomenon is understood from within the individual. Husserl’s phenomenology needs descriptions of the experience to be gleaned before they are reflected upon (Overgaard, 2003).

The term epoche (Greek word meaning to refrain from judgement) is often referred to in the underpinning theoretical frameworks related to phenomenology and this is said to require a

fresh way of looking at things, before one can bracket off preconceptions/presuppositions, and in doing so they need to be made overt, rendering them as clear as possible (Overgaard, 2003). Many authors argued that bracketing is in fact impossible to entirely achieve in practice (Fischer, 2009; Vicary, Young and Hicks, 2017).

Husserl emphasised the significance of scientific rigor when adopting a phenomenological approach, as noted by Converse (2012). Besides introducing the concept of bracketing, he also highlighted the existence of shared elements in the lived experiences of participants, which he called descriptive phenomenology. Husserl followed a traditionalist approach, striving to eliminate personal context and history from his research findings. His philosophical perspective on scientific inquiry did not incorporate the influence of culture, society, or politics on individual freedom, as discussed by Lopez and Willis (2004).

Martin Heidegger, a student and assistant of Husserl, further developed phenomenology by introducing the temporal concept of being. He emphasised the need, not only to describe individual experiences, but also to interpret the underlying meanings of these experiences, a perspective known as hermeneutics or interpretive phenomenology. Heidegger believed that understanding the true essence of a phenomenon emerges through this interpretation. In contrast to Husserl's stance, Heidegger argued that humans are deeply embedded in their world, and social, cultural, and political factors influence their choices. It was from these foundational ideas that IPA (Interpretative Phenomenological Analysis) emerged, as explained by Smith, Flowers, and Larking (2022).

Critics of research utilising IPA argue that a phenomenological approach often neglects the consideration of the environment, and the world in which individuals live. Heidegger, on the other hand, stressed the importance of including these factors to achieve a comprehensive understanding of their experiences, as highlighted by Paley (1998).

Reflexive Point

I was confident that IPA was the most appropriate methodological approach given my focus was on sonographer experiences of WRMSD. I was concerned about whether 'bracketing' was achievable given my shared experiences with the interview participants.

3.6 Participants

A purposive sample was selected from a group of sonographers known to the researcher through professional contacts. There are advantages and disadvantages to this approach. Firstly, it was advantageous because the researcher found recruiting willing participants to the study relatively straightforward, probably because the researcher was already acquainted with some of the sonographers chosen to take part in the study and consequently all responded favourably at the initial formal email contact. Secondly, the researcher is also a radiographer and a sonographer by professional background and by the nature of shared knowledge of the issues between the researcher and the research participants meant that participants felt comfortable engaging in a discussion about the phenomenon although it is acknowledged that this could potentially result in the researcher 'leading' the participants into some of their responses. Finally, the researcher initially acknowledged that this sampling approach could be perceived as coercive, although all the participants willingly consented to be involved in the study and have since maintained contact with the researcher following the

initial outputs with interest; this concern was later rejected. The potential impact of the researcher's prior acquaintance with the sonographer participants is also discussed in section 3.7, and in section 3.9 of this Chapter in an endeavour to maintain a level of openness and transparency in the study.

Reflexive Point

Decisions on the sample were initially difficult to make, given this was a key influencer to the potential findings. I wanted to ensure that I captured participants with a range of views but I knew focusing only on those specifically either with a WRMSD, or only those without, would affect the findings. Therefore, I chose to interview some 'non injured' and some 'injured' sonographers. I was anxious to ensure the participants had some post qualification experience because I had personal professional experience of getting pain myself during my student days because I was focused on getting the best images.

In order to ensure participants had sufficient time to consolidate their learning I decided 5 years post qualificatory experience gave the participants time to have consolidated their learning to have confidence in their role and experiences, as well as gaining deeper understanding of the phenomenon.

The sampling method has similarities with an approach advocated by Flowers *et al.* (2006) which aimed to sample a diverse set of individuals holding a range of views rather than a 'representative sample' as such, although it is acknowledged that the sample could also be defined as 'homogenous' because of the commonality of professional background between the participants. The sample size (n=9) is consistent with similar studies employing an IPA

methodology (Loaring *et al.*, 2015; Smith, Flowers & Larkin, 2009), and was considered sufficient to gain data saturation, in relation to the research question posed in this study.

Smith, Flowers and Larkins (2009, p.52) offered some advice on sample size for different levels of study, recommending around eight interviews for a doctoral level submission, although they highlighted the uniqueness of each individual research project may allow some variation to this. However, sample sizes used in IPA studies can vary considerably (Dickson, Knussen and Flowers, (2007), suggested that when making choices regarding sample size and homogeneity of the participants these decisions should be made, and justified, in the context of the individual research project. For this study, considerations were made in terms of timeframe, researcher resource, strategy for participant recruitment and research question. It was determined that the sample size would provide a sufficient breadth of sonographer perspective to explore the research question in depth and to reach a sufficient degree of data saturation. The concept of “data saturation” refers to the time where no new information or themes are arising from, or to be observed, in the data during data analysis (Flowers, Marriott and Hart, 2000).

3.7 Method of Data Collection

Individual semi-structured interviews with the sonographers were the most appropriate method of data collection because this was deemed compatible with the data analysis techniques utilised in IPA (Willig, 2001; Langdridge, 2007). Arguments in support of focus groups are present in some IPA studies (Smith, 2004), although in this study the emphasis was fundamentally based upon the individual experience of WRMSD and consequently a focus group was not thought to be conducive to allow for the intricate and subtle differences of individuals to emerge within the potential group dynamics of a focus group scenario. The practicalities of bringing (n=9) sonographers from various geographical locations to attend one focus

group at the same time was also thought to be virtually impossible, knowing current strains on ultrasound services and potential issues with travel.

Initially interview 1 was completed as a pilot to the main study. The pilot interview did not render any necessary substantial amendments to the interview schedule and consequently it was included in the main corpus of the study as useful findings had already begun to emerge from this initial interview.

Reflexive Point

I was conscious of the fact that 3 of the interviews were fairly brief, compared to the other 6. I noticed that the interviews which were shortest in time were conducted at the IP's place of employment. I considered whether this may have been because the IPs felt pressured by workload. I was still satisfied that data saturation had occurred because no new themes had emerged from the wider sample.

In total the interviews ranged from 22 minutes to 45 minutes in length , and this produced a total of 35,250 words of verbatim transcription. Each participant had a minimum of five years post qualificatory experience in ultrasound practice, either full or part-time. Participants were selected from four NHS hospitals (n=6), from the private sector in the region (n=1) who combines this with an academic/teaching role, a full time academic/ultrasound lecturer (n=1) who is still actively involved in clinical practice and a clinical co-ordinator/clinical tutor combining a clinical and teaching role (n=1). All participants were white British or Irish and represented a range of ultrasound clinical backgrounds from London, the north of England and Scotland. There were a combination of male (n=2) and female (n=7) participants.

It is acknowledged that this study aimed to seek participants' individual experiences and understanding of WRMSD and ways to reduce the incidence. The researcher aimed to recruit a reasonably diverse group of participants with a range of different or contradictory views, rather than a 'representative' sample of sonographers as such.

The inclusion criteria for suitable participants to take part in this study were:

Sonographers (full or part-time) working in ultrasound practice for 5 years or more.

No further participant demographics were stipulated in the inclusion criteria, to maintain anonymity of participants particularly if data should appear in the public domain through later publications. Some of the sonographers' demographics such as their gender, years qualified were already known to the researcher, and appeared in the interview transcripts, although these were not directly presented in this study either for contextual purposes or to highlight any claims of representativeness owing to confidentiality restrictions and to maintain anonymity of the participants. The very small circle of people in the UK ultrasound community has meant careful approaches have been taken to ensure participant anonymity.

The exclusion criteria for the study are outlined below:

Trainee sonographers, echocardiographers, newly qualified sonographers, retired sonographers or sonographers working in ultrasound practice for fewer than 5 years.

The rationale for the above exclusion criteria was to maintain consistency with the IPA methodology, which tends to recruit a purposive and homogenous sample of participants (Smith, Flowers & Larkin, 2009). In terms of 'homogenous', this related to background and work-related specialisms and heterogeneity within this sample was still expected. Furthermore, in relation to the exclusion criteria outlined above, it cannot be denied that perspectives from trainee, newly qualified, younger sonographers, or locum sonographers would also provide

an equally valuable perspective, although it remains beyond the scope of this study to include such a heterogeneous sample at this stage. Further sampling is likely to provide a broader range of results that may result in a more comprehensive understanding of the wider population of sonographers in the UK, and as such is proposed as a recommendation for potential future research.

The study aimed to gather sufficient information to make sense of WRMSD by 'synthesising, abstracting, contextualising, analogising or illuminating meaning' of the assertions taken from the participant interviews (Loaring *et al.*, 2015, p.434). It is acknowledged that the researcher, also being a sonographer, is central to the IPA research process and this is reflected in the data collection process and within the data analysis (Smith, Flowers & Larkin, 2009). IPA has already been successfully employed in similar studies in conversant fields (Flowers *et al.*, 2006; Flowers *et al.*, 2011; Loaring *et al.*, 2015).

3.8 Interviews

Semi structured interviews were conducted following an interview schedule, which was initially piloted on IP1, in the form of a list of guiding themes (Appendix 5) which were identified from the literature examined in the literature review. Themes for discussion were used, rather than direct questions, to allow the participants to discuss and explore each theme from a personal perspective, in the anticipation that 'richer' data could be acquired to better inform the study (Smith, Flowers & Larkin, 2009).

The interview schedule was developed following the review of the UK literature on the WRMSD amongst UK sonographers, (Gibbs and Young, 2009; Gibbs and Edwards, 2012; Harrison & Harris, 2018), and the range of issues to be explored within the research aims were considered and discussed with the supervisory team. The interview schedule focused on the major themes of understanding of how WRMSD affects sonographers and their practice, in the UK, and their approach to the identification and management of WRMSD alongside their

individual experiences of WRMSD in their professional roles. Table 10 outlines the key areas of the interview schedule. The themes were developed by the researcher, in accordance with evidence found in the literature checked by the first and second supervisor and amended accordingly.

Broad Issue:	Derived from:
<p>Injury/No injury interviewee perception</p> <p>Lifestyle activities</p> <p>General health and fitness/sickness absence/Satisfaction of job role/perception of stress</p> <p>Career pathway (time in ultrasound practice)</p> <p>Typical working week:</p> <p>Scan types/times/rest breaks/number of exams per day</p> <p>Extended working days</p> <p>Equipment</p> <p>Changes in service/workload/population characteristics</p> <p>WRMSD prevention strategies employed (novel techniques?)/protocols? Exercises?</p> <p>Workload processes/departmental organisation/Appointment booking</p> <p>Staffing issues (sonographer/support staff)</p> <p>Stress in the workplace</p> <p>Thoughts/Feelings about current role</p> <p>Education on WRMSD prevention</p> <p>Personal experiences of WRMSD</p>	<p>(Gibbs & Edwards, 2012)</p> <p>(Bolton & Cox, 2015, Gibbs & Edwards, 2012, Gibbs & Young, 2009, Gibbs & Young, 2011)</p> <p>(Bolton & Cox, 2015, Gibbs & Edwards, 2012, Gibbs & Young, 2009, Gibbs & Young, 2011, Health & Safety Executive 2015)</p> <p>(Lang <i>et al.</i>, 2012)</p>

When/How often/Affected areas	(Bolton & Cox, 2015, Gibbs & Edwards, 2012, Gibbs & Young, 2009, Gibbs & Young, 2011)
No issues – thoughts of why this is the case.	
Non-work-related injuries?	
Personal perceptions of WRMSD in ultrasound.	
Any comments on future prevention measures	(Gibbs & Edwards, 2012)
Cultural ‘norms’	(Bolton & Cox 2015)
Sonographer perceptions of pain	(Bolton & Cox, 2015, Gibbs & Edwards, 2012, Gibbs & Young, 2009, Gibbs & Young, 2011)

Table 10 Emergence of Broad Issues Covered Within Interviews

Although difficult to achieve in all situations, the interviewer tried to ensure participants were given adequate time to be able to respond to all questions fully. Interviews were carried out in a private room in clinical departments (n=3), over the telephone (n=1), in the participant's home (n=1) and in a private room in the university setting (n=4). The researcher conducted all interviews themselves to maintain consistency and parity of experience for the participants. Interviews were conducted in a location convenient to the participants, to ensure they felt comfortable enough to openly discuss their thoughts, feelings, and experiences (Loaring *et al.*, 2015).

Reflexive Point

I felt a sense of responsibility to try not to lead the participants within the interviews. I was conscious they were aware of my personal experience as a sonographer and an academic. I was afraid they may try to tell me what they thought I wanted to hear.

The focus of these interview discussions ranged from general anecdotal accounts of participants' experiences of WRMSD to retrospective detailed accounts of their individual thoughts, feelings, and experiences. For this reason, the content of each interview depended very much on each individual participant in terms of what thoughts, feelings, and experiences they chose to share with the interviewer, although the interview style remained consistent across all nine interviews because the same schedule and further probing remained consistent for each (Flowers *et al.*, 2011).

The interview schedule was designed so that it could be used in a flexible fashion and focused on the interaction between the sonographer (participant) and the researcher, rather than strictly defined categories or questions. The questions were aimed to be open and

scene setting, the aim being to encourage the sharing of individual participant views, 'what are your thoughts on WRMSD?', and 'what do you think is WRMSD?' These were designed to enable the participants to feel comfortable to answer the questions openly and honestly.

In places, interesting points were followed up by the researcher with responses such as 'why do you think this is the case?' Leading questions were avoided wherever possible, although in places this was difficult owing to the shared understanding of the phenomenon between the researcher and the participant and examples of some potentially leading questions are acknowledged in the analytical process and through the reflexive diary. In limiting the number of leading questions, it was hoped that this may reduce any pre-conceived ideas regarding the participants' experiences of WRMSD and consequently would lessen the possibility of limiting participants to a series of pre-rehearsed responses, thoughts, or feelings (Flowers, Marriott and Hart, 2000). The focus of the research interview was presented in the initial participant invitation letter (Appendix 2), and information sheet (Appendix 3) and further explained during the discussion with the participants when arranging the interview time and prior to the start of the interview. Participants had the opportunity to ask any questions and all participants were emailed a copy of both research outputs [conference posters] for comment and to ratify the credibility of the research findings and analytical process. All participants were kept informed of any further outputs from this study.

A professional typist verbatim transcribed the audio recordings. The audio recordings were then cross checked against the provisional transcriptions for accuracy and amended accordingly by the researcher. Several words and phrases had been misrepresented through misunderstanding of certain professional colloquialisms which were then corrected by the researcher retrospectively. Pauses, sighs, and 'filler' were noted on the transcripts. All transcripts were transferred to line numbered documents, prior to detailed analysis.

3.9 Analytic procedure

As is typical in IPA, the interview schedule was used in a flexible fashion which allowed the researcher to use 'open prompting and probing' of the participants rather than a set of fixed questions (Loaring *et al.*, 2015, p.428). A summary of the interview schedule was sent to prospective participants in advance of the interviews to allow them to feel prepared for the potential content of the discussion (Woods, Miller & Sloane, 2016) in the anticipation that this may ensure more considered responses by the participants.

The analysis of the data was undertaken by the researcher using IPA, outlined in detail in Smith, Flowers & Larkin (2009). The process was conducted with the assumption that human beings make sense of their world by creating their own interpretations of the phenomenon, through their own anecdotal accounts (Dickson *et al.*, 2011). Although it is acknowledged in Smith, Flowers & Larkin, (2009) that the analytical direction employed within an IPA study does not necessarily need to follow a prescriptive approach, as a novice researcher in using IPA, the stages which the authors suggest (p.79) were followed in detail, as they provide a clear framework which was considered to be crucial in order to ensure a degree of rigour and consistency within the research process. An explanation of how the analytical framework of the interviews was followed, and the stages pertinent to this study are outlined below.

3.9.1 Stage One: Reading the data and initial noting

Each of the interview audio-recordings was transcribed verbatim by an independent professional typist. It is acknowledged that this could potentially mean there was initially less familiarity with the data on the part of the researcher. However, to address this potential flaw in the research design, the researcher spent a significant amount of time re-listening to the audio recordings against the verbatim transcripts, once provided, and the researcher's initial

thoughts and ideas were recorded as a private reflexive diary. This was followed up by a series of detailed readings, and re-readings of each of the transcripts to obtain a fuller perspective of the text, and initial notes, ideas and observations were made directly onto hard copies of the transcripts, as recommended by Smith, Flowers & Larkin, (2009). The next stage was carried out on an interview-by-interview basis and focussed on three distinct processes for each individual interview. Firstly, the descriptive analysis in which key words, phrases or explanations which structured the participants' thoughts and feelings about their experiences were highlighted. Secondly linguistic observations and use of language were recorded, including aspects such as laughter, repetitions, contradictions, metaphors, pauses and tone. Lastly, conceptual comments were made on each transcript drawing on the researcher's own experiential and professional knowledge of the phenomenon (WRMSD) and being a sonographer. An excerpt from a coded transcript for one interview (Interview No.1) is provided in Table 11 as an illustrative example, demonstrating how marginal annotations were used for coding in relation to the research question.

3.9.2 Stage Two: Developing emergent themes

During this stage, the researcher further engaged in the interpretive process by refining and elucidating the initial thoughts, ultimately distilling them into what are referred to as 'emergent themes' (Smith, Flowers & Larkin, 2009). During this process, and following a discussion with the supervisory team, it was decided not to use a computer programme such as NVivo or Atlas Ti for organising the thematic analysis of the transcripts as it was felt that this has potential to limit the hermeneutic circle and potentially initiate the loss of researcher 'closeness' to the data (Smith, Flowers and Larkin, 2009, p.83).

Initial notes were made regarding aspects which appeared significant to the research question, and these provisional thoughts were developed and condensed into emergent themes.

On concluding this phase, the initial transcript was meticulously reviewed, comparing the interpretations with the participant's original audio recording. This step was taken to ensure that vital nuances of the interview were not compromised during this analytical phase.

Interview Participant 9, hereafter IP9, is provided as an example below; the analysis identified a few provisional 'emerging' themes at this point. Some were themes that were related to organisation such as 'time constraints', 'workload', 'equipment manufacturers', 'denial of WRMSD' 'lack of support' or 'isolation'. Others were more specific to sonographer practices, responding to differences in skills, experience, and motivation, and some focussed on the specific use of language using words such as 'difficulty' 'stress' 'ridiculous' 'running around'. Further themes emerged and referred to 'professional attributions', for example, which implied a sense of dilemma in conducting daily workload, a sense of being 'torn' between the workload, management, and the responsibility to the patient.

Emergent Themes	Original Transcript	Exploratory Comments
<p>Desire for support, increases satisfaction,</p> <p>Previous enjoyment of role</p> <p>Changes in professional culture</p>	<p>I: OK. [] How would you see your general satisfaction, I mean you can think back over the last 5 or 10 years if you like, but how is your general job satisfaction? How does that sit in your mind?</p> <p>P: I have to say that job satisfaction has been very good probably up until about [] 7 years ago and as we started to lose from of the radiologists that were great advocates for</p>	<p>Satisfaction, desire for support [from those perceived to be senior or perhaps more experienced]</p> <p>Age [suggest changing professional culture with a new generation]</p>

<p>Perception of own ability</p>	<p>sonographers and the er younger radiologists, there was a influx of new registrars as they upped the numbers who came along and wanted to per- form the MSK ultrasound and didn't have the background</p>	<p>Wanting to belong to a team, changes in professional culture, leads to 'less of an appealing job'</p>
<p>Dilemma ultrasound lists and targets to meet</p>	<p>knowledge or the help to want to be involved as a team with sonographers but it became less on an appealing job. Our</p>	<p>Perception of own skills and professional role compared to 'the new breed of radiologists'</p>
<p>Ruminative thinking</p>	<p>skills and knowledge were quite high and we needed the odd bit of clinical back-up but the new breed of radiologists had their lists and their targets and didn't find it in their remit to</p>	<p>Dilemmas between 'lists and targets' formation of a more target driven society and pro- fessional culture Feeling supported versus feel- ings of lack of support</p>
<p>Professional culture and pro- fessional regulation,</p>	<p>work with us a team and I found that as I've moved round hospitals as well, so...</p>	
<p>National and political issue</p>	<p>I: How do you perceive that as impacting on your job satisfaction?</p>	<p>Lack of support</p>
<p>Ruminative thinking</p>	<p>P: I think it impacts a lot along with the fact that sonog- raphy is not a regulated profes- sion so that anybody in the past</p>	<p>Fear of losing quality and pro- fessionalism in the role</p>

	<p>could have a go and make a mess and we had no, apart from filling in IR1s which again were on top of our normal working day, we had no channel back to report this. I think we were already dealing with that when the radiologists that supported us are now retiring and dwindling.</p>	<p>'on top' securing a sense of control</p> <p>'Retiring and dwindling' experiencing a sense of loss, from an 'anchor' which once added security.</p>
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Table 11 Development of Emergent Themes From Initial Exploratory Comments (IP9)

3.9.3 Stage Three: Searching for connections across emergent themes

All the emerging themes were listed chronologically and separately from the transcript and clustered into groups. Some emergent themes diminished in perceived importance, either considered to be of lesser importance in answering the research question or through being incorporated into other stronger themes. A main list of themes was created for each participant, in the left-hand column of the 'initial noting' table with comments from the analysis used to demonstrate the themes within the transcript. Figure 16 (below) highlights the emergent themes gleaned from IP 1.

List of emergent themes: Interview No. 1

- Theme 1: Vagueness, uncertainty
- Theme 2: Perceptions of self
- Theme 3: Dilemma
- Theme 4: Denial
- Theme 5: Doubt
- Theme 6: Pressure now, past through rose tinted spectacles
- Theme 7: Perceptions/feelings of stress
- Theme 8: Professional responsibilities
- Theme 9: impact of scheduling (the working practices of the working day)
- Theme 10: Changing circumstances creating freedom
- Theme 11: Challenges of role/equipment
- Theme 12: Workload increases
- Theme 13: Patient obesity
- Theme 14: Non-compliance with prevention strategies
- Theme 15: Justifying own practices/behaviour
- Theme 16: Sense of expectation
- Theme 17: Pressures external to ultrasound department
- Theme 18: Consequences
- Theme 19: Colleagues taking sickness absence
- Theme 20: Normalising the status quo 'tough'
- Theme 21: Breakdown to the 'team'
- Theme 22: Pride and feeling 'lucky'
- Theme 23: Contradiction 'think' and 'definitely'
- Theme 24: Feelings of guilt
- Theme 25: Political situation
- Theme 26: Getting through the day
- Theme 27: Technical challenges
- Theme 28: Managing change and expectations

Figure 16 List of Emergent Themes, Interview Participant (IP 1)

Figure 17 below highlights the master list of emergent themes for Interview No.7

Master List of Emergent Themes Interview 7
<p>Clinical Specialisms Perception of WRMSD Lack of conformism Lack of sickness absence Pressure Role change Job role Workload Rest breaks Pressure/Sonographer Culture/Ideological Dilemma Management/Pressure Sense of Obligation/Pressure Staffing shortages Support Workers/Prevention/Alleviation of workload Extended working days Sense of reward for additional work Management 'they' Sonographer culture, NHS culture, value for money Conveyor belt mentality Exhaustion/fatigue Political pressure and workload Impact on sonographers Staff sickness Prevention strategies, self-initiated prevention Accepting WRMSD, part of the job Defeatist attitude Sonographer culture Taking one for the team Ideological dilemma, fear of reprisal Political 'healthcare' culture Expectations Ultrasound Specialisms Positive Interventions Getting through the work/workload/overwhelming task Limitations of ultrasound/Patient obesity Raising awareness of the limitations of each modality (professionals and patients) Defeatism Overcoming challenges, using the equipment and situation to best advantage Overwhelming sense of difficulty, working hard to try to consider all issues, sense of overwhelming multitasking Making excuses, sense of the situation being challenging for sonographers, alternating sitting and standing Taking control, comparing to previous role Being in control of workload creates sense of autonomy</p>

Figure 17 Master list of emergent themes for Interview Participant (IP 7)

3.9.4 Stage Four: Identifying patterns across cases – developing subordinate themes

The analytical process from stages 1 to 3 was applied to each of the remaining interview transcripts until all nine interviews were thoroughly analysed. In the subsequent stage, the focus shifted to identifying subordinate themes by searching for patterns across all nine interviews. This involved adopting a more cyclical and analytical approach to explore connections between emerging themes and to recognise recurring patterns that held broader significance across all participants. A careful interpretative analysis was conducted to understand how sonographers demonstrated these recurring themes in both similar and different ways (Smith, Flowers and Larkin, 2022, p.81).

During the process of identifying and conceptualising themes, some themes naturally grouped together, such as 'workload,' while other emergent themes stood alone, like the motivation for working longer hours due to financial reasons. The decision to include an emergent theme was based on its perceived importance in helping participants make sense of their experiences, and whether it was well-represented in the analysis (Smith, Flowers and Larkin, 2022, p.91).

In cases where certain material seemed to deviate significantly from the overall picture, such as an individual's narrative or theme contrasting with those of other participants, a thorough review of earlier transcripts was conducted. This review aimed to ensure that any crucial issues were not overlooked or misunderstood during the analysis process.

3.9.5 Stage Five: Developing Patterns across Subordinate Themes

As subordinate themes were developed independently from each interview, the researcher then used large amounts of 'flip chart' paper to map out how the wording/terminology used by each individual interview participant mapped out across the different transcripts. Patterns

emerged which were then clustered into individual subordinate themes. Table 12 (below) provides an example of how 'pressure of the role' was developed as a subordinate theme.

Example of a subordinate theme being developed from across the transcriptions: Pressure of role		
Emergent Themes	Interview No. Line No.	Illustrative Participant Response/ Quotations
Stress of workload	9/43-46	'Erm I would think that erm probably running round trying to find somebody to give advice made your session late and made you more under pressure as your patients got aggravated, and also probably not feeling very valued as people were saying, 'no I can't help, no I don't want to help' or whatever'
Ruminative Thinking	9/112-115	'Yeah. I think it became an ethos because there was so much to do and it stemmed from when there were no radiologists from when sonographers were asked to take on the role of a lot of the radiologists' work and also work was started probably without provision, you know, without extension of service and things'
Treadmill	8/31-34	'and we're all on that kind of treadmill where we just do things automatically and we're not aware of it. When you're in pain you tend to compensate by doing different things or you stop and think, well what am I doing?'
Workload	7/46	'So a lot, conveyor belt mentality every 15 minutes a patient'
Staffing Pressures	6/21-23	'there's a big problem staffing and recruiting up here because we are so far up north so we quite often are scanning with only 1 or 2 sonographers each day'
Loss of control leading to feelings of stress	5/39-45	P: It's a combination of things I feel. You don't have to necessarily be busy, it can be a difficult patient but also you've got issues with porters bringing patients down at certain times so you might have what looks like a reasonable number but that compresses the short time

		<p>I: Yeah, and you're left waiting around for a while?</p> <p>P: Yeah, waiting for ages and then all of a sudden you've got four patients and things like that can happen, and then you can come down from AMU, 'can you just do this urgent one' and you're stuck.</p>
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Table 12 Example of a subordinate theme being developed from across the transcriptions: Pressure of role

3.9.6 Stage Six: Identification of the superordinate themes

The researcher developed superordinate themes by thoroughly examining and immersing themselves in the established subordinate themes, aiming to categorise them into broader groups. Smith, Flowers & Larkin (2009, p. 96) explained various methods for identifying superordinate themes, such as abstraction and connecting related themes, contextualisation, which relates themes to specific structures or processes, and function, which focuses on how participants expressed their own experiences during interviews. During this final stage, the emphasis was on conducting in-depth analysis as an iterative process, constantly moving between the text (interview transcripts) and interpretation to reveal the key super-ordinate themes that captured significant points from across all of the participants' experiences. The three super-ordinate themes: "WRMSD: Sonographer Identity and Context", "WRMSD and the Cultural, Professional and Environmental Perspectives of Sonographers", "WRMSD and Ideological Dilemmas Faced by Sonographers" with the associated subordinate themes are presented below in Table 13 which illustrates how the three superordinate themes with associated subordinate themes started to emerge. The finalised versions can be found under each individual Findings and Discussion Section (4, 5 and 6).

Superordinate Theme	Subordinate Themes
WRMSD: Sonographer Identity and Context	What sonographers Attribute to the Causes of WRMSD Resistance to Labelling 'I am not this but...' 'It's not work, it's age' ...Blaming other Factors Making Sense of Vulnerability and Risk Sickness, Pain and impact on Self Health and Fitness, and Self-Preservation
WRMSD and the Cultural, Professional and Environmental Perspectives of Sonographers	Sonographer Culture 'it's what we do' Professional 'this is our job' 'The Best Images' 'The Best Diagnosis' Professional Codes? Exasperation, Faceless Attribution and Anxiety Workaround 'Cutting legitimate Corners' Workload, Pressure and Stress Physical Environmental Impact on Sonographers (and experiences)
'WRMSD and Ideological Dilemmas Faced by Sonographers'	Practical Necessities of Scanning versus WRMSD Prevention techniques Acknowledging versus Denying WRMSD Increasing Workloads versus Physical and Emotional Pressure from the Job Personal Needs of Sonographers versus Perceived Imposed Pressures Awareness of the Need to Change versus Compulsion to Carry On Practical In-situ Judgement versus Experiential Ethical Judgement Increasing Workload versus Decreasing Resource

Table 13 Development of the Three Super-ordinate Themes with Associated Sub-ordinate Themes

Stage of Analysis	Explanation
Repeated reading of data	The researcher immersed themselves in this section by reading and re-reading the transcripts against the audio recordings to ensure accuracy. Pauses, sighs, laughter etc were noted on the transcripts, which had been missed by the transcriber, which may add further meaning to the data in later parts of the analysis.
Initial noting/identifying emergent themes	This part of the process examined the meaning of the transcripts in terms of the semantic content, allowing the researcher to develop their understanding and familiarity of the data.
Developing emergent themes	This stage involved changing the initial 'notes' into 'themes' which involved the researcher embedding themselves into the research, closely involving the 'lived experience of participants'. This stage was a combination of the collaboration between the researcher and participants.
Searching for connections across emergent themes	This stage focused on a mapping exercise of how the researcher considers the themes interlink.
Comparing participant transcripts for recurrent themes	Each interview transcript was considered as an individual case, and in this study 9 interviews were carried out. This stage involved attempts at 'bracketing' the ideas which emerged from the first transcript, when analysing the next transcript. This stage also required the researcher to appreciate how the analysis of the previous transcript will influence the analysis of the next.
Searching for patterns/connections across the recurrent themes	This final stage examined the analysis of the 9 transcripts, as a whole. This was presented as a narrative of themes in the findings and discussion section.

Table 14 Summary of the Analytical Process

(Adapted from Smith, Flowers & Larkin 2009; Flowers *et al.*, 2011)

3.10 Ethical and Legal Implications

University of Cumbria ethics committee approval was sought to conduct the interviews and data collection (Appendix 4). Each participant was sent an initial letter to invite them to take part in the study as well as a participant information sheet, consent form (Appendix 2) and a summary of the interview schedule (Appendix 5). Participants were informed that the interviews would be audio recorded and that a typist, appointed by the researcher, would transcribe these recordings verbatim. Participants were reminded that, although they would not be named in the study, and nor would their place of work, data gained from the interviews could be used in published work in the future.

Participation was voluntary and participants could withdraw from the study at any time up to the point of analysis. Once the transcriptions had been completed these were checked for completeness against the audio recordings by the researcher and amendments were made, which included highlighting any pauses, sighing or laughing which may have added to the relevance, meaning and interpretation for the initial analysis.

Adherence to the Data Protection Act (1998) and GDPR were maintained and any confidential, or sensitive, information such as names of participants, their colleagues or hospitals/workplaces were removed to maintain anonymity. Audio recordings remain stored securely on a password protected database and will be destroyed upon final completion of the study.

3.11 Trustworthiness

The analytical direction of the study was monitored against the standards as identified by Yardley (2000), see Table 15 (below):

Characteristics of good (qualitative) research. Essential qualities are shown in bold, with examples of each shown in italics	
Sensitivity to context	Theoretical, relevant literature, empirical data, sociocultural settings, participants' perspectives, ethical issues.
Commitment and rigor	In-depth engagement with topic, methodological competence/skill, thorough data collection, depth/breadth of analysis.
Transparency and coherence	Clarity and power of description/arguments, transparent methods, and data presentation, fit between theory and method, reflexivity.
Impact and importance	Theoretical (enriching understanding), socio-cultural, practical (health workers – sonographers in this study)

Table 15 Characteristics of Good Qualitative Research

(Adapted from Yardley, 2000)

The initial findings were presented as a poster presentation at a professional conference (UKRCO 2018, and UKIO, 2019) to assess their preliminary impact. Any thoughts offered on the poster were noted and any amendments made accordingly. Further research papers will also be written and put forward to a peer reviewed professional journal, for potential publication, outlining the final study findings. The peer review process should further underpin the professional standing of the study as further improvements and amendments are likely to be made, following reviewer feedback.

It is acknowledged that the findings are unlikely to necessarily be representative of all sonographers in the UK but moreover the study aims to reflect the shared understanding of the participants' experiences and provide some sense of each participant's individual experience (Flowers *et al.*, 2011) which will hopefully resonate within the wider field on publication and dissemination of outputs from the study. It is unusual for a team approach to be used in the analysis of an IPA study (Flowers *et al.*, 2011); however, the findings were discussed with the

supervisory team during each of the stages of analysis and potential weaknesses in methodology explored further. Sufficient transparency was ensured during the research process with the presentation of clear and detailed accounts of the data collection and data analysis processes as well as sufficient reflexivity on the researcher's part when considering factors which may affect the data or analysis and subsequent findings (Yardley, 2014, Ley, 2000). The research participants have continually been included in the progress of the study with samples of findings regularly sent to the interview participants, who were also invited to comment. No issues were raised by the participants along the way, although all responded with gratitude for continually being included.

This section has outlined the process of conducting an IPA analysis in this study to ensure transparency in the analytical process (Yardley, 2000). Section 3.9 has described how the themes emerged through discussions with the research supervisors. The provisional findings were presented at two professional conferences during different stages of the interview data analysis to enhance validity (Osborn & Smith, 1998).

In the context of hermeneutics, it is essential to acknowledge that interpretation is a dynamic process between the researcher and the participant, leading to situated knowledge (Moules, 2002; Roth, 2014). Consequently, the researchers should engage in self-reflexivity to demonstrate their involvement with the data and contextualise the nature of their interaction with openness and transparency (Moules, 2002; Roth, 2014; Murray and Holmes, 2014; Fischer, 2009).

3.12 Reflexivity and qualitative research

A reflexive account was kept as a personal, and private, reflexive diary throughout the research process. Where appropriate 'Reflexive Points' have been woven into the narrative to highlight where reflexivity has been used in the decision-making processes in this research journey. Reflexivity may be defined as a process of critical self-reflection on the impact the researcher has had on the research process, acknowledging the impact of their professional background, their assumptions, experiences, and relationship with the participants on the process as a whole and in the development of the findings and conclusions drawn (Finlay & Gough, 2008). Using reflexivity is one way in which the researcher can demonstrate that they are attempting to work with 'subjectivity' of the research findings in an explicit and accountable manner (Hicks, 2009).

Reflecting one's own professional role has been fundamental to the openness and transparency and hence the credibility of this research process (Smith, Flowers, and Larkin, 2009; Dickson, Knussen and Flowers, 2007). The researcher is fundamentally aware, as were the interview participants, that having worked as an ultrasound practitioner for a significant number of years and then as an academic, this brought with it both advantages and challenges. Firstly, in relation to clinical ultrasound practice, it is almost certain that recruitment challenges, both in terms of having access to and in terms of gaining co-operation from participants, were eased by the fact that the researcher had worked in ultrasound for the NHS for over 10 years, before taking on his current role at the end of 2010, and the fact he was known to many of the interview participants through his role as ultrasound programme leader at a UK HEI. This very likely made participants more willing to be interviewed as a consequence of a relatively long-term professional relationship with many of them. This professional familiarity has also assisted in the actual interview process where it was found to be

relatively straightforward to initiate and develop a rapport which further encouraged comfortable and open conversations. The researcher acknowledges some degree of prior knowledge, personal experiences and relationships with some of the interview participants from previous professional relationships which will have undoubtedly provided pre-existing insights and understandings into certain facts and viewpoints. Similarly, the researcher's professional drive to develop strategies to prevent WRMSD and to find out more about what it is like for fellow sonographers, and the many anecdotal narratives which have been received from sonographers regarding the issues surrounding WRMSD and other challenges being experienced must also be acknowledged, as the researcher's own personal feelings and experiences about this phenomenon are likely to have influenced the interpretation.

Supervision has played a pivotal role in helping the researcher strike a delicate equilibrium between avoiding excessive assumptions and harnessing existing familiarity with the subject matter. This balancing act has been particularly evident in certain interview transcripts and has been woven into the narrative through the researcher's own 'reflexive points'.

An example is captured in the excerpt from an interview below which demonstrates the shared knowledge and understanding of the role between the interviewer and participant:

Reflexive Point

My position as a researcher and the fact I was known to the IPs as an ultrasound academic, and sonographer, meant I was conscious of potentially leading the IPs during the interviews. I became quickly aware of the use of common professional colloquialisms because of our shared knowledge of the profession and WRMSD. As I proceeded to complete further interviews I was striving to avoid using 'leading' questions wherever possible. I kept my reflexive diary up to date to ensure my thoughts and fears were captured and so I could ensure the findings reflected this when they were analysed and written up.

P: In one week there'll be obstetrics, head and neck and that's not very good for RSI because

I: Is that a one-stop clinic.

P: That's a one-stop clinic and you're actually out of the department and you're using the portable and then you have to scan with your arm high up so extended a lot more.

I: Is that because you don't have the ergonomic equipment?

[Participant 3, Lines 51-55, hereafter 3/51-55]

Potentially, this could be deemed as 'leading' however there are also some perceived advantages to this level of shared understanding (Smith, Flowers, and Larkin, 2022). The researcher acknowledged owning a unique role as an ultrasound programme leader [academic], who maintains his clinical competence through regular ultrasound clinical practice, who has previous experience of being a full time NHS sonographer, which has further facilitated an interesting, clear, and comprehensive exploration of the research topic, albeit not without challenge. An example, highlighted above, is probably a consequence of previous longer term professional relationships with some of the interview participants enabling the researcher to empathise with many of the issues that were raised such as time and work pressures, competing demands and the dilemmas faced when choosing self over workload and patient care and lack of staffing. The researcher also acknowledges their overarching aim which is to establish what it is like for sonographers working with WRMSD and what impact the phenomenon has on sonographers' practice in general to find a basis on which to start to build new strategies for WRMSD prevention in ultrasound. It has become clear during the research process that making such a difference will be extremely difficult, especially when the sonographer participants' narratives have highlighted so many self-perceived challenges and difficulties in their role.

The demands experienced by the researcher during the research process, particularly the expectation to produce a high quality rigorous academic study, the need to ensure the participants' views were accurately represented and ensuring that the meanings and experiences that were given by the participants in the interviews were accurately presented, and clearly articulated, even if these conflicted with the researcher's views and experiences, presented challenges which were acknowledged throughout the process. Consequently, it has been vitally important to maintain an objective awareness of the potential for conflicting, multiple roles, and different perspectives which has become a critical part of the analytical process employed in this study. The support of the supervisory team and regular follow-up with the participants has also been a crucial part of this process.

Reflexive Point

Discussion with my supervisors assuaged my concerns to some degree. I understood that being reflexive about my approach and findings was a helpful process to ensuring academic and professional rigor. I clearly acknowledged my position in the research and was open and transparent about any fears of asking leading questions or creating bias.

The selection of IPA as the methodological approach for this study was primarily driven by its inherent ability to foster iterative involvement with the subject, the participants, and the researcher as integral contributors to the knowledge construction process. This approach aims to establish a contextual foundation within which the findings can be thoroughly examined (Smith, Flowers & Larkin, 2009, p.38). Fundamentally, IPA is concerned with participant experience (Smith, Flowers and Larkin, 2022, p.119), which is what this study aimed to capture, the voice of the participants.

A reflexive journal has been found to be essential, to maintain a degree of researcher reflexivity throughout each stage of the research journey and records of this were made at each of the different stages of this journey (Etherington, 2004, p.80) particularly in acknowledging that 'bracketing' has been difficult, if not completely impossible, to truly achieve in this context.

3.13 Summary of Methodology Chapter

This chapter has established the epistemological foundation for this IPA study, rooted in the theoretical principles of phenomenology, hermeneutics, and ideography (Smith, Flowers & Larkin, 2009). The research strategy, design, analysis, and interpretation are aligned with this epistemological position, effectively addressing the study's research questions. The chapter confirms that the research was carried out systematically, and efforts were made to uphold quality criteria throughout the process (Yardley, 2014).

Furthermore, the research acknowledges its subjectivity and the researcher's influence on the process. This is evident through an exploration of the researcher's epistemological stance [reflexive process], the motivations behind the chosen research topic, the relationships established with the participants, and the analysis and presentation of the research findings. The chapter highlights the ongoing reflexivity as a central aspect of this research methodology.

The next chapter of this thesis will present a summary of the findings that have emerged through the analytical process based on the super-ordinate themes as well as the accompanying subordinate and emergent themes alongside a critical discussion of the emerging extant literature related to the themes outlined. The research question aimed to explore the unique 'lived' experiences and the personal perspectives of sonographers and WRMSD, there-

fore, the next three chapters will evaluate the findings of the research in the context of relevant pre-existing evidence and associated theoretical frameworks. The Findings and discussion have been divided in to three chapters, one for each superordinate theme. Each has then been further divided into several sub-sections, evaluating the main sub-ordinate themes which have emerged from the research findings, which make up each superordinate theme.

Although the individual subordinate themes have been separated, during the analytical stages of this study, one must consider that many of the subordinate themes are also inter-related and therefore attempts are made throughout the critical narrative to acknowledge this. Consequently, it is pertinent to consider each subordinate theme in relation to the holistic experience of each IP, the overall superordinate themes, and the research question.

Quotations from each participant have been proportionally represented, wherever possible, to ensure that no participant's voice has been excluded from the study and each of their individual experiences can be illuminated (Smith, Flowers and Larkin, 2009; Smith, Flowers and Larkin, 2022). Throughout the narrative, efforts have been made to explore the depth and breadth, of findings whilst also illuminating, not only the shared experiences emerging across the sample, but also differences in participant experiences, (Smith, Flowers and Larkin, 2009; Miller, Booth and Spacey, 2019).

4 Findings and Discussion, Superordinate Theme One: ‘WRMSD, Sonographer Identity, Attribution and Context’

This chapter has drawn together the results of the semi-structured interviews, in relation to the first superordinate theme, ‘WRMSD, Sonographer Identity, Attribution and Context’.

4.1 Introduction

‘WRMSD, Sonographer Identity, Attribution and Context’ has emerged from the data analysis as the first superordinate theme. Furthermore, this superordinate theme has been illuminated in different ways, across the corpus of data.

The range of subordinate themes, forming superordinate theme one are outlined in table 16.

Superordinate Theme One	Subordinate themes from which Superordinate Theme One was developed
WRMSD, Sonographer Identity, Attribution and Context	What Sonographers Attribute to the Causes of WRMSD
	Resistance to Labelling ‘I am not this but...’ ‘It’s not work, it’s age’ ...Blaming other Factors
	Making Sense of Vulnerability and Risk
	Sickness, Pain and impact on Self
	Health and Fitness, and Self-Preservation

Table 16 Subordinate Themes Relating to Superordinate Theme One, ‘WRMSD, Sonographer Identity, Attribution and Context’

4.2 What Sonographers Attribute to the Causes of WRMSD

This section is related to attribution and WRMSD, as was perceived by the IPs. This section aimed to explore what the IPs believed to be the cause of WRMSD for both themselves and their colleagues. It will also consider what their contextualised concerns were in terms of what they attributed to be the cause of WRMSD.

Firstly, there was already much debate surrounding the causes and effects of WRMSD in the extant literature, for example Gibbs and Young, (2009), and Sommerich *et al.* (2019) which were evaluated in section 2.3 of the literature review. Across the participant interviews there were clear commonalities, in terms of each IP's personal attributions regarding the causes and effects of WRMSD and, more specifically, its impact on individuals. One of the key concerns that emerged was finding agreement in terms of defining precisely what WRMSD is, and furthermore, how WRMSD impacts upon the individual sonographer.

The IP responses were nuanced and there was not always unanimous agreement, across the IP interviews, in terms of what the IPs perceived the term WRMSD to mean, as well as what attributions they made in terms of its cause and effect. In order to set the scene, a number of definitions, which related to WRMSD, were provided by the IPs, such as 'RSI' [repetitive strain injury], 'pain', 'injury,' 'cramps' and 'problems'. Some examples of how the IPs' individually stated their own histories around a variety of issues associated with WRMSD are also provided below:

"Nothing – I do sometimes get pain, if that's what you mean." [4/3-4]

"As far as I can remember I've never had a work-related problem, RSI

[Repetitive strain injury] injury, no". [5/1-4]

Yeah, I've had neck pain but not exactly an injury as such. [6/2]

A lot of people with shoulder problems, wrists. I had one colleague actually who had a hip problem so she used to hold the cable against the couch with her leg. [8/148-149]

“At the moment if I scan a full [] day, I’m starting to get hand cramps.” [9/59-60]

The different terminology used to refer to the phenomenon was nuanced. It is acknowledged that one must consider with caution, from the interview findings alone, the degree of understanding each IP had. When considering ‘absence of evidence’ this should not necessarily imply ‘evidence of absence’; consequently, the findings from this data do not wholeheartedly suggest that any or all IPs lacked formal factual understanding of different forms of WRMSD (Miller, Booth and Spacey, 2019). Moreover, it is likely their complete understanding of the phenomena did not fully emerge from the interview discussion at the given time, and this could be attributed to several factors. Examples include potential lack of clarity in the level of questioning, lack of further probing from the interviewer, lack of knowledge on the part of the IPs, the narrative flow of the discussion or indeed how the IPs personally perceived the phenomenon or indeed how they interpreted the line of questioning. This was considered in the researcher’s reflexive process, as data was collected.

The participant responses provide some evidence to suggest that the definition [WRMSD] is not always interpreted in the same way, by different individuals. However, the term would seem to be predominantly associated with negative connotations, with the use of words such as ‘*pain*’ ‘*problem*’ ‘*RSI*’ ‘*cramps*’ all of which seemed to be particularly linked to the fundamental issues the phenomenon presents to each individual sonographer. The differences appeared to focus on the types of symptoms experienced, the anatomy affected and the personal impact on the individual. For example, the IP below noted a series of attributions in terms of ‘cause and effect’ relating to WRMSD.

“I first trapped my nerve in my neck and nobody would tell me exactly what was happening. Every time I went to scan something went worse, I either dropped the probe or started with cramps so every time I went back to my job to try it again something went worse” [9/253-256]

However, despite the IP responses highlighted above, striking similarities also emerged from the IP data, across all the interviews, which related to the IPs' attributions toward the causes and effects of WRMSD in their practice. Most IPs (n=7) talked of the impact of stress in the workplace, and WRMSD.

“even though I wouldn't class myself as having a work-related injury, what I tended to suffer from after a week of scanning was a lot of tension and I think that was as much to do with the stress of work than actually injuring yourself” [1/173-176]

Furthermore, the same IP also suggested:

“to me the only other way of reducing it [WRMSD] is to overcome the issues that are causing it which to me are the overstretched lists, the overstretched sonographers, the time that is given for examination plus the time that is given during the actual working day to sort of relieve the stresses that you have on you, and I can't see that in the foreseeable” [1/204-208]

“I think given the pressures that we've had just recently and the amount of locums that we've to have in, I think the management is just coming round now to looking at building up the sonography team”. [2/192-195]

Despite the complexities surrounding this phenomenon, the IPs responses suggested contextual understanding of WRMSD is increasing, within the professional group, although it remained clear that there were certain political barriers preventing the individual from taking control. Scholl and Salisbury (2017) also noted the complexities of WRMSD and reported on the complexities surrounding sonographers' perceptions of WRMSD, explaining that despite some established barriers to ergonomic scanning such as patient BMI, and high workload, much greater insight is needed in terms of understanding and troubleshooting the specific difficulties sonographers encounter during their working day, particularly with specific patient types, to find workable solutions. Furthermore, they also noted that additional studies may be useful to unearth additional barriers to WRMSD prevention interventions, not already evident, by exploring the culture of the 'profession' further. The cultural perspectives,

of the IPs will be explored in the next chapter; however, it seemed prudent to also consider in more detail how the IPs perceive the phenomenon of WRMSD.

From this study, it was clear that the IPs held strong views on WRMSD. They acknowledged a clear awareness of how it is seen as being a significant problem for many and they also attempted to explain why they thought the problem continues.

“I think the knowledge [regarding WRMSD prevention] out there is getting more prevalent but it’s probably not as high up as it should be. It could be increased a bit more. Erm Yeah, I just don’t think, it’s not that I don’t think it’s important enough, I think people think there are more important things to worry about”. [2/77-81]

“I think we need a different perspective on it. You can get blind to certain things when you’re actually in the role yourself and you can’t possibly look beyond that”. [Interview 3/85-87]

“That’s it, why are you doing that and why are you doing that, and how come there’s so many of those, and you just say, ‘well that’s what we do’”. [7/107-109]

The quotations above, from IP7, highlighted a degree of innate acceptance of WRMSD. The IPs generally saw the problems of WRMSD as being intertwined within the complexities and nuances of their role. Furthermore, there was a general sense that there was little they could do to solve the issue, they saw WRMSD as something they had to accept as part of the job.

“I don’t know. I don’t know whether it’s something that’s proven or not, or whether it’s more of a strength, you know whether it’s strength is more to do with it than stretching”. [4/126-127]

Given the conceptual concerns, from the IPs, which are evidenced in the quotations above, it is important for the researcher to acknowledge the context from which they have arisen. In fact, when IPs describe 'cause and effect' in terms of WRMSD, this must be interpreted as a personal attribution, and not a proven scientific fact. This must be a critical consideration when exploring such phenomena through a qualitative lens. This is particularly pertinent as this study captured the experiences of a limited sample of individuals, as is commonplace in most qualitative studies. That said, the value of experiential evidence cannot be overlooked, and this has certainly formed the foundations of what this study aimed to explore further.

Reflexive Point:

I was concerned with participant experience, I continually strived to keep this in my mind when I was analysing the data and when selecting quotations to highlight the findings and discuss meaning and interpretation. I repeatedly went back to the research question during this process which helped me to remain focused.

Some examples of the different participant attributions regarding the causes of WRMSD are offered below:

"I suppose because I've had my injury for years for me it's been more about a better awareness of what I'm doing and thinking about things before I do it. I think it's because every time I moved it hurt so I had to stop and think, well what can I do so it doesn't hurt? And I think when you're in pain you tend to be more thoughtful and aware of what you're doing." [8/16-21]

The IP (above) demonstrated an awareness of an existing injury, which then prompted them to adjust their scan technique to avoid further aggravation. The symptoms became an innate 'prompt' for the IP to change their behaviour. The IP (below) mentioned a similar injury, and

they explained how they had to problem solve, and sought advice, to find a way to assuage the symptoms and consequently gain some level of control.

“it [WRMSD symptoms] started with my thumb was sore and then because of the way perhaps I compensated and then I had an elbow problem and then shoulder and neck and that was over a few years, and then I had some physio which wasn’t much help and then somebody, a friend, suggested that I saw a physio at the [Removed for anonymity] and I had acupuncture and that was the start where I felt I was getting obviously in control.” [3/6-11]

The level of control over their workload, and the effect of WRMSD on the individual, seemed to be of significance to the IPs in general, as (n=6) talked of the importance of ‘control’ over the role and their personal attribution of this to WRMSD. IP5 demonstrated an attribution of responsibility to others, and not themselves.

“I think there should be more control, particularly in obstetrics. I think the department should look at that role more in terms of sonographers’ safety in how many you do, how close they are together, what type of patient you do [5/185-189]

The IPs also discussed a range of personal attributions which they ally to the cause and effect of WRMSD. They demonstrated an awareness of themselves, in terms of what they are doing, and how the task in hand could be adapted for themselves to improve outcomes (namely lack of pain and discomfort). They alluded to the phenomenon, in terms of the specifics of their individual job role and particularly the lack of variation in patient caseload, or challenges to adapting their role, to make themselves more comfortable. Unfortunately, despite this demonstrable theoretic knowledge, it was not clear how this transferred specifically into their practices.

The interviews highlighted that participants could make some clear attributions regarding the causes and effect of WRMSD to themselves and the difficulties they face in seeking to adapt to the challenges of performing their role and avoiding WRMSD.

“it’s more large patients although I must admit nowadays I don’t push. I tell the students not to push and I don’t push. It’s the difficult patients. It’s the ones where the foetus is in a difficult position or where I’ve got to push a little bit to get some gas out of the way.” [8/267-270]

“Well the issue is cos you want to get the results, you want to see what you need to see, you want to make a diagnosis and the only way you can do that is by pushing.” [7/170-171]

“The clinic ran to the consultants and it ran to the vascular nurse and it didn’t consider the sonographer and how long it would take, and how many patients were coming and I think that was appalling, and I think that’s probably the worst practice that I’ve come across in anything that I’ve ever done really was that”. [9/134-138]

“Oh I think definitely the twisting and squeezing, you know, from augmenting the leg and also, yes, definitely. Erm I think like the nuchal translucency I’ve spent my time looking at iliac arteries and maybe iliac veins for DVT and you get some really solid people and obviously as people are getting bigger and bigger as we know, it gets harder and harder.” [9/143-146]

Furthermore, the IP’s offered further attributions relating to why they believe there are failures to change practices to avoid WRMSD:

“There are a couple of things I can say on that. One is, somebody mentioned to me very, very recently and made me think hard is that I like [removed for anonymity] machines and I’ve worked a lot with [removed for anonymity] machines and they’ve all had sliding keyboards which slide out and the only way you can operate them is to have them nearly, well they’re on your lap, it’s the only way you can operate really, and without thinking about it the angle of your neck to look down at the keyboard, you can’t glance down at a keyboard that is actually literally on your knee, your eyes and your neck in order to see what you’re doing have got to be in a funny position and so that’s one thing that I’ve been thinking about recently as to maybe something that” [9/160-168]

IP6 also referred to failures in systems set up as an attempt to reduce WRMSD.

“So we used to get somebody who would come to our department to teach us a better way [to scan ergonomically in order to limit the risk of WRMSD] but she actually gave up [laughs] because she said there was no ergonomically better way to scan than what we were already doing.” [6/210-213]

The quotation above certainly reflected the challenges faced in finding solutions to WRMSD prevention, but it also highlighted the need for more exploration into the phenomenon, particularly in terms of assuaging its impact. This was interpreted that the IP was trying to defend her practices and had found a mechanism to support this. The onus was placed up on the individual who the IP alluded to *'teach[ing] us a better way'*. The concept of 'laughing something off' is inherently apathetic and this often maintains and reinforces the status quo, particularly in terms of sonographers and WRMSD. Similar findings have been found in the following studies, related to psychology, whereby participants were seen to be apathetic to a phenomenon in order to 'blank it out' and laughing can be an established method (Zheltnina, 2020; Santangelo, *et al.*, 2017).

Other IPs blamed the ultrasound equipment manufacturers, not themselves, in terms of how perceived limitations of the ergonomics of the ultrasound systems was affecting them in terms of WRMSD, attempting to move the responsibility away from themselves, as the individual.

"I think the ultrasound machine manufacturers could be doing a lot more to help us by making the machines more ergonomically friendly. I always wonder why can't you have a machine that comes around the left hand side so you can put your patient on the right and it all touch screen in front of you so that." [6/223-226]

"erm [sighs]I think that some departments will let some staff scan at 15-minute intervals if they are willing to do it and I think that is not enough time for an examination. I think 20 minutes for the majority, that 95% of examinations is about the minimum." [9/196-198]

For this reason, it is clear from the interview data that, WRMSD remains a fundamental problem among sonographers, and sonographers see how this either affects them personally, or indeed those around them among their colleagues and the wider professional field. There are clearly certain individual challenges faced by the IPs, particularly in terms of changing their behaviour and practices. It seemed apparent that the individual is surrounded by a

wide range of important tasks that must be completed simultaneously; the degree of concentration of focus was seen as important to the IPs.

“you’re not focussing on that side of things [WRMSD prevention] at all in the [student] training, we are focussing on how to make them a good sonographer. Yeah, and I think work-related injuries and RSIs are really way down in the list of priorities than they should be.”

[6/284-287]

The concept of changing behaviour will be explored in more detail where sonographer culture is discussed in ST2, however for clarity it will also be briefly picked up here. Changing behaviour was discussed by Peper *et al.* (2004) who suggested that people become “captured” by their work and forget to take any breaks until they experience pain or discomfort, which is also reflected in the IPs’ accounts. The narrative above has highlighted the complexities surrounding the individual and WRMSD despite the evidence which would suggest that the IPs already have knowledge about the potential risks of WRMSD. There is also acknowledgement that sonographer behaviours, exhibited when undertaking their respected roles and responsibilities at work, are also thought to be contributory to WRMSD.

The relationship between the individual sonographer and WRMSD was illuminated through the IP interviews. The findings have demonstrated several nuances, firstly in terms of exactly what WRMSD means and the subtle differences in the terminology used to describe them by the IPs. Second, the IPs presented different attributions, in terms of the causes of WRMSD which ranged from their own actions to the actions of others, to no alternative options being available (WRMSD was part of being a sonographer).

The next sub-section will explore how the IPs demonstrated a resistance to labelling.

4.3 Resistance to Labelling “I am not this, but...”

This section aims to evaluate the unique relationship the IPs had with the phenomenon in terms of how they demonstrated a degree of resistance to being labelled as having WRMSD.

The complexities surrounding diagnosing WRMSD were acknowledged in the literature review. The concept of WRMSDs being classified in terms of 'cause and effect' transcends throughout the IP data. From [n=4] there was an apparent resistance to labelling among the participant sample and some participants did not personally acknowledge experiencing WRMSD at all, in fact there is evidence of the IPs being resistant to being labelled as having WRMSD. Within some of the IP responses, a degree of reluctance toward acknowledging experiencing any form of WRMSD symptoms was inferred. For example, several IPs refused to associate pain or discomfort, specifically to WRMSD, which they alluded to having experienced during their practice. Some examples are provided below, where participants demonstrated some degree of resistance to labelling. The localised social identity of a sonographer seemed to become a problem when they discussed WRMSD; they seemed resistant to any kind of labelling. *"I am not this but..."* which indicated an awareness to how they might seem to others within their professional field, to other colleagues within their place of work and to patients.

I: Have you ever had a work-related injury in your role as a sonographer?

P: Nothing – I do sometimes get pain, if that's what you mean". [4/3-4]

In the quotation above, from IP4, the researcher noted the contradictory element of the response. 'Nothing' was stated immediately, with an almost defensive tone, which could be heard following listening to the audio recording several times. This would lead one to suppose that this respondent had in fact admitted to 'feeling pain' but the addition of 'if that's what you mean' is unusual because they are almost challenging the question back to the researcher. They are potentially trivialising the question and drawing on their own interpretation. '[I]f that's what you mean', although posed as a question, was interpreted as a rhetorical question in the interview. When asked about WRMSD, IP6 commented:

"Yeah, I've had neck pain but not exactly an injury as such".

When asked to expand and explain the pain, IP6 added:

"Yeah, when I started doing vascular training". [6/2-4]

Furthermore, IP2 commented:

"I probably have but I've not had anything that's caused me to be off work sick". [2/4-6]

The researcher noted the wording from IP6, who acknowledged experiencing pain, but quickly followed the comment up by stating *'but not exactly an injury as such'* which suggested an unwillingness to accept being labelled as specifically having a WRMSD. It is also a good example of how repeated microtrauma is misunderstood. Under-reporting of WRMSD, is not uncommon when compared to other professional backgrounds. A study by Tucker *et al.* (2014), which evaluated 21,345 young Canadian workers, found that from the 21% who declared having experienced work-related injury (WRI), around half actually reported this to their manager. Furthermore, the list of categories for not reporting WRI included: (a) Perceived low severity (i.e., minor injury), (b) Reactions of others (e.g., supervisor), (c) Employment status (e.g., self-employed), (d) Lack of knowledge about reporting injuries, (e) Blamed self for the injury, (f) Concerns about self-identity, (g) Too much time to report the injury, (h) Did not want to miss time from work, (i) Repeat, lagged, or non-attributable injury, (j) Multiple categories, and (k) Other (e.g., other reason, nonsensical, description of the injury, or not enough information to categorise). It would have been interesting to have further explored, with some of the IPs in this study, why some felt their symptoms were not specifically categorised as being WRMSD.

Similarly, IP2 remained vague when questioned about their experiences of WRMSD, having used the term *'probably have' [had an injury]* but instead used the perceived lack of sickness absence to explain that they had not experienced WRMSD. Other participants also talked about some non-work-related injuries they had experienced, which they specifically asserted were not related to, nor had these injuries impacted on, their work as a sonographer.

“I’ve injured my lower back, decorating [laughs], but that’s not - that was a while ago, and touch wood, it’s not affected my work, it’s not flared up through my work”. [7/372-373]

4.4 “It’s not work, it’s age” Blaming Other Factors

When asked about non-WRMSD, IP5 commented on the challenges in answering the question, leading the researcher to consider whether there is in fact a combination of denial and the unknown. IP5 made some light-hearted reference to his age.

“It’s difficult to answer because every time I do a different sport I get injured. It’s an age thing that apparently [laughing]. I’ve had to stop various sports and drop various sports in the last few years, I keep getting injured [laughing]. There’s nothing that’s impacted on my work ever other than when I was off for three days with a bad back at the end of last year, and that was a one-off and it’s never happened before or since”. [5/230-237]

It was of interest to the researcher that both participants above laughed when they explained their ‘non-WRMSD’. From IP7, there seemed to be some contradictory phrasing, because they talked of sickness absence from a ‘bad back’ but again there was demonstrable eagerness to ensure this was not associated with their work as a sonographer, or indeed attributed to WRMSD at all. This would perhaps suggest there is commonality amongst sonographers that WRMSD is stigmatised, but what is not evident is why the phenomenon seems to generate this stigma. The work of Stangl, *et al.* (2019) highlighted that stigma is a well-documented barrier to health seeking behaviour, engagement in care and adherence to treatment across a range of health conditions globally. It would therefore seem apparent

that a similar situation has occurred with the IPs in this study and as such, stigma has become a localised social identity of the sonographer.

Reflexive Point

I was concerned at times about using stronger language such as 'stigma' as I felt this was bias laden and potentially misleading unless carefully unpicked. Was I wanting to find 'stigma' in the participant response? I doubted myself and considered whether I was leading this finding and as such felt compelled to consider this further through my reflexive diary to acknowledge any potential biases.

Furthermore, the problem is exacerbated by talking about WRMSD. Of the nine participants, only three mentioned taking sickness absence for symptoms of WRMSD, although all admitted to some sickness absence in the past for various other reasons, including responses such as 'sickness bug' or 'd and v'.

Reflexive Point

My initial draft of this section used much stronger language in places and through discussion and self-reflexivity I re-reviewed my use of language here in describing and evaluating the interview findings. I re-considered the use of stronger words such as 'denial' and 'admitted' to better reflect the meaning and interpretation. I replaced these words with 'softer' language. I acknowledged Bolton (2010) who suggested that the truth conveyed in any writing cannot be fully objective and instead relies on the interpretation of both the author and reader.

There was a real sense of how one order of illness is implicitly classified as 'okay' to admit while another 'is not'. The underpinning tacit belief here seems to be the IPs consider

WRMSD to imply weakness. This can be related (via stigma) to literature on how people will often rank physical illness as more 'acceptable' to have - and certainly to take time off with - than mental illness. Similar findings were found in several studies; one example is Nickerson, *et al.* (2020) who conducted a randomised controlled trial of an online intervention to reduce mental health stigma and increase help-seeking in refugee men with posttraumatic stress. The study concluded that, like WRMSD in sonographers, mental health stigma was a key barrier to seeking help.

One participant, who suggested they had not experienced any symptoms of WRMSD, later in his interview, alluded to a recent episode of sickness absence from work during which he discussed a back related injury [of unknown cause].

P: "I did have a back-related one which was a bit unexplained. I just woke up in bed one morning and had a bad back.

I: And you don't think it was linked to your job at all?

P: No it was a random thing that's not occurred since". [5/26-29]

This provoked further questioning from the interviewer, as it was seen as interesting, particularly as this participant had previously alluded to having no symptoms of WRMSD.

I: "Do you have any non-work-related injuries or any activities outside of work that you feel might impact or might give you aches and pains for want of a better word?"

P: "It's difficult to answer because every time I do a different sport I get injured. It's an age thing that apparently [laughing]. I've had to stop various sports and drop various sports in the last few years, I keep getting injured [laughing]. There's nothing that's impacted on my work ever other than when I was off for three days with a bad back at the end of last year, and that was a one-off and it's never happened before or since". [5/230-237]

At this point, the participant seemed more open and willing to talk about their symptoms. Furthermore, the fact that he was laughing led the researcher to consider whether this demonstrated some potential façade the IP was utilising to bypass the question. Ultimately, the IP admitted he did not know what had caused the injury to his back, but he was adamant it was not caused by his work as a sonographer and was not WRMSD.

Reflexive Point

I kept any non-verbal cues, such as laughing, within the transcriptions because I felt these added to the nuanced meaning and interpretation. I accepted that I may never know the true meaning behind why the IP was laughing but acknowledged the significance of including it within my reflexive diary to ensure a level of consistency within the analysis and presentation of the findings.

Similarly, IP1 was equally reticent in admitting any form of WRMSD symptoms, particularly related to any sickness leave.

“No, no I’ve never [had any sickness leave for WRMSD], just the only sickness I’ve ever had from work has always been like colds, them sort of sicknesses, never long-term sickness ever, no.” [1/20-21]

The repetition of ‘no’, which was stated three times in one sentence, led the researcher to consider if the IP wanted to reinforce their perspective and confirm they had never needed to take sickness leave because of WRMSD.

Furthermore, IP5 added:

“I’ve nothing to prove given the fact that I’ve never had a work-related injury and the fact that I’ve never had any problem even though despite my technique is probably not the best technique”. [5/15-17]

The statement *'nothing to prove'* led the researcher to consider whether in fact IP5 did have something to prove and was visibly being *'resistant to labelling'* because he openly admitted that his own WRMSD prevention strategy was *'not the best'* suggesting improvements were needed in his practice from that perspective. This may also have suggested IP5 did not want to accept the stigma that he was affected by WRMSD. These findings resonate with a few studies. One example is the work of Otu and Otu (2022) who reviewed the concept of *'police subculture'* and examined its role in the management and acceptance of treatment for stress-related injury. They suggested that labelling is defined as a unique relationship between an attribute and a stereotype; a discrediting attribute that impacts negatively on an individual's normal identity, subsequently leading to social rejection, devaluation, and discrimination. Furthermore, they go on to question whether the lived experiences of those with work-related injuries are designed by the attachment of a label or by individual internalising feelings and the effects of the problem (Otu and Otu, 2022).

This sub-section has evaluated the subordinate theme 'resistance to labelling' and has highlighted the contradictions, which initially emerged from the previous subordinate theme 'the individual and WRMSD', in terms of how the IPs perceived WRMSD to comfortably apply an appropriate label. Furthermore, there were also contradictions in terms of how the phenomenon was referred to, such as WRMSD, RSI etc. Finally, there was evidence that the IPs showed resistance to reporting symptoms of WRMSD and there were contradictions in terms of symptoms and attribution, meaning it is not always clear why WRMSD is a taboo subject for some sonographers. The next sub-section will develop this discussion further by exploring the vulnerability of sonographers, represented through the IP responses and specifically, how a resistance to labelling is underpinned by this.

4.5 Making Sense of Vulnerability and Risk

This sub-section has acknowledged the discussion in the previous sub-section regarding an over-arching 'resistance to labelling' and will explore the factors which have caused the IPs to make sense of vulnerability [within themselves] toward WRMSD, and their role as a sonographer and risk. It will also explore masculinity and gender roles, power, strength, and resilience.

All the IPs attributed the complexity of combining their professional role with their everyday lives as being one of the main challenges they faced in explaining their perception of WRMSD.

It appeared that the IPs recognised that, in terms of combatting WRMSD, they need additional support locally and the apparent vulnerability appeared to act as a demotivating factor to their engagement with their professional role. There is also the sense that promoting positive outcomes is not always straightforward and the challenges faced by the IPs were often apparent. There appeared to be many barriers to overcome, which were also highlighted in the extant literature, particularly regarding having had previous experiences of WRMSD.

Some of the participants highlighted that 'other' sonographers, (not necessarily themselves), are perceived to be more at risk of WRMSD due to several personal factors including age, gender, size (build) and strength as evidenced below.

I: "Do you think it's [WRMSD] down to the individual?"

P: "I think it's probably a bit of both. I do genuinely think having worked in a lot of different places and with a lot of different people, on the whole I think its people who are quite small or quite unfit and not very strong who tend to get more injuries. Not necessarily get the injuries but get more injuries." [5/174-180]

P: "And also doing NTs we've a big issue of RSI but luckily, I've not been affected by that. The probes are too big for the girls". [5/107-108]

Furthermore, when asked whether the IPs thought WRMSD could be affected by other factors in people's lives, there were a range of nuanced responses. IP3 and IP4 commented on how they considered the build and strength of the sonographer to be related to WRMSD risk.

"I suppose it depends on the sonographer's size, I mean, I'm small, and if you're scanning big patients and you have to put pressure and obviously you have to go round the abdomen to look at the left side and if you do patients on trolley beds and that has an effect on it as well". [3/197-202]

"I don't know. I don't know whether it's something that's proven or not, or whether it's more of a strength, you know whether it's strength is more to do with it than stretching". [4/126-127]

However, IP4 highlighted some reticence prior to answering their question repeating 'I don't know' twice, further supporting the nuanced complexity surrounding the perceived causes of the phenomenon, including the point that they were uncertain. Some examples are further outlined by IP2.

"I think you have to decide what contributes to it [WRMSD]. I think there is different areas of it. I think there are bits that might be just general ageing and there's nothing to say that it might not be an age-related skeletal problem. It may also be a fitness side of it. Are the people fit to do the job that they're doing cos it is quite a physical job, isn't it really?" [2/267-270]

The uncertainty of the precise causes of WRMSD emerged, alongside the nuanced perspectives that were discussed. Again, the sonographers' own physical fitness to perform their role was questioned. This was further supported by IP5, who provided an individual perspective of WRMSD risk categories.

"I do genuinely think having worked in a lot of different places and with a lot of different people, on the whole I think its people who are quite small or quite unfit and not very strong who tend to get more injuries. Not necessarily get the injuries but get more injuries. More chance to get injured. And the people who are quite small tend to struggle to get in the right positions that are necessary with big patients and because of the size and if they follow the rules of the current guidelines they are still going to struggle". [5/177-184]

This is not to say that all IPs felt the same, some (n=2) acknowledged the vulnerability of others, and not themselves, to WRMSD and this is highlighted in example participant quotations below.

“I think yeah, some people are more prone to it [WRMSD] and some people will put a lot more pressure on than others during the scan, because when we’ve gone in to take over from each other, the patient will say, ‘oh you’re not pressing on as hard as the other girl did’. So, yeah, I think genetic make-up, positioning and just being aware of it as well”. [6/272-276]

This would suggest that those who have previously experienced pain or injury first hand tend to show more awareness of the impact of the phenomenon and the vulnerability of other colleagues. Those IPs, who demonstrated greater awareness of the associated risk of WRMSD and consistently apply this to their practice, clearly consider themselves at reduced risk of acquiring WRMSD in the future. The IPs tended overall to imply, from their responses, that they had some awareness of strategies thought to support the avoidance WRMSD but what remains unclear is how to persuade more sonographers to modify their practices to reduce their risk of WRMSD.

IP8, was asked whether they had previously taken sickness absence because of WRMSD, to which they responded.

“Yes. In 1999 I took, I think it was about 4 weeks I was off sick cos it needed complete rest and then when I went back I wasn’t scanning much for quite a long time. It was probably about 3 months before I started doing anything more than just the odd bit of scanning with a student”. [8/46-50]

IP8 commented on the challenges they faced, with WRMSD, which caused them to be off work sick. It was noted how IP8 used pain as a stimulant to ‘stop and think’, suggesting triggers were needed to make people more aware of the potentially damaging behaviours.

“Erm [sigh]It’s been an interesting one ... because I’ve had my injury for years for me it’s been more about a better awareness of what I’m doing and thinking about things before I do it. I recently fractured my ribs and after that ... I was much better in relaxing into what I’m doing

and I think it's because every time I moved it hurt so I had to stop and think, well what can I do so it doesn't hurt? And I think when you're in pain you tend to be more thoughtful and aware of what you're doing. So I found it useful generally but I've not [] it's not sort of made my wrist and shoulder feel any better particularly but I think I'm more aware of... [8/15-23]

This sub-section has explored the potential vulnerability of some sonographers, as discussed by the IPs. Discussions were held around influences of gender, power and overall physical strength and their influence on sonographers and WRMSD. Attitudes related to females being seen as less physically strong than men were raised, in relation to potential increased vulnerability to WRMSD, although the concept was beyond the scope of this study and would need evaluating further, and in more detail. The next sub-section will explore the subordinate theme relating to sickness, pain, and impact of WRMSD on sonographers' careers.

4.6 Sickness, Pain and Impact on Self

This subordinate theme is related to the consequences and impact of WRMSD on the IPs. It will explore the impact of WRMSD on the IPs in terms of colleague sickness absence (and subsequent increased workload and pressure for themselves), pain and impact on individuals' lifestyle and work, particularly in terms of their ability to complete tasks and the overarching 'political' implications which may affect staffing levels, staffing shortages, workforce challenges and the clinical specialism as a whole.

The challenges faced with sickness absence, from WRMSD, were not only significant for the sufferer. IP7, IP3 and IP2 discussed the impact of fellow colleagues taking sickness absence, for any reason, in terms of how this impacted on themselves, their workload and consequently their perceived increased risk of acquiring a WRMSD.

"We did have a period where we were reasonably fully staffed but we have got somebody on sick leave, who will be going on maternity leave, and then we've also got somebody who's actually given their notice in and are going to leave, so we will have staffing problems again". [3/139-142]

"I think [the] team base has been too small because we haven't had capacity to backfill sickness and absence or holidays or anything like that, and I think that's an issue everywhere that once you've got the sonographer in there scanning there isn't any sonographer that's walking round that's not really doing anything." [2/181-184]

[Related to colleague sickness absence] "There was no concessions to the workload or the waiting time. It was expected that we would maintain the same level of input patient-wise which didn't cause animosity amongst the sonographers but there was the question why we should be doing extra because people were off sick and it's not their fault they're off but why do we have to work longer and harder for the same amount of money to make up for them cos there's no extra capacity, so if 1 person goes off there's no back up plan, no management back up plan, they won't get agency in, we still have to do the same volume of work load" [7/113-122]

In a general sense, the IPs were unanimous in terms of the burden of additional workload that is potentially placed up on them, should a colleague take sickness absence. The striking impression was the lack of any element of choice, should colleagues go off sick. The workload still had to be completed, which always took precedence over anything else.

Views of the IP's varied tremendously in how this subordinate theme emerged, for example the IPs talked about pain and symptoms of WRMSD on themselves and the impact on their role.

"Recently, after I returned to work after maternity leave, I did get a pain in my wrist and forearm, but that only lasted a couple of weeks and it's not come back again". [4/10-11]

"because the injury doesn't go away, you just learn to cope with it and to live with it and I find ways to make it less acute, painful". [3/17-19]

"The only time I've ever experienced any aches and pains are doing head and neck clinic". [5/55]

"it was about stopping and thinking rather than just doing and we're all on that kind of treadmill where we just do things automatically and we're not aware of it. When you're in pain you tend to compensate by doing different things or you stop and think, well what am I doing?" [8/31-34]

From the four quotations above, it is apparent there are a range of perspectives regarding the term 'pain' and its impact upon each IP's career and lifestyle in general. The experiences were somewhat heterogenous and clearly some IPs experienced some pain or discomfort, which eventually goes away again (when not performing a particular task); others saw pain as a trigger to change their behaviour and adapt their scanning technique to prevent the pain and become more aware of what they were doing.

This sub-section has highlighted how sickness and the impact of pain can significantly affect sonographers, reflected in the IP responses. The next sub-chapter will explore the inter-relationship of health, fitness and self-preservation of the IPs and WRMSD.

4.7 Health, Fitness & Self-preservation

This subordinate theme is related to how the IPs saw themselves in terms of their own 'protectionism' against WRMSD, and particularly how they believed they were avoiding the phenomenon by maintenance of their own health and fitness.

The final subordinate theme, related to superordinate theme one, encompassed the personal health, fitness, and self-preservation of the IPs. When asked about their everyday health and fitness, some of the IPs demonstrated an awareness of the benefits of being fit and healthy, particularly to assuage the potential impact of WRMSD, or at least reduce their associated risk of acquiring WRMSD.

"Up until probably about 6 years ago, I attended regular aerobic sessions and ad hoc swimming. We have a large garden in [anonymised for privacy] which I mow the grass and garden extensively and a small garden in France, so I do a lot of gardening. I've 2 children, they keep me busy and I like walking – it's occasional and occasional cycling. I'm not a member of a fitness group at the moment but in the past I've done aerobics most of my life and at the moment I am doing some Pilates because of my neck.

I: OK. Does that help at all do you feel [better]?

P: Yes, very much so". [9/8-13]

The feeling of benefit, of maintaining physical fitness, was clearly apparent in IP8's response. Although it is acknowledged that any such benefits cannot be tested as such by this study. IP1 also saw some benefit in maintaining health and fitness, particularly in terms of maintaining the necessary strength to do the job.

"I've always tended to do some form of exercise from starting way back in radiography really, I've always done exercise classes or do a little bit of running, so I think that does have an effect on almost the strength of the muscles that you use in ultrasound which tends to be more shoulders, elbows, wrists, so I think it is important to try and sort of keep them muscles strong really to prevent injuries". [1/8-12]

Another perspective was offered by IP4 related to maintaining fitness/health.

"All I do is do a lot of the stretches basically but I think the fact that I work part-time now because you get that rest period from - obviously I'm doing a lot of other things like carrying the children around and things but it's different, it's not that repetitive movement all the time, but I've never had to take any sickness absence because of work-related injury." [4/177-180]

Each participant was asked to talk about their personal fitness during their interview because this was recognised in the literature review as being one of the fundamental preventative measures against WRMSD amongst sonographers. A range of responses were provided and most of the IPs (n= 7) suggested they take part in some form of exercise, or physical activity, outside of work. Although responses were generally quite broad and ranged from no exercise at all, to quite an extensive exercise regime, the majority were able to discuss the potential benefit in doing so.

"Generally, I do a lot of gardening and DIY I would suppose and walk the dog, that's my main" [2/12]

P: "I do running but I don't think the running really helps with coping with my, [implied WRMSD, although not stated] because the injury doesn't go away, you just learn to cope with it and to live with it and I find ways to make it less acute, painful. I do go to a lot of massage. There's different types of massage that's been helpful. So shiatsu is quite good and that's been useful and then I've been to Alexander Technique over the years for sort of weeks on end to try and help me to align my posture and help me with lifting, you know, when you get up

and pick up things from the floor, how you're supposed to put your head in a certain position and your body. So that's been helpful. I go to Pilates and Yoga to try and make sure I'm fit so I'm less prone to

I: Have you found it helped then? [Interrupts Participant]

P: It has. The only time you realise is when you don't go to these things and then you find that life's harder and you sort of struggle with position postures that you have to get into to scan". [3/17-24]

P: "I always do some type of gym work, running, rowing, over the years something constant at a reasonable level or lower level".

I: "Do you feel that has an impact on your ability to do your job?"

P: "I do actually". [5/12-14]

The term 'actually' presented an element of potential surprise on the IP5's part that this type of training would in fact be beneficial to being a sonographer.

IP6 demonstrated the specific exercise to the researcher during the interview. The fact she laughed during the demonstration at the time was an element of making the situation more light-hearted, perhaps as a diverging tactic from the seriousness of the subject matter.

I: "Do you do any exercises or anything to help you strengthen your muscles for your job? Are you aware of any exercise routines?"

P: Yeah, we'll quite often stand with the arm up on the wall like this [demonstrates exercise]. [laughs] Have you seen this one? It's brilliant, and you just lean against the wall

I: And stretch your arm up. So where did you find out about that one?

P: One of our girls does Yoga. She's left now but she did that and this one, just doing the windmill with your arms.

I: Almost like backstroke swimming type exercise?

P: Yeah". [6/107-114]

IP6 remained 'upbeat' throughout her interview, there was a lot of laughter. A lot of her responses showed a forward-thinking mentality, almost taking everything in her stride. This at-

titude was reflected in her use of innovation, for example she had clearly researched the issues surrounding WRMSD and her answers were presented with interest, humour, and a passion for ideas. IP6 also demonstrated enthusiasm for living a healthy lifestyle, which perhaps suggests why she has personally not experienced any significant WRMSD:

“Yeah, I do cycling and swimming, canoeing”. [6/8]

IP6 was interviewed in the ultrasound scan room where she was performing her daily ultrasound lists. To set the context, the interview was conducted following an earlier student clinical assessment, during which the researcher had observed a real time clinical ultrasound list. Performing the interview, following this session, seemed to change the dynamics somewhat, perhaps in a positive way for this study, because the IP wanted to share her thoughts. Later in this section further quotations from this participant will be presented which demonstrate shared understanding of the role with the researcher.

Several responses also acknowledged much less passion for physical activity and sport, when asked what types of fitness activities they perform.

“Mainly just walking, no other sports, just walking”. [7/9-10]

IP4, again, showed a potential lack of enthusiasm for exercise and fitness:

I: “OK. Are you aware of any injury prevention exercises that you could do?”

P: Yeah, we have posters in some of the ultrasound rooms with the stretches. I have to say I admit it's not something that I do routinely. I tend to do them if I've got a bit of pain.

Pain was clearly a motivation for some IPs to consider their health and fitness, and to protect themselves from worsening WRMSD and only as a remedial strategy.

Other IPs talked of more novel techniques such as the Alexander Technique (AT), such as IP8.

“Erm [sigh]It's been an interesting one actually because I've heard a lot of people saying that it's [Alexander Technique] almost this miraculous cure for things but I suppose because I've had my injury for years for me it's been more about a better awareness of what I'm doing and

thinking about things before I do it...And I think when you're in pain you tend to be more thoughtful and aware of what you're doing. So I found it useful generally but I've not [] it's not sort of made my wrist and shoulder feel any better particularly but I think I'm more aware of..." [8/15-23]

Similarly, IP3 also talked of their own perceived benefits of AT.

[in relation to whether Alexander technique has helped alleviate symptoms of WRMSD] "It has. The only time you realise is when you don't go to these things and then you find that life's harder and you sort of struggle with position postures that you have to get into to scan" [3/26-27]

Most IPs (n=5) relied upon some form of incentive to inspire, or provoke, them to complete preventative measures (such as exercises) to reduce their likelihood of acquiring WRMSD. Completing muscle strengthening exercises, which may help to reduce the incidence of WRMSD amongst sonographers, takes time and effort in what is already considered to be a heavy clinical workload by the IPs. This highlights a potentially dangerous scenario, for many sonographers across the UK, if the findings of this study are deemed as pertinent in a wider professional context. Furthermore, this underpins a potentially unhealthy rationale for some IPs in this study in terms of taking time to maintain their physical fitness.

The findings correlated with other studies which focused on sonographers and WRMSD. For instance, in the study by Bolton and Cox (2015), the participating sonographers generally did not appear to receive active encouragement to engage in routine muscle strengthening exercises. Likewise, they seemed to overlook the ergonomic considerations related to their computer workstations, a significant aspect of a sonographer's duties, particularly with the prevalence of PACS systems in most NHS hospitals. Additionally, the study highlighted that these sonographers did not tend to prioritise their own personal health and well-being, stress management, the risks of WRMSD in the context of ultrasound, and the general task management associated with their role (Bolton & Cox, 2015).

The findings of this study were similar and there seemed to be very little personal motivation from the IPs to engage in tackling the personal impact of WRMSD. It is sometimes difficult to gauge whether there was overarching apathy or simple disengagement with the potential impacts of the phenomenon. In addition to the difficulty of finding time, some IPs found it challenging to maintain their own physical health. Most acknowledged little to no exercise due to lack of time, potentially resulting in greater risk of acquiring WRMSD. One participant acknowledged the challenges of maintaining a consistent exercise routine when the interviewer attempted to question further to establish why the IP does not do muscle strengthening exercises.

I: "What do you think the reason is people don't do them? What are your own personal reasons for not doing them?"

P: "Time and effort and thinking about it really." [4/116-118]

In contrast IP3 commented, with regards to attending Pilates and Yoga classes,

"The only time you realise [the benefit] is when you don't go to these things and then you find that life's harder and you sort of struggle with position postures that you have to get into to scan". [3/26-27]

Both IPs offered a slightly different perspective, but both implicitly suggested the benefits of exercise on overall health and wellbeing. There was also implicit suggestion that both do not always maintain the optimum postures for scanning. This further evidenced the researcher's viewpoint that much more research is needed around sonographers and WRMSD, not only for plausible solutions and suitable prevention programmes to be designed and implemented, but to understand sonographer engagement in such programmes and establish what motivates sonographers to change. Recently the Health and Care Professions Council (HCPC) brought in self-care as one of their standards of proficiency.

"To be able to care for your service users, you must take care of yourself"

Consequently, those sonographers who are also regulated under one of the HCPC registrable professions must ensure they comply with this requirement which may help to encourage awareness of WRMSD.

Reflexive Point

At the time of data collection, the HCPC codes of practice had not been updated and as such the relevant IPs could not have been accused of non-compliance with professional codes of practice. I did consider whether such changes in the standards may have influenced the responses had the data been collected after these were implemented.

IP9 discussed fear of potential ridicule for taking time out during the working day to carry out WRMSD prevention exercises:

“I think again it comes back to benefit and also I’d like to bring in here the Alexander Technique cos that helped me when I first trapped my nerve in my neck and nobody would tell me exactly what was happening. Every time I went to scan something went worse, I either dropped the probe or started with cramps so every time I went back to my job to try it again something went worse, and the Alexander Technique is something that I think people could do at lunchtime. Sometimes, in some departments, you’ll see empty rooms at lunchtime, and I think if it was more widely known the benefits of just lying down and bringing your knees up and so that you weren’t laughed at” [9/252-259]

The fear of ridicule from colleagues is of interest, and a new concept to the researcher personally. This was only brought up by one, IP9, from the sample, but on reflection perhaps this was an issue for more IPs, and maybe other excuses were given instead, such as time. It would seem however that whatever the reason for not employing potential WRMSD prevention strategies this issue transcends the sample of participants. It does not appear to be a case of not being aware of the strategies existing, rather not wanting to do them, except

when symptoms of WRMSD emerge, which fundamentally is using the strategies as a 'cure' to alleviate symptoms rather than a method of prevention.

I: Do you have those posters in your department that give you some exercises?

P: Yes.

I: Do people do them?

P: No, not that I've noticed'. [9/227-230]

Furthermore, IP4 was also quite fast in acknowledging she did not do any form of exercise, stating:

"No, I've got young children so I don't have time for anything" [4/88].

Using her family as the reason for not doing any form of exercise could perhaps have been explored in more detail here. It would have been interesting to have pursued the exact reasoning for why 'young children' prevented her from partaking in any form of physical fitness activity. Although aware of the potential benefits of muscle strengthening exercises IP4 explained why she did not tend to complete the exercises.

"Time and effort and thinking about it really... There's just so many other things to do. I mean, if I haven't got, like if you talk about doing it actually in works time cos I wouldn't really think about doing it when I was at home but there's always something else to do, like looking at your e-mails or vetting requests or there's always, if you're not actually scanning somebody there's something else to do, sorting roll out for the room or, you know, whatever". [4/90-95]

IP4 showed a generalised doubting that any established strategies could actually prevent WRMSD; she almost demonstrates a resigned acceptance to the phenomenon being an accepted part of the job of being a sonographer. Muscle strengthening exercises have been advocated for the past 15 years or so amongst sonographers as being an important aspect of WRMSD prevention (Bolton & Cox, 2015; Morton & Delf 2008; Sommerich *et al.*, 2019). However, this did not appear to be an area that was currently taught to, or carried out by, the IPs, despite all (n=9) acknowledging an awareness of such exercises. Some IPs (n=4) admitted to

performing muscle strengthening exercises regularly, and even then, only as a consequential action following experiencing pain or discomfort. There is clearly some debate on the benefits of the exercises and the importance of sonographers incorporating these exercises into their working day routine, however no research was found to prove that sonographers who regularly perform muscle strengthening exercises are less at risk of acquiring a WRMSD, than those who do not. The sonographers who took part in this study suggested that they have posters in their department, that demonstrate how to perform several different muscle strengthening exercises, which is a strong suggestion that this type of information is being shared with sonographers. Several IPs said in relation to performing muscle strengthening exercises:

“The posters have improved lately, with an actual person [demonstrating the exercises in a photograph], rather than line drawings... [making them easier to follow] ...but it’s getting the time to actually look at it”. [7/45-47]

This is an area where repeated suggestions were made on planning and scheduling a compulsory time when sonographers must undertake their exercises which was suggested as being potentially beneficial. The participant below highlighted this well, suggesting:

“you feel so much better that you’ve done them [exercises] but it’s keeping it up”. [4/35-35]

Maintaining behaviours is clearly one of the major problems in combating WRMSD and perhaps if departments could establish a routine that sonographers were able to stick to, where they built “exercise time” into the working day improvements may take place. This feeling of being restricted by the scheduling and pressures of the workload appears to be a phenomenal strain on the sonographer participants in this study. This is a potential area where further research could take place to establish whether sonographers who perform regular muscle strengthening exercises are perceived to acquire fewer injuries or physical pain or muscular complaints than those who do not. Overall, exercises and maintaining muscle strength were considered by some of the IPs but overall, more research is required to understand where

changes in behaviour are required. Furthermore, more evidence-based strategies are still needed to underpin the worth of such interventions.

The findings in this sub-section led the researcher to consider how the IPs located most of their 'preventative' behaviours outside of the work environment. In short, 'work equals damage, leisure equals prevention'. Any attribution to WRMSD came from work-related activity, and not anything else. Finally, another aspect which was of interest to the researcher was how the participants often seemed to constitute themselves as 'outliers' when doing exercise; in short, through their descriptions they implied that the wider 'profession' is not exactly fitness-oriented and thereby 'vulnerable' to WRMSD, but not necessarily including themselves in this belief.

4.8 Summary

This chapter has evaluated superordinate theme one, through a critical narrative, and has considered the key contextual concerns of sonographers through five subordinate themes in turn, which encompass superordinate theme one. A summary of ST1 will be provided below.

Firstly, this chapter has highlighted the breadth of IP perspectives of WRMSD in terms of reinforcing the range of terminology used to identify the phenomenon (WRMSD), how it impacts up on the individual and the nuances that surround such perspectives. Secondly, it has explored how some of the IPs demonstrated resistance to being labelled as having a WRMSD (despite acknowledging symptoms). Thirdly, IP participants' vulnerability has been explored in terms of how gender, power, strength, and resilience are perceived by the IPs. Furthermore, this theme encompassed the differences in experience that were derived from the participant responses. Fourthly, sickness, pain, and the nuanced impact this appeared to have on IP career and lifestyle were explored. Finally, the IPs' overall health and fitness was

considered including how this impacted their lifestyle overall and in terms of how they control these impacts to avoid the phenomenon of WRMSD.

The IPs often tended to build the experience of WRMSD from a more mechanical attribution, through an interpersonal stage and finally into a cultural one (i.e., medical-social-structural).

The latter, of course, provides a nice segue into the next chapter which will explore superordinate theme two, which focuses on the IPs' cultural, professional, and environmental perspectives of WRMSD.

5 Findings and Discussion: Superordinate Theme Two, WRMSD and the Cultural, Professional and Environmental Perspectives of Sonographers

This chapter will evaluate the second superordinate theme, WRMSD and the Cultural, Professional and Environmental Perspectives of Sonographers.

5.1 Introduction

‘WRMSD and the Cultural, Professional and Environmental Perspectives of Sonographers’ have emerged from the data analysis as the second superordinate theme and, although the theme appears within all the interviews, this theme has presented itself in slightly different ways from each interview participant (IP). To understand WRMSD in ultrasound practice it is also important to understand what it means to be a sonographer, from a cultural, professional, and environmental perspective. The previous chapter formed the setting for what the IPs were experiencing; this chapter will explore the IPs experiences further by looking at the range of subordinate themes, which were attributed to superordinate theme ‘Cultural, Professional and Environmental Perspectives of Sonographers’, with respect to each IP as outlined in Table 17:

Superordinate Theme Two	Subordinate themes from which Superordinate Theme Two was developed
WRMSDs and the Cultural, Professional and Environmental Perspectives of Sonographers	Sonographer Culture 'it's what we do' Professional 'this is our job' 'The Best Images' 'The Best Diagnosis' Professional Codes? Exasperation, Faceless Attribution and Anxiety Workaround 'Cutting legitimate Corners' Workload, Pressure and Stress Physical Environmental Impact on Sonographers (and experiences)

Table 17 Subordinate Themes Relating to Superordinate Theme Two, 'WRMSDs and the Cultural, Professional and Environmental Perspectives of Sonographers'

5.2 Sonographer Culture: 'it's what we do'

Sonographer culture emerged as a key subordinate theme within this second superordinate theme. Firstly, it would seem prudent to refer to Chapter 1 of this thesis, which captured the emergence of sonography as a clinical specialism or 'profession'. It is widely accepted that professional control over a specific field of work develops as minimum professional standards or competencies are developed for that area (Mitchell and Nightingale, 2019). Although still not officially a recognised 'profession', sonography has developed as a niche area of practice with sonographers utilising their own established training routes to develop specialised knowledge and skills, often drawing on skills from their own primary profession such as radiography, nursing, midwifery, or other allied health professional background (Gibbs, 2011, Gibbs and Hobbs, 2009). Mitchell and Nightingale (2019) explored how sonographers' knowledge and expertise (which others lack) may be utilised to harness power and control,

to maintain professional power, potentially creating a culture where resistance to change thrives. They went on to evaluate how the current demand for sonographers' skills and expertise in the current UK healthcare setting has potentially created a position of economic, political, and professional power. This has consequently led to the emergence of a group of professionals who are embedded in a particular work culture, which is focused on the practices handed down to them from the colleagues who trained them, making changing such cultures difficult (Mitchell and Nightingale 2019).

In this study, the IPs implicitly alluded to the presence of such a culture in their interview responses; a couple of examples are given below:

"All I felt like I was doing for my last, well probably a couple of years in the NHS, was just going to work, scanning as many patients as we could fit in in a day and going home at the end of it and there was nothing in between to sort of help to build the team up or support the team, there's just nothing there any more really". [1/158-161]

"it was about stopping and thinking rather than just doing and we're all on that kind of treadmill where we just do things automatically and we're not aware of it" [8/31-32]

The quotations above are two examples where the IPs suggested they felt captured in their own role, acknowledging little insight in terms of how they may break the cycle and escape from that work culture. The term 'treadmill' was of particular interest, and this was interpreted as an ongoing cycle the IP perceived they could not deviate from. It provided a context to start to underpin why the individuals may not place WRMSD prevention at the forefront.

"I didn't like management's attitude towards ultrasound and the waiting times. They were very waiting times driven so it didn't matter if we were going to breach we would be told on Thursday, 'we've got 30 patients, we're going to breach, who's working Saturday?', and someone would have to come in and do them. It wasn't, 'ok let it breach', highlighting the problem that there's not enough staff, it would be, 'no, we just don't breach, just work harder' erm to the point where one of the lists we used to do was 16 general scans every 15 minutes in a row which was just ridiculous". [7/62-68]

“Yeah, the workload has gone up a lot and management do seem to be in utter fear of breaching waiting times. In my old job we had 1 woman go off with breast cancer, 1 woman would go off because her father was dying and there were no concessions to the workload or the waiting time. It was expected that we would maintain the same level of input patient-wise which didn’t cause animosity amongst the sonographers but there was the question why we should be doing extra because people were off sick and it’s not their fault they’re off but why do we have to work longer and harder for the same amount of money to make up for them cos there’s no extra capacity, so if 1 person goes off there’s no back up plan, no management back up plan, they won’t get agency in, we still have to do the same volume of work load”. [7/113-122]

It would also seem evident, from the data, that most sonographers originally entered their vocation to help others, namely patients.

“Well I think the bottom line is people are here because of their vocation. That’s the bottom line. You don’t want to not help people”. [5/194-195]

There are two perspectives within the quotation above. The phrase ‘their vocation’ is attributed to the overall professional role. It is about the desire to help others. This was also reinforced with the phrase ‘you don’t want to not help people’. The researcher has interpreted this to imply that the IP saw themselves as potentially ‘not’ helping patients if they were to prioritise WRMSD prevention.

The IPs all tended to try to see matters from a patient perspective, who was prioritised above themselves in all cases.

“Because the patient, yeah, you see obviously the clinical implications and you think if you were that patient” [4/197-198]

“You feel you’re giving a little bit more to the patients’ experience” [7/290]

Consequently, it would seem, from the implicit nature of the role, what is missing within sonographer culture is a full appreciation from sonographers of the need to protect themselves

from WRMSD. It is not a priority for sonographers who have either not experienced symptoms of WRMSD, or who have only experienced mild symptoms that quickly resolve.

Despite a broad awareness of the issues surrounding WRMSD, an unconscious desire to follow or conform to the established culture which is being seen to be a good sonographer, is evident from the IP responses. A potential reason for this, from the findings of this study, is that sonographers become embedded in their own work culture (McGinnis, Guenther & Wainwright, 2016) and consequently may not always fully appreciate or indeed be aware what is happening to themselves, both physically and mentally, until they get symptoms of WRMSD.

This sense of being captured by their role is highlighted here:

"I think we need a different perspective on it [WRMSD]. You can get blind to certain things when you're actually in the role yourself and you can't possibly look beyond that'. That's it, why are you doing that and why are you doing that, and how come there's so many of those, and you just say, 'well that's what we do''. [5/225-228]

The IPs did not always fully articulate, in their responses, precisely what they are experiencing both physically and mentally during their working day, in terms of WRMSD. IP5 alluded to being questioned about the rationale for aspects of their role and attributed the questions to 'well that's what we do'. This would suggest a generalised acceptance of the present cultural norms with no desire to change, which potentially impacts on themselves and WRMSD.

The cumulative nature of WRMSD was discussed in the literature review and this has led the researcher to consider whether the gradual chronic nature of the phenomenon means that a sonographer's ability to cope with pain and discomfort slowly evolves during their daily work over a long period of time. This leads one to consider the distinct differences, when having analysed the data, between the unsaid and the unknown.

The presence of a 'sonographer culture', and given the IP responses above, would suggest to some extent sonographers are conforming³ to their role and their professional culture without question. From the evidence presented, patients are disadvantaged because of sonographer shortages, from staff sickness absence (including from WRMSD) (Gibbs and Young, 2009, Gibbs and Edwards, 2012). Worryingly, the IPs did not foreground this in their responses, suggesting they may not be considering the 'bigger picture' in terms of how culture and practices need to change to protect themselves, from WRMSD, which in the longer term may have a significant impact upon patients.

The present situation in ultrasound, based on the literature and on the findings from the interview data analysis, has been interpreted as reflecting a culture of potentially dangerous pain acceptance on the part of sonographers. This concept has previously been observed within the field of sports psychology (Weinberg, Vernau & Horn, 2013), although in the context of the participants involved in this study, it is most probably driven by altruistic motives rather than egotistical ones. While the latter is more conspicuous in sport, the former appears to be more probable in the field of sonography.

An example is provided below where one of the IPs tried to explain this sense of pressure, based fundamentally on altruism:

"Because the patient, yeah, you see obviously the clinical implications and you think if you were that patient you wouldn't want to be waiting for a scan and I guess not being perceived to be awkward to the clinician or you're not causing or thinking "I'll say no" and then somebody else will say "Yeah", so that sort of pressure". [4/190-200]

³ Further detail on conformism can be found in Shepherd and Stephens (2010), Bendassolli (2017) Lönnqvist (2009) and Pelton (2002).

“Increasing demand, increasing pressure, everybody wants it now, they’re target driven. So we can have peaks and troughs now, you know, we can have stress where everybody is running round because there’s a lot of patients breaching”. [2/100-102]

Resonance was found in terms of cultures of institutionalisation and conformism from other professional fields including Shepherd and Stephens (2010), Bendassolli (2017), Lönnqvist (2009) and Pelton (2002) who noted a strong tendency of healthcare workers to prioritise patients above themselves. It is therefore difficult to criticise sonographers for their actions, which are increasing their own risk of WRMSD; they are motivated by ‘doing good’ and ‘putting the patient first’. This has been a mainstay in many health care professional roles and such feelings are conversant with wider professional fields (Shepherd and Stephens 2010; Bendassolli 2017; Lönnqvist 2009; Pelton 2002). There are several nuanced strands to sonographer culture, which include professional pride (in terms of patient care, the technicalities of the role, professional expectations, and requirements) as well as other pressures and requirements which appear to potentially inhibit sonographers from considering the implications of WRMSD.

5.2.1 Professional Pride - ‘this is our job’!

The next subordinate theme which emerged was ‘professional pride - ‘this is our job,’ which was a significant aspect of sonographers’ culture. Demonstrated in the IP responses is pride and protectionism of their professional role, which has consequently been interpreted as one of the reasons why the IPs talked of putting the patient first, above protecting themselves from the associated risks of WRMSD.

The following quotation illustrated the sense of professional pride, which IP6 felt about their role:

“Yeah because in true sonographer style, you still try your hardest to get decent images so all you do is push harder and obviously you’re putting more pressure on your shoulder”. [6/80-82]

When questioned further, regarding the phrase “true sonographer style” IP6 explained the context.

“I just think that we all have pride in our work and that we don’t like to be defeated. This is our job so a radiologist will always say, ‘go for a CT, go for MR’, but we don’t have that to fall back on. This is our job, scanning”. [6/83-87]

When compared to the established WRMSD prevention strategies, the IPs seemed to prioritise what they perceived to be the fundamental elements of their job, performing the scan, making the diagnosis, looking after the patient. This would suggest sonographers in general may fear what they perceive as professional failure, which is inferred through the IP interviews. Achieving the “best results” from the scan, the “best images”, the “best diagnosis”, seemed to be paramount for the participants, even when there were legitimate technical challenges present which posed genuine limitations to ultrasound as an imaging modality. Consequently, although referring the patient to an alternative imaging modality, where ultrasound was not proving effective in answering the clinical question, is accepted practice, the participants saw this to some extent as personal failure. The desire to be seen as a good sonographer would seem to significantly outweigh the need to consider the real risk of acquiring WRMSD. It is accepted in medical imaging, that different imaging modalities are better suited to imaging certain anatomical areas, and indeed answering certain clinical questions. Some examples from the interviews were presented, which highlighted these feelings, attributed to a sense of ‘failure’ from some participants when they acknowledged being unable to acquire certain clinical detail, which they considered should have been achievable from a particular examination. This seemed to be an issue particularly when the IPs discussed the challenges of scanning patients with a high body mass index (BMI).

High BMI is one of the factors which affects the quality of the image in ultrasound imaging, although attempts to assuage the impact of this often requires more physical exertion on the sonographer's part, potentially increasing their associated risk of WRMSD (Bolton and Cox, 2015, Waring, *et al.*, 2018).

"You feel you've got to really strive to get the best images that you can. Although you're qualifying that in your report, 'image is degraded', but you still try your hardest, put more pressure on than you should do. [6/89-91]"

Again, a sense of altruism was seen here. An upshot of this was to recurrently "take one for the team" and work through excessive pain, even when this would likely result in greater prospective physical damage (Bolton, Booth, and Miller, 2018).

The next subordinate theme will explore the IPs' determination to produce the 'best images' above considering WRMSD prevention.

5.2.2 'The best Images'

One of the key cultural issues surrounding the sonographers, reported by the IPs who took part in this study, was the fixation on obtaining the best quality imaging in their role. The interviews demonstrated a sense of dilemma amongst the IP's and in one sense the 'best imaging' is seen to take precedence above WRMSD prevention as well as personal health and well-being of each sonographer. Some examples from the interviews below outline the IPs perspectives of their individual position as a sonographer and WRMSD prevention.

"Well as a sonographer you have to produce best image at the diagnostic route and then you try and do your best but I think I feel recently that you have to look after yourself and you have to sort of say, "Well I've done my best and that's it", you know, and not carry on, and you have to have a limit on the time". [3/104-107]"

"Yeah, they need to understand the limitations of ultrasound. I know there are articles out there about it but I think they still think we are miracle workers sometimes. If in doubt, send them for a scan". [7/406-408]"

Similarities were found in the field of social work, where it was seen that there was a ‘common-sense ideology’ to act for the needs of others (Weinberg, 2014)⁴.

5.2.3 ‘The Best Diagnosis’

Not only was the ‘best imaging’ seen as significant, but this also crucially needed to lead to ‘best diagnoses’. The IPs seemed culturally bound to deliver on providing an accurate diagnosis for the patient, and the referrer:

“I mean, I’m small, and if you’re scanning big patients and you have to put pressure and obviously you have to go round the abdomen to look at the left side and if you do patients on trolley beds and that has an effect on it [getting the best diagnosis] as well. [3/200-202]”

The quotation above demonstrated some culturally embedded professional reasons as to why some of the IPs may strive to achieve the best imaging and the best diagnosis, and indeed why this is ranked professionally more important to the IPs than their own health and safety, in relation to WRMSD. Clearly, the patient, the imaging and the diagnosis are seen as fundamental to the role which is also embedded in many of the professional codes of conduct, which those sonographers who are registered under another professional field, such as radiographers, are duty bound to adhere to. The work of Mitchell and Nightingale (2019) further supported this concept and suggested that professional culture, in sonography, is often resistant to change because it is built on tradition. Furthermore, they went on to say that sonographers maintain power and control through a complex clinical competence matrix, which fuels professional pride and protectionism.

⁴ To improve the narrative flow, this will be explored further in Chapter 6 of this thesis, as there are links with Ideological Dilemmas here.

There is evidence to suggest that sonographers adhere to cultural norms, which have already been foregrounded in this study, and one of those norms is putting the patient at the fore front of everything they do in their role. When asked about the challenges faced in preventing WRMSD, some examples from the interviews are provided below:

“I think it [WRMSD] is a major issue. I think it’s difficult because like I say in a lot of the cases we are squeezing patients into slots where we shouldn’t really be doing it but the emphasis is on the individual at that point in time to scan that patient or not or whether you want to, whether you’re prepared to put your foot to that person who is asking for that scan or you know that that’s really going to change the clinical management of that patient, you’re not going to say ‘no’”. [5/55-59]

“I think it’s tricky because you can say this scan requires 20 minutes, this scan requires whatever but it is always going to be down to that individual sonographer who has somebody knocking on their door saying, “This patient really needs a scan or they can’t come back for whatever reason” whether it’s a clinical reason why they need the scan that day or whether it’s a convenience reason, you’re always going to have that, so I don’t really see how you get round that”. [4/217-222]

“I think so. I just think it’s the awkward positions you get in and it’s not only that, it’s the constant pressure you need to put on things like arteries and veins, you can’t take the pressure off. Don’t get me wrong, some abdos are difficult as you know, but you tend not get a row of those, you’d be unlucky, but you can definitely get a run of difficult vascular cases, and sometimes the beds”. [5/246-250]

The issues, illustrated within the above quotations, are concerning because they may eventually lead to more cumulative WRMSD problems, as well as further challenges for sonographers to face within their roles (Bolton and Cox, 2015; Gibbs and Edwards, 2011). There seems to be a cycle, which has been highlighted in the diagram below [Figure 27].

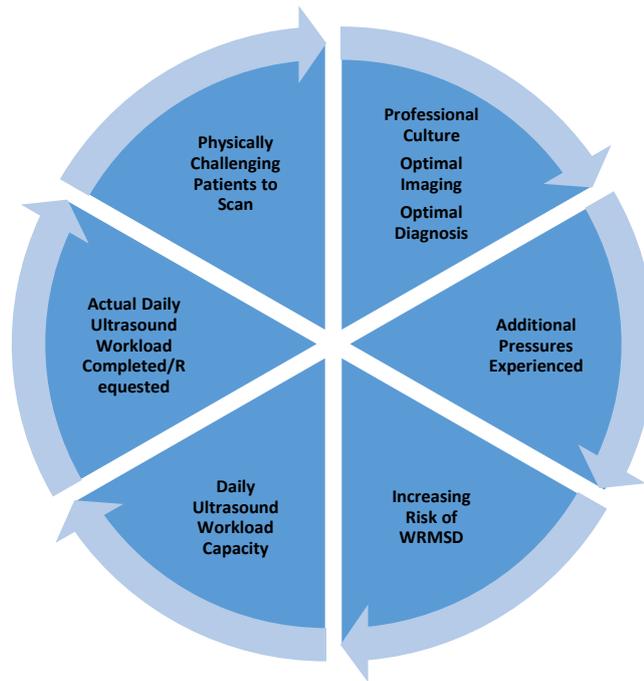


Figure 18 Diagrammatical Representation of how Sonographer Culture and the Challenges of the Role Inter-relate

The cycle above demonstrates increases in the levels of pressure felt by the IPs, which could further impact on their ability to consider WRMSD, and measures to reduce the risk, alongside other relevant tasks within their role.

The next section will explore the pressures faced by the IPs further, particularly in terms of how this pressure has impacted upon their lived experiences of WRMSD. It will also explore how experiencing feelings of exasperation, faceless attribution and anxiety is significant in terms of WRMSD and how this has emerged as a further subordinate theme, linked to sonographer culture.

5.3 Exasperation, Faceless Attribution and Anxiety

As a professional group, there was a generalised theme running through the interviews (n=9), faceless attribution, almost 'shouting at the heavens'. This section also speaks more to

experiencing feelings of exasperation. The participants needed to blame someone, but they either did not know who to blame, or simply would not name them even in an interview where the data will be redacted of proper names. What did emerge was the elusive 'they' are to blame, suggesting that the IPs did not have the power or the control to challenge the phenomenon. This resulted in a strong feeling from the IPs (n=5) that there remains a lack of management support locally for themselves, and from 'the profession' as a whole, particularly in terms of WRMSD prevention. 'They' were primarily seen to be imposing the pressure on the sonographers.

"cos I choose to maintain my hour's lunch sometimes they'll book me something in my lunch so it'll mean that unexpectedly I don't get that". [4/33-34]

"All day Saturday at the moment and then they want someone to cover Sunday in-patients as well". [6/56-57]

"Increasing demand, increasing pressure, everybody wants it now, they're target driven. So we can have peaks and troughs now, you know, we can have stress where everybody is running round because there's a lot of patients breaching". [2/100-102]

There was a perception of cascading levels of stress, a pervasive theme from the IPs, potentially arising because of pressure from managers, cascading down to the IPs, as sonographers, in terms of targets and workload contribution, and distribution. These findings are pertaining to similar examples given in Mawson, Miller, and Booth, (2021), and Waring et al., (2018). This theme was important here, as it emphasised the impact of other people's stress (as second-hand problems). Further exploration is required around power relationships and workplace pressure and specifically in terms of how this relates to sonographer lived experience, in future studies. Many of the participants made mention of the pronoun 'they' but it was never actually articulated exactly who 'they' were. The researcher interpreted 'they' as being 'the establishment', 'the NHS', 'the radiology managers', 'the government', an umbrella term relating to numerous groups or individuals, but not themselves (the IPs). It was

used as an attribution to the phenomenon, without any actual premise to substantiate this. The researcher has understood the term 'they' to be a collective pronoun related to those who the IPs felt were affecting the status-quo.

The participants did not always seem to be looking at the entire picture, including the political climate, in terms of why their own lived experience of their role was as it was. The IPs seemed to see their overall situation as one which was imposed upon them from someone in a perceived higher authority. Many of the IPs also seemed to allude to 'they' as being in a position of power over them, and one which can miraculously 'solve' the dilemma of WRMSD. The participants did not consider themselves as part of the cause, or indeed the solution, to the phenomenon that is WRMSD. The IPs instead were embedded in their own working culture, their individual ultrasound rooms, often spending many hours a day just with the patients and perhaps a support worker, often only seeing fellow sonographers during their lunch time or break periods. The encapsulation of the true isolation felt by sonographers, the way in which ultrasound services are managed, lends itself to the development of these feelings, potentially exasperating sonographers' feelings of isolation and therefore opening opportunities of vulnerability, in turn creating 'a perfect storm' for WRMSD to develop more frequently, as one participant phrased it. Furthermore, the phenomenon seemed to be expected to get worse for those with existing work-related conditions (Waring et al., 2018; Mawson, Miller and Booth, 2021).

"I think it's no one thing, it's no way one thing, it's definitely a combination of factors and if those factors come together, it's a 'perfect storm', particular time it will impact on someone. For example, you get a small person doing a very heavy list on very heavy people or awkward people, or not even loads of people, you might get two or three in a row". [5/240-243]

'The perfect storm' suggested changes needed to be made across established sonographer culture. One might also consider whether this is, from the IPs' experience, purely a manage-

ment issue, or a fully embedded culture within sonographers that needs to be better understood. Although beyond the scope of this study, challenges exist in terms of initiating potential changes of established behaviours among sonographers and there are several studies including Nieuwenhuijsen *et al* (2004) who acknowledged that changing behaviours is a difficult process and advocated further research in this area.

Sevens and Reeves (2019) found that most sonographers, in their study on professional protectionism, detached themselves from the notion of taking sonography forward and instead had, what they perceived as, a 'laissez-faire' attitude. This attitude similarly reflected findings from this study with IPs looking for others, not themselves, to solve the issues surrounding WRMSD. Several participants discussed a lack of control in relation to WRMSD avoidance and personal feelings of helplessness in terms of the phenomenon being imposed up on them. The participants implied a 'top down' approach, where a metaphorical 'they' are imposing the issues of WRMSD onto sonographers, which ultimately meant that the sonographers who took part in this study did not feel a personal sense of control when managing their own workload, and consequently their perspective of WRMSD was affected. Some examples are provided below which demonstrated this.

IP8 articulated the situation well:

"I think as a profession we probably need to be thinking more about looking after each other and looking after ourselves". [8/374-375]

Overall, the IPs showed some awareness of the need to take some control over the issues related to WRMSD, although there remained very much a cultural tendency to expect someone else to sort out the issue. This is a significant point, because without some collective action, the challenges of WRMSD cannot be overcome successfully.

5.4 Workaround

The term 'workaround' originates from the information technology (IT) field, although it has become more commonplace in the healthcare setting in the last decade, given the complexities and peculiarities of several roles in this field (Halbeslaben, 2010). The types of work in the healthcare setting are hugely heterogeneous and range from highly structured and safe practices to irregular, demanding, sporadic and potentially harmful activity (Mansour and Tremblay, 2018). Wheeler *et al.* (2012), discussed the emergence of workaround activity and attributed this to the complexity of roles and culture within the healthcare setting. Furthermore, they went on to suggest that "employees develop inconsistent and idiosyncratic work patterns which they believe increase their performance and patient safety" (p.547). Debono *et al.* (2013) suggested there are four reasons that provoke workaround behaviours, factors which they perceived to compromise patient care, factors which are not in the best interest of the patient, factors which make their job more difficult, or longer, to perform and factors which threaten professional relationships.

There are some conflicting views on the concept of workaround, for example, such activities can be seen to speed up processes and make them seem more efficient, allowing professionals to navigate complex rules or processes (Berlinger, 2016). For example, in this study, IP5 talked of the pressures of workload and the desire to not let patients down which consequently led to them not having the time to consider WRMSD prevention strategies.

"Yeah, and you tend to work round a lot of the in-patients and vascular patients particularly vascular cos you have to work round them rather than getting yourself in that perfect position [to avoid WRMSD] otherwise you wouldn't be able to do the scan". [5/254-256]

As a result of workaround, a further subordinate theme emerged surrounding the sense that sonographers may 'cut legitimate corners' in their roles, which may increase their risk of WRMSD, but not affect the patient.

5.4.1 Cutting Legitimate Corners

This sub-section will explore how the IPs discussed ‘cutting legitimate corners’ as part of the concept of workaround activity, which is another potential risk of WRMSD embedded in sonographer culture.

Workaround activity is one of the risks and practices ‘essentially cutting legitimate corners’ (but only in relation to WRMSD prevention for the sonographer, and not in any way compromising the quality of the examination). The concept of ‘workaround’ has therefore potentially developed in the world of sonographers. Workaround has already been considered in other healthcare fields; for example, Halbesleben (2010) examined “workaround” as a predictor of occupational injury amongst the nursing profession. He suggested that employees adopt unsafe, “speed-up” strategies that allow them to complete their task more quickly to achieve their “goal” or an end in their work/task, or to finish more quickly. In doing this, any safer practices that may benefit the employee, may often be ignored completely. Sonographers, therefore, may be putting themselves at increased risk of WRMSD by adopting a poor work style including missing rest breaks, working in pain, and rushing ahead without considering safe body postures all to complete tasks in a timely fashion (van den Heuvel *et al.*, 2007). Some examples are provided from the participant interviews below, who were asked about implementing WRMSD prevention strategies:

“Sometimes I do [consider WRMSD prevention when scanning patients]. If I’ve got a day where it’s nice and relaxed and I’m on top of the list, I’ll stop and think, and one strategy I use, which I find successful, whether it’s a proper strategy or not, is I like to stand up on certain types of scans. I think that’s really helpful”. [5/129-131]

“and so then you’ve got the backlog and then you’ve got the pressure that comes off that and you’re still trying to teach, so I think getting them seated comfortably and patient positioning, you actually don’t have time for it”. [6/295-297]

[When asked about WRMSD prevention strategies] “So the workload of obstetrics has gone up and then additionally to that is the expectation that because the clinics are on at a set time we have to scan all those patients in the clinic times, so they end up getting squeezed in” [4/68-70]

From the interviews, the IPs suggested that as workload and pressure increased, fatigue or exhaustion set in, and consequently they started to adopt “riskier”, or “workaround”, behaviours, which meant they are more likely to cause personal injury to themselves. This is also embedded in sonographer culture in section 5.2.

'Time' is also an essential feature of all working cultures; it is the 'root of being busy' (i.e., 'time is full') (Aldrich and Aldrich, 2017) and it is therefore seen as a significant factor for the IPs in this study. WRMSD would appear to be given the lowest level of priority compared to performance of the scan and patient care, and throughput.

“I think, yes, there does need to be some variety like there is in vascular where if you got 2 complex legs you were given a lot more time etc, than 2 varicose veins on somebody who had not had surgery before and it’s got to work like that. Erm er [I think gynaecological examinations these days, in order to get an accurate examination, the majority of us will do a TV scan which adds time to the examination and so I think the days of an abdomen and pelvis being fit in a 15 minute slot should be well gone really”. [9/204-209]

“You regularly worked through the afternoon break because a patient would be found that needed a [scan]” [7/53-54]

“I think you’ll find in every department there’s some sonographers just naturally get stressed a lot easier than other sonographers. Some sonographers have a very laid-back attitude towards it, they just get on with their lists, whatever is chucked at them they’ll just chug right through it, other sonographers, the more that’s thrown at them the more stressed they get. My last job did have quite an ageing [sonographer] population, I would say”. [7/378-382]

“We try and move around, if you will, so that nobody is – for the purpose of booking we have set rooms, so because we have booking teams now who book the workload, it’s easier for them to book a list of 20 fetal anatomies, a list of dates and growth, so what we try and do is rotate the staff round so they spend half a day in each so that you’re not doing the high impact stuff over and over again”. [2/51-55]

“I think the general team base has been too small because we haven’t had capacity to backfill sickness and absence or holidays or anything like that, and I think that’s an issue everywhere that once you’ve got the sonographer in there scanning there isn’t any sonographer that’s walking round that’s not really doing anything. So therefore, unlike radiography you don’t have somebody to pull from another department to backfill what you’ve got, and by the time you’ve got those short-term issues, you’ve got all these patients and it’s what you do with them, isn’t it?” [2/181-188]

A number of studies, from wider fields, highlighted links between time pressures, leading to ‘cutting corners’ and productivity losses, e.g., Ruppner *et al.* (2018).

5.5 WRMSD, Workload Pressures and Stress

From the interviews, all (n=9) IPs referred to various ways in which they perceived a certain degree of ‘pressure’, related to their own interpretation, and lived experiences, of their role. Furthermore, they explained how this has impacted on them personally and as a sonographer and in terms of their experiences or perception of WRMSD.

5.5.1 The Pressure ‘is just ridiculous’.

Throughout the interviews several adjectives and metaphorical expressions were used to define the pressures of the IPs’ role. The perception of pressure, and how it potentially impacted on the IPs, in terms of WRMSD, varied across the sample. Examples are provided below.

“I do think the stress levels have risen. I think over the last 10 years they’ve shot through the roof if I’m being honest because everything’s been changed: the targets and the pressures we’ve been put under have changed the working environment from when I trained”. [5/58-62]

“Partly targets cos there’s the breach waiting list target to get – I don’t know how much it costs but it must be a huge amount if they’re breaching, they find money for agency staff, they find money to pay staff overtime, so it must be a lot. I think it’s massive the waiting time targets and the increase in complaints”. [6/65-68]

“Not generally, just – I suppose it depends day-to-day really. You can have a stressful day. Other things can affect it like obviously if appointments haven’t been booked properly, that’s quite frustrating”. [4/27-29]

“Time management and being given enough support to manage it, to cope with the workload because the workload can be quite heavy with vascular and you have loads of wards and they can be chairs, trolleys and you have nobody to turn to”. [3/39-41]

“The workload has increased, it’s more like a conveyor belt, you’re having to rush through. Also, the population has increased in size, there’s a lot more obesity and that has an effect in all areas of obstetrics”. [3/99-101]

However, most IP’s (n=7), owing to the general feeling of “pressures of workload”, attributed prioritising getting through their scan list, and consequently adopting suboptimal postures and scan techniques, which they suggested places them at increased risk of acquiring a WRMSD, which is also highlighted in previous studies (Bolton & Cox, 2015; Morton & Delf 2008; Evans *et al.*, 2010). Perceived levels of stress, caused by the sense of pressure within their roles, were again attributed to the acquisition of WRMSD by some IPs (n=6). The perception of exhuming pressure on individuals has also been reported to result in individuals prioritising, and therefore dealing with matters they perceive at that moment to be the most important.

“I do think the stress levels have risen. I think over the last 10 years they’ve shot through the roof if I’m being honest because everything’s been changed: the targets and the pressures we’ve been put under have changed the working environment from when I trained. And the situation we’ve got as well, the build of the department and how it’s laid out, we’re isolated from the main radiology department”. [2/201-205]

Levels of stress within a role is conversant with emerging themes in wider studies and the causative factors affiliated with the acquisition of WRMSD (Mawson, Miller, and Booth, 2021). The perception of increased stress and pressure on individuals tends to lead employees to prioritise what they perceive to be the most important, critical aspect of their role,

which is generally 'getting the work done' (Debono, *et al.*, 2013). Montgomery *et al.* (2019) explained how stressors within healthcare professionals' roles lead to burnout. Interestingly, they suggest often, this may not lead to a reduction in job performance, rather 'performance protection' measures instead, which are initiated and perceived to be high priority tasks which are then preserved. For sonographers, priority is given to ensuring the scan is performed, and reported upon, to a high standard and finally the referrer gets the appropriate answer to their clinical question for the examination requested.

"I do think the stress levels have risen. I think over the last 10 years they've shot through the roof if I'm being honest because everything's been changed: the targets and the pressures we've been put under have changed the working environment from when I trained". [2/34-36]

Provided professional expectations were being met, the IPs tended to be satisfied they had effectively carried out the required duties of their role. Consequently, WRMSD was interpreted as being a 'low priority' issue and was subsequently either forgotten or ignored. Theoretically, the IPs attributed few professional consequences to ignoring WRMSD prevention strategies in terms of the 'here and now'. There was a sense that no-one would ever check if they carried out the scan in a manner deemed to be safe for themselves in terms of WRMSD prevention, and as a result there would be no immediate consequence.

"Yes definitely [] I think you can relate it back to any time that you're stressed. For example, when you're in the car and you're a little bit stressed, you tend to be more tense overall, so I think it is, and I think the other side of that is the length of time that you have to perform a scan now. Again, it used to be quite standard to have 20-30 minutes for any scan but that has, in some places, halved, even less now. So again, yes definitely stress would to me has an impact". [1/45-50]

"Yes, I'm sure that would aggravate it but I think because if you are stressed already I'm sure that has a detrimental effect" [3/195-196]

"[W]e don't tend to have time to all sit together and get rid of the stress so it just sort of builds up. All I felt like I was doing for my last, well probably a couple of years in the NHS, was

just going to work, scanning as many patients as we could fit in in a day and going home at the end of it and there was nothing in between to sort of help to build the team up or support the team, there's just nothing there any more really". [1/157-161]

Furthermore, without investment in addressing the sonographer shortage at national level, sonographers will continue to struggle to meet service needs and demands because of staffing shortages whilst continuing to experience the feelings of physical and mental stress and anxiety which is thought to be fuelling their experience of, or risk of acquiring, a WRMSD.

Stress is just one aspect of sonographer culture, and to better understand the concept of stress in the role, and how this is attributed to causation of WRMSD, the physical environmental perspectives also need to be considered.

5.6 Physical Environmental Impact on Sonographers and WRMSD

This sub-section will explore the environmental impacts on sonographers and WRMSD. Consideration also needs to be given to the impact of the relevant environmental factors on sonographers and WRMSD.

The physical environment was one of the key causes which sonographers have attributed to acquiring WRMSD.

"There have been a couple of sonographers within my team who have suffered shoulder and wrist injuries and have had to be seen by physios and wear the strapping on their wrists. What I try and teach them is not to actually push patients' tissue but lift it up and scan underneath it and get them to hold it up". [2/110-113]

"I think you have to decide what contributes to it. I think there is different areas of it. I think there are bits that might be just general ageing and there's nothing to say that it might not be an age-related skeletal problem. It may also be a fitness side of it. Are the people fit to do the job that they're doing cos it is quite a physical job, isn't it really?" [2/267-270]

"[with vascular ultrasound] you have to put a lot of pressure on with your arm adducted and it's tiny, tiny movements over a longer period of time, so I think with abdominal you're kind of more gravity dependent but with vascular you do, you're putting pressure upwards, so you're getting the pressure going back up to the neck and shoulder...You're on the floor, you're on

your knees, your patient is on the steps, patients will quite often faint as well or albeit poorer quality of patient ...” [6/124-133].

“Well, we do try and monitor workload I think a bit more, but you’re always still put under pressure with extras coming in, aren’t you, that are urgent”. [2/162-163]

“I mean I remember when I first started if somebody went off on maternity leave you would have somebody brought in for however many weeks they were off as a maternity cover. You don’t tend to cover for people being off on maternity leave, you see there’s a shortage of sonographers which is a national disaster at the moment unfortunately so not only are you having issues with people going off on long-term sick, because of the extra stresses associated with the job, people going off on maternity leave and there’s no cover for this obviously, and on top of that you have retirements that haven’t been planned for, so overall yes staffing issues are a big problem”. [1/138-146]

The quotations above highlighted a range of physical factors about the job which the IPs attributed to causing WRMSD. Furthermore, to maintain high standards in their clinical roles, the IPs tended to acknowledge a degree of neglect toward themselves, which they attributed to physical environmental impacts, when scanning patients, prioritising the quality of the scan, and often discounting any potential risks of WRMSD. Consequently, any WRMSD avoidance strategies may be being ignored completely, highlighting a barrier for WRMSD avoidance. One IP acknowledged this.

“I probably don’t pay enough attention [to WRMSD prevention] as I should do, especially in busy periods, which I probably think is an issue for a lot of sonographers.” [5/21-22]

Another IP also suggested when asked why they feel sonographers do not do more to protect themselves from WRMSD:

“It’s a combination of things I feel [challenges of preventing WRMSD]. You don’t have to necessarily be busy; it can be a difficult patient but also you’ve got issues with porters bringing patients down at certain times so you might have what looks like a reasonable number but that compresses the short time” [5/39-41]

Such occurrences may lead the sonographer to rush through a larger number of patients over a shorter period of time, owing to organisational, and physical environmental, issues beyond the sonographer's personal control. As a consequence of this, WRMSD prevention strategies may be overlooked; priority is instead given to getting the scan completed satisfactorily.

The next sub-section will explore specifically how equipment design was felt by the IPs to affect the physical environment in which they worked and consequently how this was seen to contribute to WRMSD.

5.6.1 Poor equipment design

Equipment design was discussed by all IPs (n=9) in terms of its attribution to WRMSD. There were mixed perspectives from the IPs, although discussions were raised regarding whether ultrasound systems remain adequate in terms of ergonomic design.

"it's definitely more ergonomically designed but I also feel that that's never to me really been the issue. The issue has been people using the design and I think that they provided an ergonomically designed kit book. In quite a lot of places the staff don't know how to get the best of it and again with the time pressures, I don't think people have given themselves time to get themselves comfortable ... at all" [1/76-80]

"Ergonomic-wise I don't think it's too bad". [4/54]

"I still don't think manufacturers have hit the right target with that because some of the TVs don't move easily, do they? They go up and down and they don't pull round, don't move never quite where you want them. So I still think manufacturers could do quite a bit more. We have rise and fall beds, tilt and turn". [2/86-91]

"I think that it would be quite useful actually having input because you can point the areas that you know are having problems and that would be useful. You could have lighter equipment, lighter probes, smaller [transducer] heads and things like that, all those sorts of things, yeah". [3/93-05]

“[W]e had a training day for the Alexander Technique across the group. I got all the sonographers in on a Saturday for a full day and she went back to the skeleton and how we sit and how we stand and she did a relaxation exercise in the gym and then she came to our work areas and sat with each sonographer and showed them how to sit and she recommended that we get more saddle seats cos we had 2 but not everybody used them, but I think now they’ve been trained or they’ve seen how it can work, people are more keen to get on the saddle seats”. [2/123-129]

It was difficult to evaluate the IPs’ experiences of equipment in this type of study and this highlighted an opportunity for further study in the future.

5.7 Summary

This chapter has evaluated superordinate theme two, through a critical narrative, and has considered the key experiences of sonographers through five subordinate themes in turn, which encompass superordinate theme two (ST2). A summary of ST2 will be provided below.

Firstly, this chapter has explored how the IPs experienced the cultural perspectives of their role, and how this has directly impacted on their experiences of WRMSD. The professional culture spoke to a generalised ‘pride in their professional role’ which overshadowed everything else, in particular, considerations regarding WRMSD. Secondly, it considered the IPs’ sense of exasperation, faceless attribution and anxiety related to WRMSD and the challenges faced in carrying out their role. Thirdly, this chapter looked at the concept of ‘workaround’ and how this featured as a significant justification, from the IPs’ experiences to avoid WRMSD prevention strategies and ignore the phenomenon completely, at their own risk.

Fourthly, it evaluated the professional and environmental experiences of the IPs and WRMSDs, particularly in terms of how workload and stress made their role evermore challenging. Finally, this chapter has considered the physical environment, and its impact on the IPs. This chapter concluded by outlining how this was experienced by the IPs in terms of its attribution to WRMSD.

Consequently, there are significant ethical, and dilemmatic, considerations for sonographers to make, which will be explored further in the next chapter, which will evaluate the ideological dilemmas faced by sonographers in the context of WRMSD.

6 Findings and Discussion: Superordinate Theme Three: Ideological Dilemmas

The previous chapter has explored WRMSD from the cultural, professional, and environmental perspectives of sonographers. Superordinate Theme 3 (ST3) describes a set of tendencies that are very well illuminated by the concept of Ideological Dilemmas, which is why the theory starts in this chapter, and not in the earlier findings and discussion Chapters 4 or 5. This chapter aims to capture the progressive and developing nature of the role of the sonographer in relation to the phenomenon, WRMSD, in terms of the dilemmas faced by the IPs within their practice. It will also explore the complex nuances that exist surrounding these dilemmas, as experienced by the IPs. This chapter will also recognise the participant experiences as being potentially unstable and fluid. See Table 18, section 6.2, for the related subordinate themes and the prevalence of these across the interview participants.

Firstly, this chapter will provide a contextual account of what ideological dilemmas are, by identifying the key features related to this concept, underpinned by examples from pertinent healthcare related studies to demonstrate how this superordinate theme has emerged, and most importantly how it has developed 'roots' within the healthcare setting. The second part of this chapter will explore how ST3, related specifically to the IP interview findings.

6.1 Ideological Dilemmas (A Contextual Account)

The concept of the term dilemma is a complex and multifaceted one. It has origins in social pre-conditions, based on moral reasoning and decision making, emerging from common-sense ideology. IDs therefore include aspects of socially shared beliefs, which drive forward individuals' inherent dilemmatic and contradictory thinking (Seu, 2016). 'Ideological dilemmas' differ from the more commonly used notion of 'ethical dilemmas,' used in social work and other healthcare settings, and Billig *et al.* (1988) have offered Ideological dilemmas as an alternative concept, which operate as 'taken-for-granted notions' in society and are the pre-

conditions of individual thought. By exploring an ideological dilemma, the social co-construction of one aspect of a worker's identity as an 'ethical' individual will also be discussed. The ideological dilemmas investigated, for this study, are that of subordination of the self, versus self-care, a common theme transcending this study.

One of the key concepts that social scientists ask, regarding health beliefs, is not necessarily about an individual's concerns or feelings of the 'moment' but rather the more generalised concerns to do with peoples' general health, because it is these ideas which shape an individual's experiences of a particular illness (Radley and Billig, 1996). Furthermore, they go on to discuss how individuals construct their state of health over time, and when offering views on the matter, they are making claims about themselves as either 'more' or 'less' 'fit' in specific activities of their lived world (Radley and Billig, 1996).

Billig *et al.*'s (1988) notion of Ideological dilemmas, placed the individual as "richly embedded in social contexts, and engaged in 'internal and external' 'argumentative debate' about how to be or how to act" (p. 19). The sense of the term 'dilemma' has been developed by Billig *et al.* (1988) further than the basic concept of an individual's choice between two or more difficult options. The use of the concept of an ideological dilemma points to a greater interest in the 'moral and ideological complexities' of a dilemma (p. 12), and in the social preconditions which set the stage for dilemmas to exist. According to Billig *et al.* (1988), dilemmas occur through 'common-sense notions of value, community and suitable ways of behaving that are socially and culturally imbedded and that are often conflicting and contradictory' (p.28). Billig *et al.* (1988), however, moved further than the notion of a dilemma as being individually or socially situated to one that is deeply imbedded in the relevant culture through the expression of language. Often the dilemma can be represented by proverbs or 'well known maxims' (Billig *et al.*, 1988, p. 14). For example, if a socially constructed group were to discuss an element of risk taking, they may conclude their discussion with the well-known

maxim 'nothing ventured, nothing gained'. As can be seen with these examples, the dilemmas rest upon 'socially shared images' of each dilemmatic choice (Billig *et al.*, 1988, p. 14).

This would suggest a dilemmatic tension may exist between values within a professional community and 'popular voice, and respect for forms of rationality', that are understood to be 'contingent precisely upon an individual's capacity to extricate themselves from the psychological constraints of local community influence' (Billig *et al.*, 1988, p.96). According to Billig *et al.*, (1988), no one 'maxim has the monopoly of common sense' (p. 16) but rather the maxims 'collide in a way which on occasions necessitates difficult decisions' (p. 16). The ways in which maxims come into conflict with each other depend on the social context in which they occur, meaning the dilemmas faced may be different from individual to individual (even within the same professional context).

Similarly, ideological dilemmas therefore exist in relation to individual perspectives of health and illness. For studies exploring experiences of a given illness, which may focus on certain patient groups, on the surface it may seem to be a clear-cut response of 'health' or 'ill', whereas these are far more nuanced. Healthy individuals may have much to say about their experiences of illness whereas 'the sick' often want to show elements of 'normality' (Radley and Billig, 1996). Ideological dilemmas become significantly apparent where issues of health and illness are directly connected with places or situations of employment, and earning money (Radley and Billig, 1996).

There are also nuanced differences between the concept of 'ethical dilemma' and 'ideological dilemma' in that the former tends to relate to two or more perspectives, or actions, which may be in direct conflict, usually with positive or negative consequences, where both options can be defended as being 'viable or appropriate'. Ideological dilemmas, on the other hand, differ in that they tend to arise as 'common sense' within a particular group or com-

munity and may not generally appear as immediately contradictory of one another (Weinberg, 2014). Some of these principles may be challenged by individuals themselves, but they tend to be present within the wider professional field as well; they tend to be almost 'taken for granted notions' for that group.

The next sub-section will explore how the concept of ideological dilemmas emerged from the interview data, in this study specifically, and this will be explored through a critical narrative as a holistic view of the research findings.

6.2 Ideological Dilemmas as an Interpretive and Holistic View of the Research Findings

In this sub-section the emergent, subordinate themes will be discussed through a critical narrative in relation to literature. This section aims to provide a holistic and interpretive take on the findings overall in terms of ideological dilemmas which have emerged as the third superordinate theme which seems to embody most of the emergent and subordinate themes discussed in the previous chapter.

The relevant subordinate themes are illustrated in Table 18:

Superordinate Theme Three	Subordinate themes from which Superordinate Theme Three was developed
'Ideological Dilemmas', Sonographers and WRMSD	Practical Necessities of Scanning versus WRMSD Prevention techniques Acknowledging versus Denying WRMSD Increasing Workloads versus Physical and Emotional Pressure from the Job Personal Needs of Sonographers versus Perceived Imposed Pressures Awareness of the Need to Change versus Compulsion to Carry On Practical In-situ Judgement versus Experiential Ethical Judgement Increasing Workload versus Decreasing Resource

Table 18 Subordinate Themes Relating to Superordinate Theme Three, WRMSD and Ideological Dilemmas

The concept of ideological dilemmas has drawn interest from the researcher. From the interviews, one of the significant challenges in tackling the issues related to WRMSD is sonographers feeling torn between two or more emotions whilst carrying out their role (Radley & Billig, 1996). The key ideological tensions evident in the findings pertained to those between individuality and collectivity, and freedom and necessity. Evidence indicated that the participants often freely chose to work while injured, despite being aware of the prospective personal costs. In doing so, they underscored their own agency as professionals, and their own commitment to a broader altruistic model that reinforced their identities as good healthcare professionals.

Each subordinate theme will now be explored further. This exploration will encompass an assessment of the theme, supported by selected verbatim quotations from the interview data.

This approach aims to illustrate the connections between the findings and the themes that

emerged during the data analysis. Moreover, it will also investigate how these connections align with the pertinent literature.

6.3 Practical Necessities of Scanning versus WRMSD Prevention Techniques

The practicalities of scanning would seem to be placed above WRMSD prevention techniques in the daily role of sonographers. The level of importance sonographers place upon their professional performance, demonstrated through how they perform each scan, is given precedence above protecting themselves from WRMSD.

“I think the knowledge out there is getting more prevalent but it’s probably not as high up as it should be. It could be increased a bit more. Erm Yeah, I just don’t think, it’s not that I don’t think it’s important enough, I think people think there are more important things to worry about”. [7/356-359]

“Yeah, and you tend to work round a lot of the in-patients and vascular patients particularly vascular cos you have to work round them rather than getting yourself in that perfect position otherwise you wouldn’t be able to do the scan. I think it’s important that education is improved and increased and up to the training as a proper part of training, but I think that will have limited success because unless you alter the intensity of the list and the type of population, you’re not going to be able to address it fully. You are going to help it but you’re not gonna address it. It’s never gonna work unless you can get some way of...”. [5/254-272]

From the interview data, emerging evidence has suggested that the participants felt torn between two or more emotions whilst carrying out their role. In the quotation below, the participant may be aware of the risks of ‘pushing’ harder on the patient during a scan, they may be aware of the increased WRMSD risk and struggling with the pressure to perform the scan to a high standard and achieve the images they required, alongside the pressure on their body from having to struggle to press too hard (Radley & Billig, 1996).

“Yeah, I think the problem is with students, they get so focussed on [the job], they just get engrossed in what they’re doing. It’s either concentrating on what they’re looking at or what the machine’s doing or talking to the patient and then eventually trying to do all those together”. [8/202-204]

“Oh, I think definitely the twisting and squeezing, you know, from augmenting the leg and also, yes, definitely. Erm I think like the nuchal translucency I’ve spent my time looking at iliac arteries and maybe iliac veins for DVT and you get some really solid people and obviously as people are getting bigger and bigger as we know, it gets harder and harder”. [9/143-144]

“[S]omebody mentioned to me very, very recently and made me think hard is that I like [removed for anonymity] machines and I’ve worked a lot with [removed for anonymity] machines and they’ve all had sliding keyboards which slide out and the only way you can operate them is to have them nearly, well they’re on your lap, it’s the only way you can operate really, and without thinking about it the angle of your neck to look down at the keyboard, you can’t glance down at a keyboard that is actually literally on your knee, your eyes and your neck in order to see what you’re doing have got to be in a funny position and so that’s one thing that I’ve been thinking about recently as to maybe something that”. [9/160-168]

Targeting strategies for implementing ergonomic interventions is perhaps what is seen as the ‘obvious’ when attempting to assuage the impact of WRMSD, however gaining the acceptance from employees toward new ways of working would appear to be more challenging. To tackle these issues, detailed observation is needed to fully appreciate the nuanced dilemmas faced by employees to understand how they might be torn between several considerations to appreciate why employees may not always follow guidance provided for limiting the associated risks of WRMSD (Haslam, 2002). Furthermore, Haslam (2002) evaluated the challenges faced in bringing about favourable ergonomic changes and concluded that the actions of individuals are generally shaped by their knowledge, abilities, habits, and desires. Consequently, to break down the barriers caused by the ideological dilemmas experienced by the IPs in this study, a willingness to adopt new strategies of working is needed. This may include sonographers developing new methods of performing some ultrasound examinations, and advances and further developments in training (particularly regarding behavioural change) to develop a more reformed sonographer work culture.

“They [Occupational Health] just had a general broad base of knowledge of how to prevent injuries at work but not specific to ultrasound and they should maybe have a link person with ultrasound who understands how we scan, how we have to scan and if I hear once more

someone say when you have a big patient, 'well just don't push'. It's like, well yes that's great but then you don't get the diagnosis. Well, you don't." [7/164-168]

This IP seemed to show a sense of frustration, given the dilemma they faced. Their frustration was evident where they said *'if I hear once more'* which was interpreted as having been given an unachievable suggestion for a strategy for avoiding WRMSD, which in turn made achieving the required imaging impossible. There was a sense they felt there was no reasonable solution to the dilemma.

Reflexive Point

Through the reflexive process I acknowledge that knowing whether or not the IPs were indeed feeling a 'sense of frustration' is open to question and perhaps a missed opportunity at the time of interviewing for not having explored this perspective further. However, I was able to revisit the audio recording of the interview during the analytical process to better appreciate meaning, and this led me to draw a conclusion from that to inform my interpretation.

The ideological dilemmas superordinate theme, which has emerged from the findings of this study, had a rather different stance. Rather than attempting to only judge participant opinion according to its informational content, the ideological dilemmas approach focused instead on the study of sonographers' functional practices, through the lens of the IPs. This was achieved by exploring the ways in which ordinary sonographers, the IPs, reasoned about the concept of WRMSD in practice, how this reasoning transcended throughout their professional roles, and how it affected overall processes in everyday life by drawing upon general ideological resources presented.

6.4 Acknowledging versus Denying WRMSD (being ill versus not being ill)

The fundamental challenge sonographers face is juggling the multifaceted experiences they share of their professional role, which generally includes putting the patient first, against protecting themselves, and their colleagues, from WRMSD. The ideological dilemmas outlined henceforth all generally act as a barrier for sonographers in terms of prioritising the prevention of WRMSD.

“I really don’t know for definite I mean [] When you look at the research there are so many who have an injury. If you’re talking 89-92% who have had an injury, I know there’s bias in all the articles because it’s often people who have had an injury that respond, and even the article that said we found lots of people who don’t have injuries, when you look at it actually there are quite a few of those did have an injury but then they found a way to overcome that, and I know quite a lot of people who have had an injury at some point, realised it was work-related injury, did something about it and then it’s gone”. [8/313-319]

The concept of even acknowledging whether the IPs considered themselves to *have* a WRMSD was a significant dilemma. It was noteworthy, and already considered, that those with an existing WRMSD are more likely to take part in any research regarding the phenomenon. The next quotations highlighted the invisible nature of the phenomenon, and the fact sonographers may feel afraid to ‘admit’ to having symptoms through fear of not being believed. This relates to Radley and Billig (1996)’s concept of how individuals relate to health and illness in terms of how others see health and illness and the nuanced perspectives which emerged, especially when related to positions of employment (income).

“Yes, I think you’ve still got some who just think it’s in people’s heads in the same way that some doctors think it’s in people’s heads in the same way that some people think dyslexia is not a real thing. I do think there’s a problem with individual perceptions, but there’s also the issue that you can’t see injuries sometimes. If you’ve no swelling and no redness [] there’s nothing visible, and I must admit I did at one point think I was going mad [] cos there were no signs”. [8/330-340]

“I mean in hindsight I definitely do know it was work at the time because at the weekend it went away. I’d go back in on Monday, it got worse again and gradually worse by the end of

the week. I think it's those kinds of things that people are more aware of now hopefully. In terms of general education, I think it's that proactive approach for somebody taking a lead, monitoring the sickness, looking at risk assessment, doing the peer review and having that one person responsible for the department and pushing things forward. And also, not pushing cos so many students come in and we say, 'don't push, don't push. If you've got a big patient and you can't change your equipment settings, you know if you change your equipment settings and you still can't get a good view, don't push', and they're coming back to us and saying, 'my supervisor says I don't push enough'". [8/341-352]

This issue can be further illuminated by Foucault's (1980) discussion of the relationship between sovereign power and a single truth; one might argue that resisting this interpretation of 'intellectual' will allow the emergence of alternative ways of constituting ideologies and the impact of them on people's actions. Certain dominant ideologies may, for example, influence a person's social practices in ways that are not comfortable for a person who holds intellectually (that is in their own reasoning and internal debate) an alternative possibility for practice within this dominant ideology. Alternatively, an individual may hold an intellectual ideology (which may or may not be informed by academic debates) which is not reflected in their social practices, and which is influenced by alternative ideologies or knowledge. The enacting of these intellectualised alternative possibilities for social practice, however, may be limited by certain mechanisms of power: surveillance or discursive institutional practices, common sense, and community ways of being. Furthermore, as Foucault (1980) noted in his later work on power, these mechanisms of power are how sovereign power maintains its influence without the use of violence.

"The injuries are related to my neck. They weren't sure but I've had nerve conduction tests and er muscle tests and they feel there's still some damage in my neck. So I've had a disk spacer put in, one level and they feel that the level below probably is erm impinging as well. So, I've not at the moment been back to the GP, this is where I am at the moment. I can't imagine because my quality of life is quite good at the moment that anybody is going to be in any rush to go back and perhaps offer another level at the moment. There's always the risk of if you put a level in it impacts on the level further down, but then I did have the hand cramps

before the surgery so again whether if I did have the surgery that would cure them, I don't know. I don't think I'm going to find anybody to tell me if that will happen". [9/62-70]

While there is an ideology of subordination of the self, it is also common sense that, within the healthcare environment, practitioners must look after themselves and not do so much that they cannot function effectively. But what remains unknown is when is 'doing a bit more' considered to be 'ethical' behaviour and when is it 'too much', leading to a point of not practicing 'self-care' to oneself? Billig *et al.* (1988) argued that the distinction between civic and technical issues is not clear-cut, but rather involves a 'dilemma of equality and authority', involving a degree of dispute over which decisions should be treated as a matter for public opinion, and which resemble the technical issues requiring specialist qualification to do the job, in this case as a sonographer. In this context, the dilemma is better defended from the perspective Radley and Billig's (1996) article on the background of potential criticisms from others (be it managers, colleagues, patients) for acknowledging illness, leading to an unwillingness on the part of the 'ill' to acknowledge the phenomenon itself (WRMSD).

6.5 Coping with Increasing Workload versus Physical and Emotional Pressures from the Job

Increasing workload has already been seen in the previous two findings and discussion chapters, from the IPs' perspective, as a significant cause of WRMSD. Coping with the increasing demands of workload versus the physical and emotional demands of the job has emerged across the participant interviews (n=9) as an ideological dilemma. Furthermore, there seemed to be dilemmas that have presented themselves, particularly in terms of the IPs' experiences of WRMSD, as a phenomenon.

P: Yeah, and we're looking at more intricate areas and more sort of – but we're still given the same time to scan it in so there's a lot and obviously population characteristics is obviously patient size is definitely a factor that has increased and

I: Have you noticed that?

P: I've noticed that definitely yeah.

I: Has it had an effect on your practice?

P: It does affect your practice because I think it makes you more sort of aware of the limitations of ultrasound and I think with experience and with confidence as you become more confident and experienced in ultrasound, I think you are more likely to accept the patients that you are not going to get a good or do a good scan on and I think when you're

I: So, you mean you know when to draw the line.

P: Yeah, and I think that comes with experience. I think of that as more of an issue with the younger sonographers who aren't perhaps at the stage where they know when enough is enough with a patient. [1/92-105]

This was interpreted that the IP was torn between tackling the levels of increasing workload versus the challenges of making decisions related to the physical and emotional demands of the job, such as knowing where to draw the line in terms of performing the 'best scan', one of the known causes of WRMSD. Learning how to tackle the nuanced decisions such as knowing when to 'draw the line' and stop persevering with trying to obtain better images on a challenging patient, potentially leading to WRMSD, is a significant issue for sonographers, given this theme emerged across all IPs in this study.

In sonography, one of the common-place parts of the role is to act for the benefit of others and to put the needs of patients ahead of one's own needs. A profession involves certain expectations of behaviour and conduct and ethics (Parker, 1999, p.175). Sonographers are given autonomy, professional pride, and remuneration in exchange for providing what is seen as a good service to their patients, while setting aside their own interests and needs. Whereas there are those who would critique professionalisation as in fact a self-interested process enhancing the benefits of its members, at times to the detriment of their clients (Flynn, 2002, Margolin, 1997), there are others who argue that altruism is an essential ingredient in the very definition of being a professional (Cruess *et al.*, 2004). This subordination of

the self in professional relationships is held as a moral responsibility, underlined in codes of ethics for many professional roles.

Another IP commented further in terms of this dilemma, outlining the struggle sonographers potentially face, which highlighted a feeling of 'having no choice' given the nature of the role:

"It's just in the nature of the job and the people who do it. But I think the more education they get the more they might just stop and think, and in terms of where you might just fly through it and get on with it, you might stop and think you're gonna get some where there's no choice and you have to get the patient done, but in the other scenario where you're just getting busy, you just forget, that will be less likely if you're trained properly, so that it's still worth doing that". [5/265-272]

And furthermore, from the sense of having multiple things to consider, when performing the ultrasound examination, another ideological dilemma emerged in this IP quotation:

"Augmenting the calf muscle so you're not twisting, trying to augment to work the controls, balance the probe and try and do it all at once, that's a big help. It is an older population and the patients can be sometimes quite decrepit and difficult to get up onto the table so it is much easier, before you've even started the scan you're not out of breath trying to get the patient into the chair. Scan-wise there's not a lot for general really I don't think they can do. I think GPs and our midwives could perhaps approach the subject with the patients and just give them a more realistic view that if they are overweight" [7/193-199]

The quotations above demonstrated the sense of dilemma felt by the IPs, whereby the two metaphorical and physical positions cannot easily be reconciled. The range of complexity in performing various aspects of the role from the individual sonographer who would be aware of the need to look after themselves (by maintaining safe WRMSD prevention strategies), versus the sonographer who is altruistic and wishes to 'go the extra mile' for the patient, irrespective of their own condition or the challenges faced in performing the scan. This sense of dilemma was also evidenced in the field of social work (e.g., Weinberg, 2014).

6.6 Personal Needs of Sonographers versus Perceived Imposed Pressures

Ideological dilemmas also presented themselves in the contact of the IPs' personal needs against the perceived imposed pressures they alluded to experiencing in carrying out their professional duties. Although the dilemma itself was not directly attributed as being the cause of WRMSD, the underpinning challenges potentially lead to practices which increase a sonographer's risk of acquiring WRMSD.

"You don't have the ergonomic equipment and the other thing is you haven't got the support - you're actually in quite a stressful situation so that aggravates it because you've got to get your patients registered on the system and got to do the scan and then you've got to report on it so you do virtually 3 people's job and plus you have to take the portable across and the portable, if that's not ergonomic at all, it means you having to go outside and it can pull you in different directions so you can kind of get injured quite easily with back aches and things like that, so that is quite an issue". [3/56-62]

"It's a tricky one really. The ergonomics of the machinery, obviously that's sort of been addressed over the years, it is better the probes and the wires are lighter and the machines are more manoeuvrable but I think it's tricky because you can say this scan requires 20 minutes, this scan requires whatever but it is always going to be down to that individual sonographer who has somebody knocking on their door saying, "This patient really needs a scan or they can't come back for whatever reason" whether it's a clinical reason why they need the scan that day or whether it's a convenience reason, you're always going to have that, so I don't really see how you get round that". [4/215-222]

"I think that supportive management is a massive issue and if you don't have support from your managers [] it was kind of dismissed when I had my injury and I know that was at the time but it did make me feel [] like I'd no support and nowhere to turn to but then nobody really believed me and I wouldn't mind if I was the kind of person that was always taking sick leave but I hadn't had a day off sick [] in years, so for me it was that almost 'you're a nuisance', and I think that's what other people, in talking to other people are a little bit nervous about reporting it because they think they'll let their colleagues down and I think as a profession we probably need to be thinking more about looking after each other and looking after ourselves". [8/367-375]

Weinberg (2014) discussed the term 'consciousness of identity' whereby employees may show a clear awareness of the many factors which may influence, or are indeed affected by,

their role, but they may struggle to separate themselves entirely from their job. The IPs seemed to struggle in terms of defending their needs as an individual against the perceived imposed pressures of being a sonographer.

There are also subtle differences between the concept of 'ethical dilemma' and 'ideological dilemma' in that the former tends to relate to two or more perspectives, or actions, which may be in direct conflict, usually with positive or negative consequences, where both options can be defended as being 'viable or appropriate'. Ideological dilemmas, on the other hand, differ in that they tend to arise as 'common sense' within a particular group or community and may not generally appear as immediately contradictory of one another (Weinberg,

Reflexive Point

I was initially struck by the complexity of the concept of dilemmas and the nuanced differences between ethical and ideological dilemmas. This provoked lengthy conversations with my supervisory team. This made the selection of verbatim quotations challenging as I wanted to do justice to my IPs and tell the story of their experiences in relation to WRMSD. The notion of 'taken for granted' resonated well with me and the peculiarities of being a sonographer. I could understand the IPs perspectives in this.

2014). Some of these principles may be challenged by individuals themselves, but they tend to be present within the wider professional field as well; they tend to be almost 'taken for granted notions' for that group.

6.7 Awareness of the need to Change Practices versus Compulsion to carry on

There seemed to be a general awareness that the IPs acknowledged they needed to play a part in changing their working practices to reduce their likelihood of acquiring a WRMSD,

however they appeared to be struck by a sense of dilemma between knowing they need to change and being compelled to carry on regardless of the known risk.

“I think it’s a lack of knowledge and it’s a lack of – it’s [sigh] almost like they want to get the day done, and they just want to get through it. You know, you’ve got your patient on the bed and to get the patient in the optimum position, knowing the optimum position would just take that extra two minutes and even though it sounds quite extreme, I just think sometimes they just can’t even spare that extra two minutes. So I think it’s not just education, I think there’s other things that affect it as well”. [1/211-217]

“Well, we have got an exercise sheet on the wall in each room. I don’t think people use it, no, unless – personally myself unless I’ve got pain and then you think, “Oh I should really be doing those exercises”, and then you give it a go, but if everything’s OK you’re so rushed you just carry on, you don’t do it” [6/112-115]

The IP (below) alluded to the dilemma he faced in a previous role. He alluded to his awareness of the benefits to changing practices, including managing his stress. There are implied nuances in terms of the subtle links between feelings of stress, alongside being compelled to continue through the workload presented. As a result of the pressures, this IP changed jobs, which resulted in a perception of less pressure, which resulted in him reflecting on the benefits of that on his wellbeing.

“Erm [] I think actually there are different aspects of stress. I think it really affects your posture and the more stressed you are, for some reason, personally the tighter I grip the probe sometimes you don’t realise that your shoulders are hunched and you just very, very tensed erm and then that’s just going to add to your problems. But more times than not in this job I am noticeably more relaxed, I can feel it in my shoulders [] cos there isn’t that pressure. You’re not waiting for that e-mail to come through saying there’s 30 people about to breach, someone has to do it erm. Yeah, it is more relaxed and you do get your protected breaks”. [7/280-287]

Just as dilemmas may be understood to be internally and externally contradictory so, Billig *et al.* (1988) argued, ideologies may be understood in the same way. Ideology has been taken to mean a single consistent way of being. Billig *et al.* (1988) argued, however, that ideologies

can hide their own contradictions and inconsistencies in a more complex and nuanced manner. In this sense, ideologies themselves are cultural constructions and are subject to various competing interpretations. For example, ideologies may be lived as evident in our social practices, or purely intellectual (Billig *et al.*, 1988, p. 27). As Radley and Billig (1996) discussed, in relation to ideological dilemmas and health, by behaving in a way that might appear 'stronger of character' the IPs could be influenced to carry on, rather than change practices (which could make them appear 'weaker').

6.8 Practical in-situ Judgement versus Experiential Ethical Judgement

A 'sonographer' professional culture also emerged within the superordinate theme of 'ideological dilemmas'. For example, IPs discussed instances where the conduct of sonographers influenced students and trainees. The interviews highlighted concerns that some IPs perceived a lack of effective consideration of WRMSD risk and prevention among students, even in the initial stages of their training. This phenomenon arises primarily because the students are more engrossed in grasping the technical facets of their role.

"Yeah, I think the problem is with students, they get so focused on the [job], they just get engrossed in what they're doing. It's either concentrating on what they're looking at or what the machine's doing or talking to the patient and then eventually trying to do all those together.

I: I think it's because they're learning, isn't it, rather than them confident just to do.

P: Yeah, they can't be aware of their body as well as all these other things. It's just overdrive for them, really". [8/202-208]

Furthermore, this predicament extends not only to students but also to sonographers themselves. They too become entangled in the challenge of balancing their professional judgement with the intricate ethical and ideological decisions they must navigate. These decisions pertain to both the anticipations set by their professional responsibilities and the ethical considerations regarding their wellbeing, aimed at safeguarding against the risk of WRMSD.

“Well as a sonographer you have to produce best image at the diagnostic route and then you try and do your best but I think I feel recently that you have to look after yourself and you have to sort of say, “Well I’ve done my best and that’s it”, you know, and not carry on, and you have to have a limit on the time” [4/120-124]

IP2 concluded that experience, derived initially from specialist training followed by several years of practice, must ultimately trump moral principle as the legitimate basis for professional decision making, especially when the outcome is likely to cause them injury. The quotation below is an example where experience may allow a sonographer to make a professional judgement which ultimately may reduce their likelihood of acquiring a WRMSD.

“I think more experienced staff know when to say “Ultrasound isn’t the technique for this lady, it needs another examination” and I think the junior staff perhaps need to be told to stop, and you can only go so far before you reach a limit” [2/118-120]

In the quotation above, the participant has alluded to experience of sonographers in terms of being aware of the risks of ‘pushing’ harder on the patient during a scan. They appeared to accept that younger sonographers may already be aware of the increased WRMSD risk and the fact many may be struggling with the pressure to perform the scan to a high standard and achieve the images they required, alongside the pressure on their body from having to struggle to press too hard. However, there is a complexity in terms of how sonographers may be torn between, not only looking after themselves, but between the health of the patient and any potential repercussions. This is also combined with a perceived pressure from above, in terms of hospital management. There is a tendency for individuals, when faced with an ideological dilemma, to ‘keep going’ and ignore the ‘stress’ of the task, subordinate their own needs, with a compulsion to go above and beyond the reality of the prescribed limits of their role (Weinberg, 2014).

The IPs also seemed to fear looking like a 'bad sonographer', which created a range of nuanced tensions and dilemmas within their role, which result in WRMSD prevention being prioritised to a lesser extent. The quotation below demonstrated the range, and complexity, of tensions presented for IP7 in particular:

"I think it might look like that they are a bad sonographer because if that was the case then a lot of the reports would say that the scan was incomplete because the patient was large and at the end of the day you need to get to the bottom of the patient's condition, so you do need to push otherwise you'd just be sending everyone through the CT scanner or MRI scanner and especially with the pregnant ladies they are a lot older or there's more older mothers, they are a little bit bigger and you have to think about the health of the new born baby, you want the best for them, so you do have to push a little bit and if you don't and the report is incomplete you will, I would say 50% of the time, get a complaint from the midwife or from the patient as to why the scan was incomplete and then you're having to go, and you're on the back foot defending yourself, and the management are like, 'why don't you just try it again', cos they don't want the complaints and I don't think the midwives properly explain to the patient if you have a BMI over 30 it's going to be difficult to get the scan" [7/173-184]

Finally, for this subordinate theme, the stress of juggling professional judgement and experiential ethical judgements is apparent, as one IP said.

"I would think so yes because I think if you're under stress to [] do too long a list, too fast or whatever, patients' expectations are that they shouldn't wait a minute, then you don't adjust your chair as much or the tension is felt maybe in your neck and your shoulders and it doesn't release and that can probably add to all your disorders. I think if you are expected to work somewhere that you've never worked before without anybody that knows [] the room or what's happening round you or the procedures and you're expected to go in and start something without that background, I think that's stressful because you want to do your best". [9/310-317]

These findings relate to Goffman's term, impression management, and the desire to look good, as a sonographer, against individual ethical judgements (such as employing WRMSD prevention): the way in which individuals act, in order to control how other people might see, or judge them (Leary and Kowalski, 1990).

6.9 Self-Preservation versus Professional Pride

Differences were naturally found across the IP interviews in terms of how the respective IPs saw themselves in their professional roles, and through their experiences of WRMSD. There is an implication in a sense that some sonographers experience conflict between their professional pride in their role and the need for self-preservation. They are acutely aware of the pressures that are being put on them and implied 'someone' in a higher authority ought to be doing something to tackle the issue (although this was not happening). A few examples are provided below from the interviews.

"I didn't like management's attitude towards ultrasound and the waiting times. They were very waiting times driven so it didn't matter if we were going to breach [not meet expected waiting times] we would be told on Thursday, 'we've got 30 patients, who's working Saturday?', someone would have to come in and do them. It wasn't, 'ok let it breach', highlighting the problem that there's not enough staff, it would be, 'just work harder' ... which was just ridiculous" [Participant/Line]

"I think you'll find in every department there's some sonographers just naturally get stressed a lot easier than other sonographers. Some sonographers have a very laid-back attitude towards it, they just get on with their lists, whatever is chucked at them they'll just chug right through it, other sonographers, the more that's thrown at them the more stressed they get. My last job did have quite an ageing population, I would say". [7/377-381]

"I just think that we all have pride in our work and that we don't like to be defeated. This is our job so a radiologist will always say, 'go for a CT, go for MR', but we don't have that to fall back on. This is our job, scanning". [6/101-104]

"I think again it comes back to benefit and also I'd like to bring in here the Alexander Technique cos that helped me when I first trapped my nerve in my neck and nobody would tell me exactly what was happening. Every time I went to scan something went worse, I either dropped the probe or started with cramps so every time I went back to my job to try it again something went worse, and the Alexander Technique is something that I think people could do at lunchtime. Sometimes, in some departments, you'll see empty rooms at lunchtime, and I think if it was more widely known the benefits of just lying down and bringing your knees up and so that you weren't laughed at". [9/252-259]

According to the ideological dilemmas approach, it was prudent not to necessarily expect to find social actors espousing singular and consistent sets of beliefs, values, and attitudes (Weinberg, 2014). Consequently, it was not surprising to find that, in the conversational interview context, respondents could endorse values of WRMSD acceptance, as well as denial, whilst also embracing normative concerns relating to how the phenomenon brings about ideological dilemmas to professional practice. It is common for social psychological approaches to treat variability in discourse as evidence of logical contradiction (e.g., Potter & Wetherell, 1987), when in fact variability is more connected to what speakers are trying to 'do' when they speak, defend, blame, or persuade etc. On a personal level, the IPs could have mitigated their own lack of acknowledgement of WRMSD, or engagement with any associated WRMSD prevention strategies, by instead invoking a professional responsibility to the patient.

It has already been noted in section 5.2.1 how the interview participants' tendency to position themselves as 'good sonographers' might lead one to question whether the construct of sonographers' professional culture should be equated with the construct of professional identity in any straightforward way. Similarly, the observation that our respondents could on occasions initiate cultural norms of 'putting the patient first' and 'professional responsibility' to justify non-engagement in the prevention of WRMSD process might prompt us to question whether everyday understandings of sonographer behaviour necessarily entail injunctions to WRMSD prevention.

It is recognised that in sonography, being empathetic in terms of the needs of others and being exposed to repeated workload pressures daily, can be challenging both physically and psychologically for sonographers. While the need for self-care may not be the dominant side of this ideological dilemma, the interpretative repertoire of self-care has emerged as a familiar metaphorical expression in sonography, from the interview transcripts.

Self-care is also an ethical imperative, to protect patients and to ensure adequate ultrasound services remain available. Its moral implications are underscored by it being a principle in the code of ethics itself. To illustrate the point, individual practitioners are expected to use strategies to avoid, or at least minimise, the effects of WRMSD (Weinberg, 2014). Sonographers may be held accountable for their own health, even though there is recognition of the significant impact that broader structural issues play in these effects (Lizano and Mor Barak, 2012). Furthermore, the consequences of not looking after oneself may be viewed as 'risky', from one perspective (Canfield, 2005, Kanter, 2007, Newell and MacNeil, 2010) meaning there is a conflict between self-preservation and professional pride. If participants are viewed as being excessive in terms of doing that 'little bit more', they may also be judged as efficient and be regarded as 'a good sonographer'. The inability to 'apply the brakes' on accepting more patients can also be viewed as having poor professional boundaries which, furthermore, can be seen as adding pressure toward fellow colleagues, who may either be unable or unwilling to do the same.

6.10 Summary

This chapter has discussed, and evaluated, nine subordinate themes relating to ST3. 'Ideological dilemmas' have provided a useful analytic framework for understanding some of the IPs' everyday experiences of working with WRMSD in ultrasound. Further exploration of the conceptual facility is still recommended. The present situation in ultrasound mirrors a culture of potentially dangerous pain acceptance which has been noted in the psychology of sport for some time (Weinberg *et al.*, 2013) albeit for altruistic, rather than egotistic, reasons. There is a clear body of evidence to suggest that sonographers are in crisis point both in terms of staffing levels and in terms of inter-related issues of WRMSD. The issue of WRMSD remains complex and under-researched and no studies can establish a definitive cause of the condition, because the causes are defined as multifactorial. Most of the literature discussed poor

posture, repetitive movements and insufficient strength as the main physical causes, but little has been explored in terms of the philosophical underpinning of sonographer behaviour and culture as a causative factor.

7 Contribution to knowledge

It is already widely known that WRMSDs are a complex and under-researched phenomenon, of which the causes are multifactorial. This study has provided a unique contribution to knowledge by allowing the voice of a small number of sonographers, from across the UK, to emerge. The IPs were able to share their personal and unique experiences of WRMSD, from which others can learn. This study has also formed a stronger basis, and has provided a clearer foundation, for future research to continue to emerge.

As was highlighted in the findings and discussion chapters, three inter-related superordinate themes emerged from this study. The uniqueness of the contribution to knowledge, which transcended all three superordinate themes, was an overarching professional culture, unique to sonographers. This had a significant impact on the IPs experiences of WRMSD. Similarities were found relating to the complexities and restraints of this culture and tradition, in sonography, with a study by Mitchell and Nightingale (2019), which acknowledged the risk of the emergence of a culture of negativity and resistance impacting on progression within the 'profession'. Similar findings also emerged relating to WRMSD, and the impact this can have specifically on individuals, including the challenges of implementing positive behavioural change. In terms of WRMSD prevention, sonography culture was seen as a limiting factor in bringing about the necessary behavioural shift among sonographers.

The complexities of this phenomenon were present throughout, and with a degree of 'cross-cutting' of issues and implications, across the three superordinate themes. The unique dilemmas faced by sonographers, between their professional pride and their perception of an ever-increasing level of workload, were examples of this. There was also a significant emphasis on 'putting the patient before themselves', by ignoring WRMSD risk and prevention strategies, and continuing by 'blindly' scanning additional patients and adopting suboptimal postures. Furthermore, there was an overarching inability, and in part unwillingness, for the IPs

to see the 'bigger picture' and they seemed encapsulated in their own world, referring to an intangible 'they' who 'should' address the pertinent issues surrounding WRMSD, rather than themselves. The IPs also seemed, at times, unable to accept how their own actions, or indeed omissions, were impacting on both themselves and the wider 'profession', from a WRMSD perspective.

There are significant implications for current ultrasound practice, that have arisen from the findings of this study, which have further cemented the significant amount of pressure, particularly in terms of workload, that sonographers were experiencing in the NHS climate. This pressure was considered by the IPs, not only to be a significant cause of WRMSD, but also impeding its prevention. Without adequate awareness of these significant barriers to WRMSD prevention existing, it would seem that little can be done to address them in terms of moving forward.

Several strategies which sonographers can use in their own work to assuage the impact of WRMSD were highlighted in this study. For example, the wider sonographer community may learn from the experiences of the IPs in this study and then endeavour to act for themselves, particularly at a local level, and begin to tackle the challenges faced. Even by understanding that other sonographers are also going through the same significant challenges may encourage the wider 'professional' community of sonographers to take a stance on what is a significantly complex, multifactorial phenomenon. Furthermore, role identity has a significant impact on behaviour and practice, and it would seem this has influenced the sense of dilemma felt by sonographers in this study.

The sense of 'ideological dilemma' faced by sonographers illuminated a new concept which is unique in terms of how it was represented in the interviews and how it related to WRMSD. It is therefore of no surprise there are new findings in this study because this type of research has not been done previously with sonographers specifically. Despite the dilemmas,

and despite reports of WRMSD being career ending in some situations, the challenges faced by living with the risks, and the unique experiences of the phenomenon, the IPs still prioritised the patient, and not themselves. Breaking down these barriers was beyond the scope of this study, but the foundations have now been laid for further research in this field to emerge.

This is the first study which has explored WRMSD and sonographers in the UK through the lens of an IPA methodology. It is also the first study which has explored UK sonographers, and their experiences of WRMSD, from a purely qualitative perspective, and not from within a simulated environment. In addition to WRMSD, the study captured some of the unique perspectives of a group of sonographers, rather than a representative sample, in terms of how they perceived their current role. This has allowed the researcher to better understand why some current social and political influences impact upon the sonographers' 'lived experience' in carrying out their professional role.

As is typical in an IPA methodology, data presented in this study were derived from a small sample of participants, and as such, it is difficult to generalise the findings to the wider population. Nevertheless, future research will need to consider the complexities of WRMSD within a sonographer culture, particularly in terms of ideological dilemmas. When evaluating why sonographers may not engage in WRMSD prevention, the researcher has concluded that lack of engagement reflected a condition of apathy or a lack of conformity, with normative concerns relating to professional responsibility.

Sonographer culture however also overwhelmingly emerged as altruistic, an embodiment of what being a sonographer stands for, which has previously been evident in studies related to sport. The development of professional cultures is not a new concept in other professional communities, but little evidence exists as to what it really means 'culturally' to be a sonographer. Although this study has filled some of the gaps in the knowledge base, it has also

highlighted new ones; issues surrounding the complexities of the fundamental pressures placed upon sonographers, which further underpinned 'the pressures' which the IPs in this study attributed to causing WRMSD.

The concept of ideological dilemmas has previously been discussed by psychologists in the world of teaching, social work, and health. To date, this concept has not been explored in relation to sonographer practices, and more specifically, in terms of WRMSD. Furthermore, findings are unique in terms of how this phenomenon transcends the lived experiences of sonographers. This concept relates specifically in terms of personal injury and in the wider context of how WRMSD impacts on the social, political, personal and professional lives of sonographers, professional colleagues, patients and the NHS.

8 Limitations

The potential limitations of IPA as a research methodology have already been considered and discussed through a critical narrative within the methodology chapter. These will also be discussed a little further in this section to outline several potential limitations which appeared pertinent.

It is acknowledged that the researcher took a direct role within the research process and in terms of interpreting the findings. It is recognised that it is impossible to completely bracket out any personal or professional preconceptions, however attempts have been made to address these limitations through a reflective and reflexive approach to the research process. The 'position' of the researcher was identified throughout the study to maintain a degree of openness and transparency. In addition, clear attempts have been made in terms of outlining the procedures and presenting transcript extracts within the thesis to allow the reader to reflect on the interpretations and consider possible alternatives for themselves. It was beyond the scope of this thesis to include all the data from within the interview transcripts, and this may also have had the potential to reveal the identity of some participants in this relatively small 'professional' field. Interview transcript extracts have been included within the thesis to provide the reader with a flavour of how the analysis has been conducted, however it is acknowledged that they may potentially seem to be out of context to the reader and consequently potentially lack depth (Potter & Hepburn, 2005) in places. As is consistent with this methodological approach, this study used a small sample size of (n=9) participants and consequently the results cannot be regarded as necessarily generalisable across the entire ultrasound workforce in the UK. It was however felt that the research findings do resonate within the wider context of the ultrasound specialism, and in the researcher's opinion data saturation had been achieved, within the limitations of the chosen methodological approach.

The purposive method of sampling should also be considered when discussing the potential limitations of this study. Although this method of sampling is consistent with ensuring that the experiences investigated were of significance to the participants, which is considered appropriate when adopting an IPA methodology (Smith, Flowers and Larkin, 2009), it is possible that the participants selected in this study were unconsciously approached because they were perceived as being the type of people who are generally more engaged with their role and more motivated to wanting to discuss the phenomenon of WRMSD. Unconscious bias may have been employed owing to the IPs' general motivation to have influence on the future of their profession. This view should therefore be considered when evaluating the potential transferability of the research findings.

Qualitative research of this nature tells you nothing specifically, from a scientific standpoint, about cause and effect of the phenomenon, only what participants believe to be causalities, because the study has looked at WRMSD through the lens of the IPs' experiences. It is acknowledged that, although the study has found some valuable participant experiences, further studies of a qualitative nature may be required to explore some of the IPs' attributions regarding the causes of WRMSD further.

It is also acknowledged that different sampling methods might have generated different results; for example, newly qualified sonographers may have had a different perspective to more experienced sonographers, as used in this study. There may also have been merit in considering more specific areas of ultrasound practice in greater detail, for example focusing the study primarily on just obstetric sonographers, or vascular scientists. These are all useful considerations for future research and it is overwhelmingly acknowledged that differing perspectives could have been gleaned by adopting a different sample or indeed a different approach.

Finally, it is acknowledged that recruiting a more homogenous sample may have also altered the findings, for example had the study focused on just those participants who identified as having WRMSD, or indeed those who did not. These are again factors which could be considered for future studies, although given the original aim of this study, the researcher remains satisfied that overall, a heterogenous sample was the most appropriate option. Although one cannot 'know' beyond what is shown by the participants themselves, this study does reveal the IPs' experiences, and from these experiences, others can learn.

9 Conclusions

The research aims of this study were met by exploring (n=9) sonographers' experiences of WRMSD. This was irrespective of whether they currently considered themselves to have or to have had WRMSD. The research built upon and extended existing accounts which have offered broad insights into WRMSD (Simonsen and Gard, 2017, Bolton and Cox, 2015). By utilising IPA (Smith, Flowers, and Larkin, 2009) as a foundation for thematic analysis, the research has provided rich contextualised narratives of the experiences of these participants. As such it has contributed to the current research knowledge in the field by providing insight into this unique and complex phenomenon related to current UK ultrasound practice by offering a wider appreciation of the subtleties and variations of the unique perceptions of sonographers and WRMSD. By focusing on a small sample with considerable experience of working in ultrasound practice, from various regions within the UK, this study has sought to provide further understanding into this important and significantly under researched phenomenon.

The study has highlighted some pertinent findings regarding the unique perspectives of sonographers and WRMSD, however it has also highlighted further that the subject remains under-researched. Consequently, not enough is known on what is required to bring about the essential changes needed to reduce WRMSD. Sonographers remain torn between the social, political, professional, and personal boundaries of their role. More research is suggested in this area to establish new ways of thinking, which may influence positive changes to create an "ideal system" in terms of WRMSD prevention. It seemed apparent that there is great pride and passion from the IPs about their 'profession' and they appeared to see the importance of educating colleagues, and students, about the risks of WRMSD to reduce the number of sonographers acquiring the phenomenon during their careers. Unfortunately, the

knowledge base continues to remain insufficient for establishing a standardised WRMSD prevention training programme.

Sonographers themselves must now begin to play a part in the evolution of the 'profession', specifically in terms of developing more knowledge regarding the phenomenon to allow changes to be made for the better. This study has highlighted a degree of apathy, and the IPs focused on an elusive 'they', who they suggested should sort out the issues of WRMSD for them. It is therefore hoped that the results of this study will inspire further research related to the prevention of WRMSD. Most importantly future research needs to work towards raising awareness. This is important amongst sonographers, for the wider imaging workforce and also politically, to better inform strategies and reduce the incidence of WRMSD in sonographers as an emerging 'professional' group.

Overall, the study has highlighted some useful perspectives, from UK sonographers, in terms of the types of education trainee sonographers are currently receiving in the UK on WRMSD prevention both in the university and the clinical environment. It has also highlighted some negative attitudes towards changing behaviours. The IPs seemed to be aware of their own physical position, and importance of posture, and the prevention of WRMSD, in terms of ultrasound scanning. Unfortunately, owing to the highly under researched nature of the subject, not enough is yet known regarding how to bring about the changes and develop an acceptable WRMSD prevention training programme. More research is therefore suggested in this area to establish how a successful WRMSD prevention programme could be created. Despite endeavours to develop this further, the knowledge base remains insufficient to standardise the overall training for WRMSD prevention given at a national level. Without adequate changes to existing culture amongst sonographers, increasing WRMSD prevention training may also continue to be ignored, after a period of time, following any training given. Further

research is therefore needed to drive forward cultural changes and facilitate practical solutions to some of the pressures being experienced by sonographers in the current UK climate.

Hopefully, the results of this study will inspire further research in the prevention of WRMSD, for an “ideal system” to eventually be created. Such a system may include solving the staffing crisis in sonography, creating better working conditions for sonographers, as well as a complete and successful educational programme for WRMSD prevention. Such changes should increase WRMSD awareness amongst sonographers from the very beginning of their training and help to reduce the incidence of WRMSD.

10 Recommendations

10.1 General Recommendations

The recommendations purposively start with those directed at the current political situation which impact sonographers and their working practices. Chapter 1 has evidenced how the national situation has begun to set out a framework of key strategic drivers in which the role and expectations of individual sonographers are confirmed. For the last 20 years various reports have been published outlining how WRMSD is potentially affecting sonographers and there is strong evidence to suggest that this is not a cost-effective approach, owing to the potential further loss of staff in an already understaffed workforce. Literature consistently presents that healthy lifestyle behaviours are required to reduce WRMSD. However, there would seem to have been limited attention given toward understanding the relevant operational context of ultrasound practice and furthermore, addressing the existence of significant variations in the attitudes, knowledge, skills and practices of sonographers working with symptoms of WRMSD or the potential thereof.

Yet the findings of this study indicated that, although sonographer health, wellbeing and fitness are potentially beneficial in combatting WRMSD, such activities are often subsumed by other more pressing issues such as the clinical need of the patients and the departmental workload demands to prioritise, including resource and infrastructure constraints in the clinical setting. Findings suggested this is likely to remain the case as ultrasound practice continually faces rising demand, workforce shortages and year on year reductions in funding. For this reason, sonographers need to be allowed the time to be 'themselves' in a professional sense, scan their patients, issue a report, and continually reflect on their practice. Similarly, they need the freedom to use their professional experience, and judgement, to provide the best possible care according to the patient's individual needs, whilst maintaining their own physical and mental health. It is questionable whether this will be achievable without further

social and political changes in organisational policy, infrastructure, and investment in resources at a national level.

Finally, as Chapters 4-6 have demonstrated, without an overall national commitment to addressing the demands for sonographer regulation, from the ultrasound community, the activities of individual practitioners will be extremely limited because the continued workforce shortage is likely to persist and therefore continue to have a negative impact on those sonographers who remain in current practice. Therefore, without increased government investment, in addressing the sonographer shortage at national level, sonographers will continue to struggle to meet service demands because of significant staffing shortages. Consequently, sonographers are likely to continue to experience feelings of physical and mental stress and anxiety, which are thought to be fuelling their experience of, or risk of acquiring, WRMSD.

10.2 Sonographer Education and Training

Given the reluctance of many of the IPs to attend specific training on WRMSD prevention, it is recommended that any training is delivered alongside other areas of compulsory professional development which sonographers must attend. This may include educational sessions delivered as part of their employment mandatory training, university mentor workshops and, for students, as part of their ultrasound qualification. It is recommended that all training is directly relevant to an individual sonographer's role and includes content that would stimulate and motivate the sonographers to change their current 'unhealthy behaviours' for example, by including real patient cases, and problem-based learning case scenarios. These may include topics such as raising the issue of WRMSD more widely within the professional group, evaluating WRMSD prevention strategies in their own clinical departments, and focusing on behavioural assessments to better understand sonographer culture. Other education may include physical posture assessments by ergonomic experts and maintaining follow

up consultations with sonographers who are experiencing symptoms of WRMSD which may potentially be delivered through employer occupational health teams. It also important to consider, in such training, that sonographers are encouraged to examine their own attitudes to WRMSD and acknowledge the wider professional nature of the problem. Given the time commitments which sonographers raised as barriers to access training, or when considering the wider issues related to WRMSD, during their busy scanning lists, it may be worth considering the internet, webinars, or podcast style learning on WRMSD prevention which could be made available to sonographers. This may be of particular relevance if it were to be developed at a national level, through a collaborative process led by the relevant professional bodies, such as BMUS, ScoR and CASE.

10.3 Professional Recommendations

Given the researcher's position as an ultrasound programme leader, SCoR member, BMUS member and CASE committee Vice Chair, and then Chair, (at the time of writing) there are pertinent professional recommendations which must be taken forward from this study. The researcher intends to use these platforms to help the findings of this study to reach sonographers. It is recommended that a WRMSD multi-professional working group is set up to drive forward the necessary changes to sonographer practices and WRMSD to encourage a change in sonographer culture. In encouraging sonographers to take ownership of the risks associated with this phenomenon, negative consequences could be assuaged.

The research aimed to gain a deeper understanding of sonographers' experiences of WRMSD. Objectives 2-5 focused on sonographer experiences of WRMSD and how these experiences potentially impact, not only on themselves, but on their wider 'professional' group. From the findings, staffing levels remained a serious concern for the IPs, specifically in terms of contributing to WRMSD through additional workload pressures. This would suggest more work is needed in resolving some of the wider issues, such as growing the sonography workforce to relieve some of the wider pressures being experienced by sonographers which may in part be attributed to non-engagement in WRMSD prevention.

The research highlighted that sonographers themselves need to be more proactive in tackling the issues of WRMSD. A 'whole systems' approach is needed which not only ties together national guidelines but continues to challenge and develop them further. Furthermore, it is recommended that each ultrasound department creates, rather like a health and safety representative, a 'WRMSD champion' to monitor WRMSD prevention strategies, sonographer health and wellbeing and share good practices as well as areas of concern locally.

Finally, through working with the principle national bodies, including BMUS, SCoR, CASE and NHSE, conversations need to continue which surround the key issues which underpin WRMSD. In

doing so, this may help towards developing a multifaceted solution, not only to WRMSD but also the wider national issues that the ultrasound 'profession' is experiencing.

11 References

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12 Appendices

12.1 Appendix 1: Literature Review Method:

The initial research question was vague, and 2 acronyms were used to try to formulate a clear and focused question, for the project to answer.

SPIDER was used to guide the initial development of the research question.

Sample

Phenomena of Interest

Design

Evaluation

Research

S – Sonographers

PI – Work Related Musculoskeletal Disorders (WRMSD)

D – Interviews

E – Views and attitudes

R – Qualitative

PICOT was then used in addition.

Population

Issue

Context

Outcome

Type

Population (sonographers/Ultrasound Practitioners in the United Kingdom)

Issue (Work-related musculoskeletal disorder (WRMSD))

Context (Ultrasound practice within the UK)

Outcome (Personal views and attitudes)

Type (Qualitative) (or perhaps a mixed methods approach)

(Aveyard, 2019)

From the above processes the following research question was generated:

“What are the individual attitudes, beliefs, feelings and experiences of sonographers towards work-related muscular skeletal disorder?”

Search Terms	Alexander Technique, Biomechanics, Burnout, Clinical Ergonomics, Effort-Reward Imbalance, Ergonomics, Ergonomic Injury, Ergonomic Interaction, Lifestyle, Lived Experience, Muscular-skeletal, Muscular-skeletal Pain, MSD, MSK Discomfort, Muscular Fatigue, MSD Prevention, MSD, Muscular Strain, Occupation, Organisational Constraints, Pain, Prevalence, Prevention
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	Strategies, Psychosocial, Psychosocial Health, Psychosocial Work Stressors, Repetitive Motion Injury, Repetitive Strain Injury, RSI, Repetitive Task, Risk Factors, Role Conflict, Stress, Sonographer, Sonographer Abuse, Sonologist, Ultrasound, Ultrasound Practitioner, Upper Extremity, Work Environment, Work-Related Muscular Skeletal Disorder, Work-Related Upper Extremity Disorder, Work-Related Upper Limb Disorder WRMSD, WRMD, WRUED, WRULD,
Databases	University of Cumbria: One Search, CINAHL, Google Scholar, Medline, Science Direct,
Additional Search Strategies	Hand Searching (selecting suitable references from journals found above)
Years	Initially No Criteria Set, Journals Hand Selected but on reviewing the articles it was decided to create an inclusion criterion of 1980-2022
Language	English
Studies	All Methodological/Literature Types including Systematic Reviews, Theoretical Literature, Research Literature, Practice Literature and Policy Literature

Inclusion Criteria	Relevance to research question, published 2005 onwards. All literature types including peer reviewed and 'grey literature' such as newspaper articles, professional journals*.
Exclusion Criteria	Pre 2005 (with noted exceptions), Not English Language,

*Most robust related evidence is likely to have relevance to this research question (Aveyard, 2019)

Boolean operator 'AND' was used to ensure the searches were adequate limited and to ensure relevance and 'OR' was used to ensure the search was sufficiently wide not to exclude useful resources with synonyms in the title.

The Following search terms and BOOLEAN operators were also used during the literature searches:

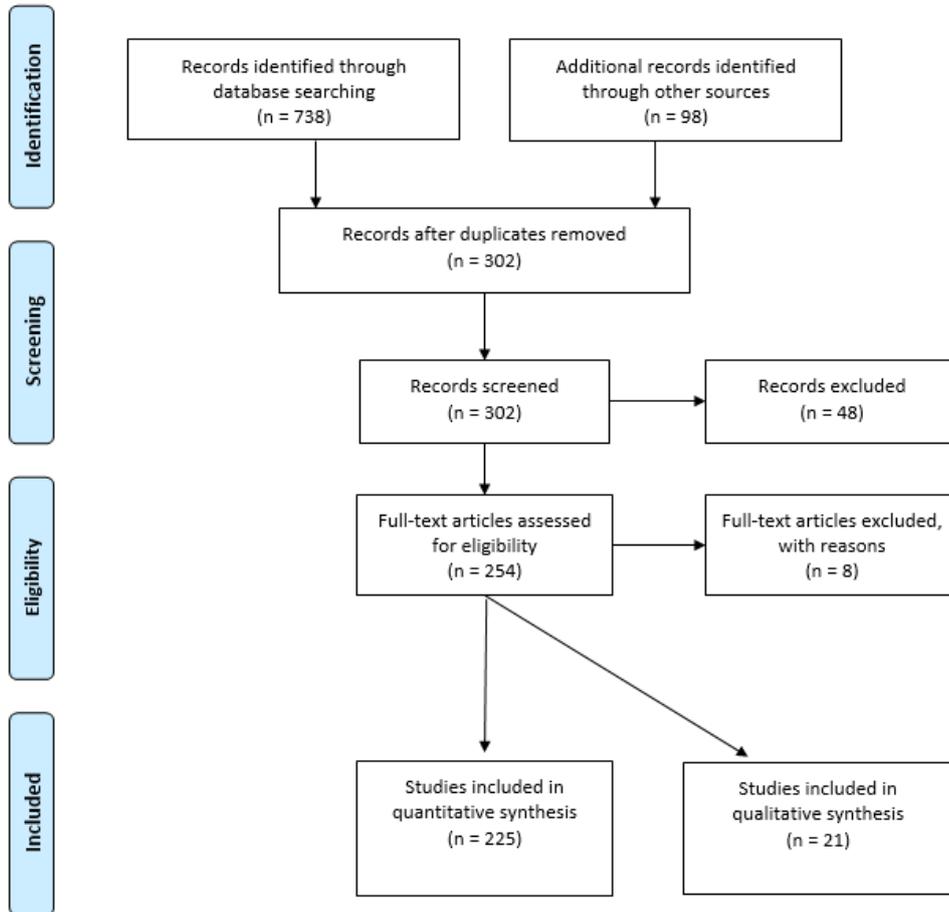
WRMSD OR WRMD OR MSD AND Sonographer OR Ultrasound OR Ultrasound Practitioner
Work related muscular skeletal disorder AND Sonographers OR Ultrasound OR Ultrasound Practitioner
MSK Discomfort AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Upper Extremity Disorder AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Ergonomic Interaction AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Occupational Injury AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Biomechanics AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Psychosocial Work Stressors AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Clinical Ergonomics AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Stress AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Psychosocial Health AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Psychosocial AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Muscular Fatigue AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Muscle Strain AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Effort-reward Imbalance AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Organisational* Constraints AND Sonographers OR Ultrasound OR Ultrasound Practitioner

Role Conflict AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Burnout AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Prevalence AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Risk Factors AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Repetitive Motion Injury AND Sonographers OR Ultrasound OR Ultrasound Practitioner
WRMSD AND Sonographers OR Ultrasound OR Ultrasound Practitioner
WMSD AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Lifestyle AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Repetitive Strain Injury AND Sonographers OR Ultrasound OR Ultrasound Practitioner
RSI AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Repetitive Task AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Work Environment AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Injury AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Abuse AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Alexander Technique AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Pain AND Sonographers OR Ultrasound OR Ultrasound Practitioner
WRUED AND Sonographers OR Ultrasound OR Ultrasound Practitioner
WRULD AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Prevention Strategies AND Sonographers OR Ultrasound OR Ultrasound Practitioner

MSD Prevention AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Musculoskeletal Pain OR Muscular-skeletal Pain AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Lived Experience AND Sonographers OR Ultrasound OR Ultrasound Practitioner
Muscle Fatigue AND Sonographers OR Ultrasound OR Ultrasound Practitioner
AND Sonographers OR Ultrasound OR Ultrasound Practitioner



PRISMA 2009 Flow Diagram



(Adapted from Moher et al, 2009)

12.2 Appendix 2: Initial Invitation Covering Letter & Participant Consent Form

Medical & Sport Sciences

University of Cumbria

Bowerham Road

LANCASTER LA1 3JD

Tel: [REDACTED]

Fax: [REDACTED]

email: Gareth.Bolton@cumbria.ac.uk

PP Name

Address

Dear PP Name,

I am radiographer/sonographer working in academia and working towards a part-time PhD with the University of Cumbria in Lancaster. I would like to invite you to participate in my research which is evaluating sonographers' experiences of work related muscular-skeletal disorder (WRMSD) and attempting to minimise sonographers' risk of acquiring this condition

while performing ultrasound scans on a regular basis. This is a highly under-researched area and there is little robust evidence available to guide practitioners like yourself. Your input, as an experienced sonographer, would help provide a better understanding of your perspective of why those who perform this task on a daily basis may encounter WRMSD and why others may not. Most of the advice to date has been provided by evidence from other occupations and has not always considered the issues facing sonographers in the United Kingdom (UK). This research is an opportunity for sonographers to contribute to a body of knowledge which would stem from their own professional experience and practice.

I have enclosed an information sheet which explains what your involvement in the research would be, should you choose to accept my invitation to participate.

It would be very much appreciated if you could inform me whether or not you would be interested in taking part in the study, by returning the tear-off slip at the end of this letter, I shall look forward to your reply.

Yours faithfully,

Gareth Bolton MSc, PgDMU, PgCAP, BSc (hons), SCoR, HCPC, FHEA.

Senior Lecturer/PhD researcher

I would/would not be willing to take part in this study.

(If you are willing to be involved please complete the participant details below)

Name:

Email:

Telephone:

Signed:

Date:

**'Research into Sonographers experience of Work-Related Muscular-Skeletal Disorder
(WRMSD) Prevention'**

Participant Consent Form

Please answer the following questions by circling your responses:

I have read and understood the participant information sheet dated relating to this study. YES NO

I have been able to ask questions about this study and have had my questions suitably answered. YES NO

I understand that I am free to withdraw from this study at any time and do not have to give a reason for my withdrawal. YES NO

I agree to have my interview with the researcher audio recorded. YES NO

I give permission for members of the research team to have access to my anonymised interview. YES NO

I understand that my direct quotes from my interview may be used in subsequent publications. YES NO

I am happy to be contacted by the researcher after the interview and be offered a copy of the interview transcript and a precis of the initial results. I understand that I can decline this offer and am not obliged to comment on either the transcript or the results. YES NO

I agree to take part in this study. YES NO

Your signature will certify that you have voluntarily decided to take part in this research study having read and understood the information in the sheet for participants. It will also certify that you have had adequate opportunity to discuss the study with an investigator and that all questions have been answered to your satisfaction.

Signature of participant:..... Date:.....

Name (block letters):.....

Signature of researcher:..... Date:.....

Please keep your copy of the consent form and the information sheet together.

Researcher contact details can be found below.

Researcher Contact Information:

Gareth Bolton

Senior Lecturer

Department of Medical & Sport Science

University of Cumbria

Bowerham Road Lancaster, LA1 3JD

Tel:



12.3 Appendix 3: Participant Information Sheet



'Research into Sonographers experience of Work-Related Musculo-Skeletal Disorder (WRMSD) Prevention'

Participant Information Sheet

About the study

This research will aim to provide a deeper understanding of the difficult task facing sonographers in terms of work-related musculo-skeletal disorder (WRMSD) avoidance and prevention. It will focus on individual sonographers' experiences of current practice and workload issues and any issues that arise from having been working as a sonographer for a significant period of time. The goal of the study will be to address the lack of information and literature available to guide the researcher around the issues surrounding this complex issue.

This study forms the basis of a doctoral research project undertaken at the University of Cumbria, awarded by University of Lancaster. The researcher is a qualified radiographer, registered with the Health Care Professions Council (HCPC), and a sonographer (for over 10 years) as well as now leading the MSc Programme in Medical Ultrasound and working part-time towards their PhD qualification.

Some questions you may have about the research project:

Why have you asked me to take part?

As a qualified sonographer, with more than five years' experience of working in ultrasound, the information you can provide about your experiences of WRMSD will be invaluable to this project. Your verbal accounts will form the core data of the preliminary research.

What will I be required to do?

You will be invited to discuss your experiences with the researcher for approximately one hour, although this time may vary. This discussion is essentially an unstructured interview which will be audio recorded for the purposes of analysis later on. You may feel uncomfortable discussing your health concerns, however we can stop the interview at any time should you wish.

Where will this take place?

You may choose a location for the meeting where you will feel most comfortable, bearing in mind that the location must be suitable for audio recording. You can discuss this with the researcher.

How often will I have to take part and for how long?

You will be interviewed only once by the researcher. The interview will last approximately 60 minutes. If you wish, the researcher may contact you at a later date and ask you to look at a copy of the interview transcript and a precis of the initial results. This is entirely optional and you will be free to comment on both.

When will I have the opportunity to discuss my participation?

You may discuss your participation at any time before you consent to take part in the study, at any time during the study and after the study is complete. Please remember that your participation is optional, and you may withdraw from the study at any time. The researcher's contact details can be found at the end of this information sheet.

Who will be responsible for all the information when the study is over?

The researcher.

Who will have access to it?

The researcher and supervisory team.

What will happen to the information when this study is over?

Interview transcripts will be retained by the researcher for a period of 5 years following completion of the study. These will be anonymised and will not contain any information that could be used to identify you. All audio recordings will be destroyed, following completion of the study.

How will the researcher use what they find out?

The results of the research will be written up as a PhD thesis and submitted to an examination board. Certain findings may also be published in peer reviewed journals.

Will anyone be able to connect me with what is recorded and reported?

No personal details that would allow you to be identified will be included in any written work (e.g., name, location, place of work etc.).

How long is the whole study likely to last?

The entire research project should be completed within 7 years.

How can I find out about the results of the study?

If you agree, the researcher will send you a précis of the initial results. The researcher can also contact you with details of any publications relating to this study.

What if I do not wish to take part?

Your participation in the study is entirely voluntary.

What if I change my mind during the study?

You are free to withdraw from the study at any time without having to provide a reason for doing so. In addition, you will have editing rights during the recorded interview, for example if you wish to retract something you have just said, it will be wiped from the recording. You will also be able to review the transcript of the interview.

What will happen if I disclose any unsafe or illegal practice during the interview.

Although the researcher has a duty to maintain confidentiality in relation to what you tell them, they also have a duty of care to any patients that may suffer as a result of unsafe or illegal practice. These duties are set out in the professional codes of conduct of both the Society of Radiographers and the Health Care Professions Council and take precedence in the event of unsafe or illegal practice being disclosed.

Will I need to sign any documentation?

You will be asked to sign a consent form before participating in the study. This does not mean that you are obliged to take part in the study. You may still withdraw at any time.

Whom should I contact if I have any further questions?

Please contact the researcher directly (details below). If you have any complaint about your experience in the study you may contact the main supervisor in the first instance (details below).

Where can I find further information on WRMSD?

Your employer's Occupational Health Department or your General Practitioner (GP) Practice will be able to advise you and make appropriate referrals where necessary.

Researcher Contact Information:

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12.4 Appendix 4: University of Cumbria Ethical Approval

Letter Redacted for online version

12.5 Appendix 5: Interview Schedule

Injury/No injury interviewee perception

Lifestyle Activities

General Health and fitness/sickness absence/Satisfaction of job role/perception of stress

Career Pathway (time in ultrasound practice)

Typical working week:

Scan types/times/rest breaks/number of exams per day

Extended working days

Equipment

Changes in service/workload/population characteristics

WRMSD prevention strategies employed (novel techniques?)/protocols? Exercises?

Workload Processes/departmental organisation/Appointment booking

Staffing Issues (sonographer/support staff)

Stress in the workplace

Thoughts/Feelings about current role

Education on WRMSD prevention

Personal experiences of WRMSD

When/How often/Affected Areas

No issues – thoughts of why this is the case?

Non-work-related injuries?

Personal perceptions of WRMSD in ultrasound.

Any comments on future prevention measure