

Thesis submitted in partial fulfilment of the degree of Doctor of Clinical Psychology (DClinPsych)

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Doctorate in Clinical Psychology

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July 2023

Word Count by Component

Systematic Review of the Literature……6809 words

Service Improvement Project…….. 4890 words

Theoretically Driven Research Project……..... 4911 words

Executive Summary……..675 words

Connecting Narrative……... 787 words

Total word count…….18,072 words

Please note: these word counts do not include figures, references, or appendices.

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Abstracts

Systematic Review of the Literature

Objectives: This systematic review focuses on neuropsychological outcomes in school-aged children (5-17yrs old) with a confirmed diagnosis of non-syndromic craniosynostosis (NSC).

Methods: PsycINFO, PubMed & CINAHL, and reference lists of previous reviews were searched until March 2023. Inclusion criteria: Standardised neuropsychological tests, were performed on children between the age range of 5-17 years old, and quantitative data was available. Two raters were used for screening, eligibility, extraction, and quality assessment.

Results: 18 eligible studies were included in this systematic review. The quality of studies was mixed, with n=7 "strong"; n=5 "moderate"; n=6 "weak". Data indicated that children with sagittal, metopic and Unicoronal NSC were not significantly different in Full Scale Intelligence Quotient (FSIQ) and specific cognitive domains in comparison to controls. Sagittal NSC patients most consistently demonstrated no difference in cognitive profile from the general population. For metopic patients, some studies showed a more uneven cognitive profile. Unicoronal focussed studies showed cognitive differences between left/right sides. However, these two sub-types had lower sample sizes in general.

Discussion: Overall, evidence to date indicates children with NSC are performing similarly to controls, with some differences between suture sub-types. Higher quality research studies are needed to draw reliable conclusions regarding outcomes in this population. However, there is an improvement in quality since 2015. The biological, developmental, and environmental factors that may mediate the results are discussed. Finally, recommendations are made to future researchers for acknowledgments of bias, improved methodological quality and directing research toward those in hard-to-reach populations.

Service Improvement Project

Aims: This service improvement project aimed to increase access to psychological support for older adults admitted to the Major Trauma Centre (MTC) who have a Fear of Falls (FOF). This entailed working in conjunction with MTC physiotherapists to promote the use of cognitive behavioural therapy (CBT) strategies and developing a psychoeducation resource for older adults.

Methods: This project was carried out in three phases: Phase 1 involved scoping of the literature and current interventions used by physiotherapists and their response to proposed interventions. Phase 2 consisted of the development of resource materials including a psychoeducation workbook for older adults with FOF to use in the MTC and designing and implementing a staff training session on working psychologically with FOF. Phase 3 involved an informal evaluation of the materials developed using a questionnaire on confidence and knowledge of FOF pre and post training and qualitative feedback on the psychoeducation workbook.

Results: Findings from phase 1 revealed limited inpatient interventions for FOF in older adults in the United Kingdom. Staff were motivated to attend training and have more access to resources such as psychoeducation. In phase 2, a psychoeducation workbook and training session were developed. In phase 3, staff rated their confidence and knowledge as being higher post training; main differences included psychological explanations of FOF and introduction of cognitive restructuring strategies. Staff gave positive feedback on the use of a psycho-educational workbook and felt it would be a useful resource across inpatient wards.

Discussion: Future directions of this project should look at formal evaluations over longer time points to assess the impact of psychoeducation material and training with both physiotherapists and the older adult population admitted to the MTC.

Theory Driven Research Project

Aims: Current cognitive behavioural conceptualisations of eating disorders (EDs) place an emphasis on dysfunctional assumptions (DAs) relating to shape, weight, eating and size, and give little attention to addressing longitudinal or predisposing cognitions such as core beliefs. The current study aimed to compare the role of DAs and core beliefs in an adult female sample grouped into "low ED symptoms" and "high ED symptoms". Further exploration focused on the content of the core beliefs, specifically "self-loathing" and whether this uniquely contributed to high ED symptoms, even when potential covariates were controlled. Finally, it was investigated whether participants' qualitative responses were in line with our current understanding of the contents of these beliefs.

Method: A mixed method cross sectional method was employed in a non-clinical sample. The high group (n=82) and low group (n=77) completed demographic measures, measures of ED symptoms, DAs, and core beliefs relevant to EDs, as well as measures of potential covariates. A further content analysis was conducted to ascertain participant self-beliefs.

Results: Mixed method ANOVAs, post hoc t-tests and regression analyses were used. There was a significant difference between high and low ED symptom groups on DAs and negative self-beliefs (NSB's), with the high symptom group reporting higher scores on DAs and NSBs than the low ED symptom group. There were significantly higher DAs than NSBs in the high ED group compared to the low group. Further analyses revealed that DAs accounted for more variance in ED symptom severity than core beliefs. The secondary analyses revealed all core belief subscales were higher in the high ED symptom group compared to the low ED symptom group revealed no significant interaction between different core belief subscales in the low and high groups. However, when self-loathing was analysed, it explained a small but significant amount of variance in symptom severity, over and beyond other sets of core beliefs. The content analysis revealed that self-loathing statements were significantly stronger in the high symptom group and matched those found in the "self-loathing" subscale of the measure.

Conclusions: The hypotheses were partially supported. DAs explained greater variance in ED symptom severity than negative core beliefs in this sample. This supports current understanding about the vital role of DAs in EDs. However, self-loathing beliefs were unique in explaining some variance in ED symptoms. This study was limited by using a non-ED sample and did not control for comorbidities. Future studies may focus on investigating self-loathing further as a potentially key core belief in relation to ED symptoms.

Keywords: Eating disorders; core beliefs; dysfunctional assumptions, cognitive behavioural theory.

Systematic Review of the Literature

Title:

Neuropsychological outcomes of school-aged children with non-syndromic craniosynostosis: A systematic review

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Date: May 2023

Word Count: 6809

Proposed Journal: Journal of Craniofacial Surgery (Appendix D)

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Abstract

Objectives: This systematic review focuses on neuropsychological outcomes in school-aged children (5-17yrs old) with a confirmed diagnosis of non-syndromic craniosynostosis (NSC).

Methods: PsycINFO, PubMed & CINAHL, and reference lists of previous reviews were searched until March 2023. Included studies: standardised neuropsychological tests were performed on children between the aged of 5-17 years old and quantitative data was available. Two raters were used for screening, eligibility, extraction, and quality assessment.

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Discussion: Overall, evidence to date indicates children with NSC are performing similarly to controls, with some differences between suture sub-types. Higher quality research studies are needed to draw reliable conclusions regarding outcomes in this population. However, there is an improvement in quality since 2015. The biological, developmental, and environmental factors that may mediate the results are discussed. Finally, recommendations are made to future researchers for acknowledgments of bias, improved methodological quality and directing research toward those in hard-to-reach populations.

Introduction

What is Non-Syndromic Craniosynostosis?

Non-Syndromic Craniosynostosis (NSC) is a rare craniofacial disorder that affects infants. NSC is predominantly diagnosed as a "stand alone condition", and a small proportion of cases are associated with genetic syndromes or congenital abnormalities (Garza, 2012). Infants with NSC experience a premature fusion of one or more of the sutures in the skull, causing a change in growth pattern where the skull compensates by growing in the areas that are not fused (Johnson & Wilkie, 2011). Please find a diagram of this in **Figure 1** and **Appendix A.** This results in an "abnormal" head shape, facial features, and an increased risk of increased intracranial pressure (ICP) (Johnson & Wilkie, 2011). NSC is often also called "single suture" craniosynostosis and is most often classified according to the fused suture site. In order of prevalence the most common types are sagittal, metopic, unicoronal and (most rare) lamboid (Lee et al, 2012). A glossary of terminology used in this review is available in **Appendix B**.

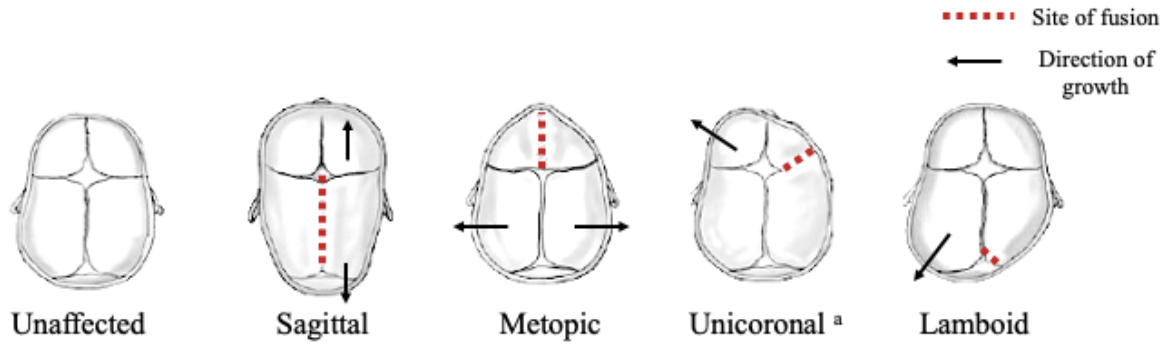


Figure 1. *Non-syndromic craniosynostosis suture subtypes and direction of growth in comparison to an unaffected brain.*

a= can be left sided or right sided unicoronal NSC.

NSC is commonly treated surgically. Research has indicated this should be performed in early infancy to reduce the risk of raised ICP, reshape the skull, allow for normative brain growth, and achieve better cosmetic outcomes (Ursitti et al, 2011; Patel et al, 2014). Guidance from the

National Institute of Health and Care Excellence (NICE) does not currently indicate that surgery should occur solely to improve neuropsychological outcomes (Mathejjsen, 2015).

Neuropsychological Outcomes in NSC

Literature has reported cognitive profiles of infants with NSC which have not been followed longitudinally to school-age, therefore the trajectory of cognitive functioning remains unclear. It is theorised that testing at school-age may provide a more reliable account of cognitive impacts of NSC by picking up more subtle differences and giving a better representation of a child's long term cognitive functioning (Shim et al, 2016). Over time, small variations to neural organisation can lead to significant changes in cognitive functioning, therefore there is a good rationale for testing to occur in infancy as well as school age, especially as cognitive demand increases (Munakata, Casey, & Diamond, 2004).

Narrative reviews in the early 2000's have indicated that NSC is associated with mild but consistent neuropsychological deficits (Kapp-Simon et al, 2007; Speltz et al, 2004). Early infant studies have shown increased psychomotor difficulties in infants with NSC in comparison to age-matched controls (Da Costa et al, 2013). However, as mentioned above this could change over time, and there is a lack of standardised tests for infants that could measure higher processes such as attention and memory (Kapp-Simon et al 2007). In school aged children, a review by Kapp-Simon et al (2007) indicated that language, attention, planning, processing speed and visuospatial skills may be negatively affected, and studies should provide a focus in these areas.

Osborn et al (2021) conducted a recent meta-analysis on cognitive, behavioural, and psychological functioning of individuals with NSC and found that Full Scale Intelligence Quotients (FSIQ) fell within the "average-low average range". However, they critiqued the use of some neuropsychological measures e.g., the Weschler Abbreviated Scale of Intelligence (WASI), by which FSIQ scores are generally a few points higher than more detailed tests such as the Weschler Intelligence Scale for Children (WISC) (Osborn et al, 2021). Nonetheless, the correlation between the WASI and WISC is high (0.83-0.86), and studies have deemed the WASI outcomes comparable to the lengthier WISC by providing a quick measure of general intelligence (Van Ool et al, 2018).

Biological, developmental & environmental factors

The relationship between distortion of the skull, suture sub-type and cognitive function has been explored. Metopic NSC has been associated with language impairments which anatomically relate to malformation in the temporal lobes (Shimoji et al, 2002). Sagittal NSC has been associated with increased attentional difficulties which would relate to impacts of brain growth on the frontal lobes (Magge et al, 2002). For unicoronal NSC, general intelligence, speech and learning have all been implicated to be affected which involve temporal and parietal lobes (Becker et al, 2005). However, these studies are old, have been difficult to replicate and present with very small sample sizes. Furthermore, it is increasingly accepted that in NSC suture sub-type has not been implicated to directly affect a certain region of the brain i.e. neuroanatomical changes resulting from the interaction between the growing skull and the developing brain can extend beyond that of the area beneath the fused suture area (Aldridge et al, 2005). The deformation hypothesis would state that stress on the cerebral cortex affects the subcortical structures which spread throughout the brain (Munakata et al, 2004). Therefore, it is unclear if suture type and brain function abnormalities have a direct causal link, and this relationship is complicated by other biological, developmental, and environmental factors.

Within the field there has been longstanding interest in the neuropsychological consequences associated with NSC. Some researchers have argued that infants who suffer early "insult" to the brain from either the surgery or abnormal brain growth may have a higher likelihood of neuropsychological disruption later in life (Tahiri et al, 2017), whereas others have argued the plasticity of the infant brain can allow more room for adaptation if "insult" occurs at this point (Da Costa et al, 2006).

In a previous review conducted by Knight et al (2014) on "neurodevelopmental outcomes in children with Single-suture craniosynostosis" the researchers focussed particularly on factors that made the infant brain vulnerable to disruption such as, biological, environmental, and developmental factors (Knight et al, 2014). Theories on biological risk factors suggest that in NSC the specific suture fusion, presence of ICP and the severity of abnormal brain growth can all have negative effects on neuropsychological profiles of children (Sergesketter et al, 2019). Environmental factors such as socio-economic status and family dynamics can have an

influence on the development of the brain (Lin, 2015). Finally developmental factors such as the age of surgery and type of surgery can also influence a child's neuropsychological outcomes (Da Costa et all 2006). These factors are important to consider when drawing conclusions from studies as they are likely to provide more explanation for specific outcomes in some children with NSC as opposed to others.

Quality of Research

Knight et al (2014) highlighted the following limitations with research in their last systematic review, which included studies published until 2012: (1) biased or unclear sampling and criteria (2) broad ranges of age of surgery (3) broad ranges of age at assessment (4) limited details on participant characteristics (5) mixed samples of NSC subtypes (6) mixture of children who have/have not had surgery in the sample (7) lack of sensitivity in the neuropsychological tests used (8) research looked at overall general intellectual ability or developmental assessment, not specific domains.

Rationale & Clinical Relevance

In summary, research to date suggests that there are negative consequences of having NSC on cognition. However, these studies have primarily focussed on infants, and consequences for school-aged children are less clear at this point. It is also unclear to what extent biological, environmental, and developmental factors may play a role in affecting the findings studies have reported.

The charity "Headlines" (2016) stated one of the most common questions parents ask for their child with NSC is "What does this mean for the future of my child?". It is hoped this review will provide learning points for researchers and clinicians to communicate with families about how the cognitive trajectory for their child may look like at school age. This is the first systematic review that is focussing on neuropsychological outcomes of NSC in school-aged children only, and the findings may help to guide national screening protocols in the UK. For the purposes of this review only sagittal, metopic and unicoronal NSC are reported due to extremely low sample sizes of data for lamboid NSC.

Research Questions

The following questions are addressed in this review.

1) What are the neuropsychological outcomes in school aged children with NSC vs non-affected children i.e., controls or normative population controls.
2) Is there evidence that indicates that certain cognitive domains are more likely to be affected?
3) Does the evidence indicate that full-scale IQ is negatively affected to a clinically significant level? i.e., if the study reports a statistically significant difference ($p<.005$), does this apply meaningfully in a real-life clinical setting i.e., is the child at a disadvantage in school due to this finding?
4) Does the evidence indicate neuropsychological outcomes vary by suture fusion?
5) What is the quality and limitations of the research evidence included in this review?
6) What recommendations can be made for subsequent research?

Methods

Protocol and registration

This review was registered and published at the PROSPERO Centre for Reviews and Dissemination (ID=CRD42023396874) on the 07.02.2023.

Identification and selection of studies

A systematic search of published studies was conducted by the first author using the following electronic databases: PsychINFO, PubMed and CINAHL. The search was carried out till March 2023. The key terms used in the search were: "Neuropsycholog*"; "cognitive" "non-syndromic craniosynostosis"; "scaphoceph*" "single-suture craniosynos*". Additional papers were added from hand searching reference lists of retrieved relevant systematic reviews (Knight et al, 2014; Osborn et al, 2021).

Inclusion criteria

- School aged children aged five to before their 18th birthday.
- Standardised neuropsychological tests
- Quantitative data availability
- NSC is clearly stated and differentiated from syndromic cases.
- With and without surgery
- Any age of surgery
- Cross sectional, cohort, longitudinal and mixed methods
- Peer reviewed
- Available in the English language

Study Selection

This systematic review was conducted using Preferred Reporting Item for Systematic reviews (PRISMA) (Moher, Liberati, Tetzlaff, Altman & PRISMA Group, 2021. To ensure adequate inter-rater reliability two clinicians (SH & KD) separately conducted each stage of the process i.e., screening, eligibility, extraction, and quality assessment/risk of bias. Throughout each step a Cohen's Kappa (Cohen, 1960) rating of >.81 was required between both raters to proceed to the next stage.

Title & Abstract Screening

In accordance with guidance from the Cochrane Review Methods group (Henderson et al, 2010), a standardised title and abstract form was used. This included definitions and the inclusion/exclusion criteria. SH and KD reviewed 25% of abstracts and titles separately. At this stage all papers included by either rater was sent to full-text screening, even in the event of disagreement. There was substantial agreement between the two raters (k=0.91). SH then proceeded with the rest of screening.

Full text screening

30% of full text records were then independently checked for eligibility by SH & KD. Inter-rater reliability was met, and rater SH then checked if the remainder of the full texts met

eligibility. The Cohen's Kappa for this was k=1, indicating full agreement between raters. SH then proceeded with the rest of full-text screening.

Data extraction

Data was extracted using an adapted form from the Cochrane Collaboration Data Extraction template (Noyes et al, 2018). Factors that could influence the results of neuropsychological testing e.g., biological, environmental, and developmental information were also extracted. Extraction of full text records were done separately by SH and KD for 50% of papers. The inter-rater agreement for 50% of the extraction was a Cohen's kappa core of 0.89, indicating strong reliability between raters, SH then proceeded with the rest of data extraction.

Quality Assessment

The quality rating describes an indication of the degree to which there is a risk of bias in the study design or reporting. The Kmet Tool (2004) "Checklist for assessing the quality of quantitative studies" was used to assess this for the studies included in this paper. The tool contains 14 items. Items 6 and 7 regarding blindness and item 8 regarding control groups of were at times not applicable for some cross-sectional studies, however as per instructions of the tool, these items were pro-rated for the number of relevant items. 40% of papers were separately scored by two raters for agreement on quality assessment. The inter-rater reliability between researchers was a Cohen's kappa of 0.94, indicating strong reliability. SH then assessed the rest of the papers.

Results

Search Results

The database searches identified a total of 453 studies and hand searches identified an additional 6 studies. After removing duplicates, 380 articles remained. After title and abstract screening 28 articles were identified for full text screening. Following this process, 18 articles were identified as being eligible for inclusion in this review. **Figure 1** shows a PRISMA flow diagram (Moher et al, 2009) of the search process.

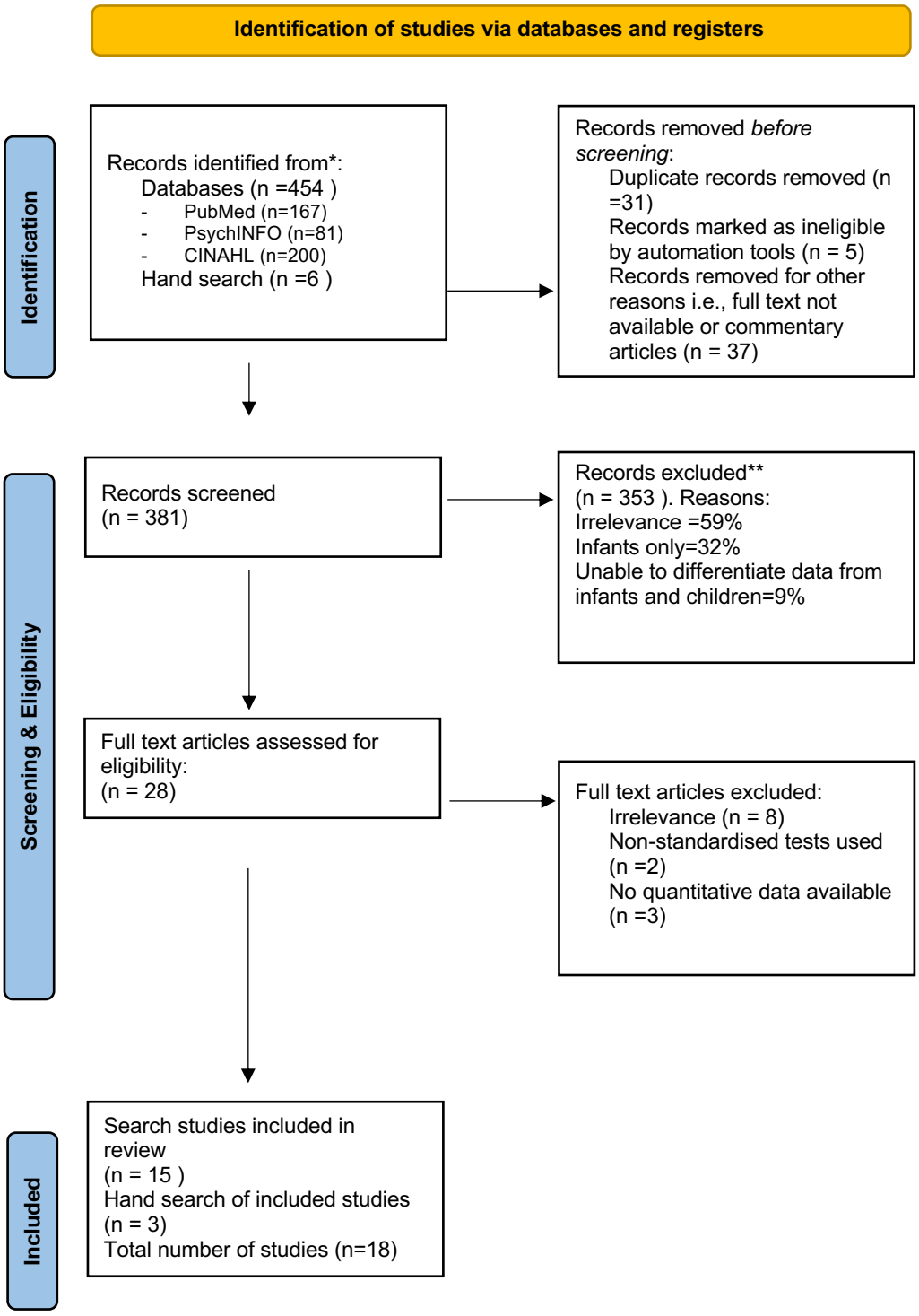


Figure 2. *A PRISMA Flow Diagram of the Search Process*

Summary of Study Methodologies and Reported Data

Please see table 1 for a summary of methodologies and reported data. 17 studies employed a cross sectional design in which school-aged testing occurred at a singular time point. One study (Bellew & Chumas, 2015) conducted a prospective cohort study which longitudinally followed the same patients from infancy and compared scores from infancy to school age.

Three cross sectional studies did not use any control groups or comparator groups (Van der Vlugt, 2012; Klajic 2019; Klajic, 2020). Nine studies used control groups, six of which were matched pairs with unaffected controls (Speltz et al, 2015; Osborn et al, 2021; Craddock et al, 2015; Alperovich et al, 2021; Chieffo et al, 2010; Bolthauser et al, 2003), and three of which were normative data controls (Magge et al, 2002; Wu et al, 2020; Bellew & Chumas, 2015). One study used sibling matched pairs (Bolthauser et al, 2003).

Eight studies used between-group comparison designs in which the same population i.e. participants with NSC were compared by sex (Cradock et al, 2015), sub-type of NSC (Wu et al, 2020; Da Costa et al, 2006; Bellew & Chumas, 2015; Alperovich et al, 2023) age of surgery (Bellew & Chumas, 2015), age of evaluation (Shipster et al, 2003) operated/unoperated (Bellew & Chumas, 2011), operated once and re-operated (Chuang et al, 2021), types of surgery (Patel et al, 2014).

16/18 studies reported robust statistical analyses in the methods and results sections. All 18 of the studies reported where they collected participants from, in which these were either paediatric hospital or craniofacial centres. All 18 studies collected participants with diagnosed NSC by using confirmed radiological reports from computerised tomography (CT) scans.

10 out of the 18 studies reported some form of demographic data i.e., sex, socio-economic status, ethnicity, family history. All papers reported age of neuropsychological evaluation in the form of mean ages with standard deviation or age ranges. All the included papers used standardised neuropsychological testing in their studies.

Table 1.

Summary of Studies included: Design, and frequency of reported data

Study Design	No. of Studies	Statistical Analyses	Sample Origin	Confirmed NSC	Demographic Data	Surgery Status	Age of Surgery	Age of Evaluation	Standardised Neuropsychological Tests
Cross sectional [a]	17	17	17	17	9	16	16	17	17
Prospective [b]	1	1	1	1	1	1	1	1	1
Total	18	18	18	18	10	17	17	18	18

Note: Table 1 shows the number of papers split by study design, that reported various methodological data and demographic data.

[a] = shows the types of controls and comparisons in prospective control designs: Matched pairs control group (n=5); Normative data control group (n=3); between-group comparisons (n=7); no control groups=3

[b]= Bellew & Chumas (2011) longitudinal study.

Demographic Information

Demographic information is presented in Table 2. Overall, participant ages ranged from 5-17yrs old in the studies included. The number of participants in each study ranged from 14-182(M=53.3). Two studies (Cradock et al, 2015; Klajic et al, 2020) reported novel data on samples of children from two previous studies (Speltz et al, 2015; Klajic et al, 2019).

Sex distributions in the sample were not reported by six studies (Magge et al, 2002; Patel et al, 2014; Chuang et al, 2021; Shipster et al, 2003; Da Costa et al, 2006; Bolthauser et al, 2003). Male participants were most prevalent in all studies expect for Wu et al (2020) who collected two more female participants than male.

All studies used NSC cases and divided into sub-type i.e., Sagittal, metopic and Unicoronal. Most studies were conducted on sagittal NSC (n= 14), the next most researched being metopic (n=8), followed by Unicoronal (n=7).

Ethnicity was reported by five studies (Speltz et al, 2015; Klajic et al ,2019; Alprovich et al, 2021; Wu et al, 2020; Junn et al, 2023). All studies were conducted in European or North America which reflected a Caucasian majority (76%) sample.

Socioeconomic status was reported by seven studies (Speltz et al, 2015; Osborn et al, 2021; Cradock et al, 2015; Alperovich et al, 2021; Wu et al, 2020; Junn et al, 2023). There was a general dominance of upper-middle to high socioeconomic status of samples collected (range=53-76%) (Speltz et al, 2015; Osborn et al, 2021; Cradock et a, 2015; Alperovich et al, 2023). Household income over $50,000 was reported by two studies (Alperovich et al, 2021; Wu et al, 2020; Junn et al, 2023) (range=61.3-75%). Two studies reported parental education level which was 53% of parents attending University/College (Klajic et al, 2019; Junn et al, 2023).

Apart from one study (Speltz et al, 2015), all included studies reported surgical status of children i.e., whether they had been operated on or not (Table 2.). 11 studies included participants who had undergone surgical treatment for NSC, three studies included both

operated and unoperated children (Shipster et al, 2003; Bellew & Chumas, 2011, 2015); one study reported outcomes of children who had been reoperated on (Chuang et al, 2021) and two studies included only participants who had not undergone surgical treatment (Osborn et al, 2021; Bolthauser et al, 2003).

All studies aside from four (Speltz et al, 2015; Osborn et al, 2021; Da Costa et al, 2006; Bolthauser et al, 2003), reported ranges or means for "age of surgery" which ranged from 1.2-48 months (Table 2). All studies reported mean or ranges of "age of neuropsychological evaluation" (Table 2.)

Table 2.

Demographic and Participant Characteristics

First Author (Year)	*Country of Research*	*Age of evaluation* [a]	*No. of NSC cases* [b]	*Sex* [c]	*Ethnicity* [d]	*SES (%)* [e]	*Surgical Status* [f]	*Age of Surgery (months)* [g]
Speltz et al (2015)	USA	6.9-9.5 (mean 7.5)	Total=182 Sagittal=76 Metopic=48 Unicoronal=46 Lamboid=12	M=114 F=68	White=145 Other=37	Middle-upper=76%	NA	NA
Osborn et al (2021) *	Australia	6-18+	Metopic=38	M=26 F=12	NA	Middle-upper=58%	Unoperated	NA
Kljajic et al (2019)	Sweden	11(2.4) [7-15]	Total=72 Sagittal=41 Metopic=24 Unicoronal=6 Lamboid=1	M=49 F=24	Swedish=80.8%	University level maternal=61.0%	Operated	7-48.7

						University level parental education=53%		
Cradock et al (2015)	USA	7.4(0.5) [6.9-11.1]	Total=182 Sagittal=75 Metopic=48 Unicoronal=45 Lamboid=12	M=133 F=67	White=80%	Middle-upper=67.8%	Operated	6-9
Van der Vlugt et al (2012)*	Netherlands	[5-17]	Metopic-61	M=68 F=14	NA	NA	Operated	11(+/-4)
Alperovich et al (2021)	USA	10.3(3.2)	Sagittal=75	M=65 F=35	White=78.6%	Household income $65k+=61.3%	Operated	4.8
Magge et al (2002)	USA	10.3 [6.4-15.9]	Sagittal=16	NA	NA	NA	Operated	1.2-10.4
Patel et al (2014)	USA	6-17	Sagittal=70	NA	NA	NA	Operated	6-12+

Chuang et al (2021)	USA	5-16	Sagittal=47	NA	NA	NA	Operated	4.9-15.5
Kljajic et al (2020)	Sweden	11.4 (2.4) [8-15]	Total=61 Sagittal=38 Metopic=23	M=43 F=18	NA	NA	Operated	2.8-12.8
Shipster et al (2003) *	USA	7-16	Sagittal=14	NA	NA	NA	Mixed	6-48
Wu et al (2020)	USA	12(0.2)	Total=20 Left Unicoronal=10 Right Unicoronal=10	M=9 F=11	White=13; Other=7	Household income $50->$100k=75%	Operated	8.1
Bellew et al (2011)	UK	5.35(3.29)	Sagittal=55	M=45 F=10	NA	NA	Mixed	2.8-39.9
Chieffo et al (2010)	Italy	9.2-16.11	Total=65 Sagittal=35 Unicoronal=30	M=48 F=17	NA	NA	Operated	7.2(4-12)

Da Costa et al (2006)*	Australia	7.1-15.8	Total=15 Sagittal=6 Metopic=3 Unicoronal=6	NA	NA	NA	Operated	NA
Bolthauser et al (2003)*	Switzerland	9.25 [6-16.11]	Sagittal=14	NA	NA	NA	Unoperated	NA
Bellew & Chumas (2015)*	UK	8.01-11.87	Total=75 Sagittal=47 Metopic=13 Unicoronal=15	M=53 F=22	NA	NA	Mixed Operated=62	<7->9
Junn et al, (2023)	USA	10.9(+/-4)	Sagittal: =139 Metopic= 39 Unicoronal=22	M=110 F=94	White=74%	$65k=56.7%	Operated	9.0(12.2)

Note: NSC= non-syndromic craniosynostosis. M=Male; F=Female; NA= Not Available; USA= United States of America; UK= United Kingdom

* Indicate larger studies in which data that met the current reviews inclusion criteria was able to be extracted.

[a] = age of evaluation expressed in either mean (standard deviation) or [range]

[b] = number of cases per NSC suture subtype reported

[c] = sex i.e., number of male and females within the sample

[d] =ethnicity stating ethnic group by number or % within the sample

[e] = Socioeconomic status which has been expressed as either middle-upper class, education level of gross annual income. University level of university indicating middle-upper classes, and gross annual incomes of $50,000 per Anum or above grouped as middle-upper class.

[f] = refers to whether the sample collected were operated, unoperated, reoperated i.e. 2+ operations, or mixed (both operated and unoperated).

[g] = age of surgery transformed into months expressed as mean (standard deviation) or ranges.

Study strengths, limitations, and quality assessment

The quality of included studies was assessed using the Kmet quality assessment tool (Kmet et al, 2004). The tool has items that assess a study's research question, design, sample/input data, sampling method, intervention design, outcome/exposure measures, analysis and conclusions. This key, which differentiates between strong (>0.8), moderate (0.6– 0.8) and weak (<0.6) studies, was used in the current systematic review (Henry et al, 2016). Please see **Table 3.** for study design, strengths, limitations, and quality assessment ratings for each study.

Nine of the 18 studies included in this review scored above 0.8 giving a score of "Strong" on the Kmet tool (Speltz et al, 2015; Osborn et al, 2021; Cradock et al, 2015; Alperovich et al, 2021; Chuang et al, 2021; Wu et al, 2020; Bellew & Chumas, 2011; Bellew & Chumas 2015; Junn et al, 2023). Common areas in which these studies scored highly were due to strong methodologies including: adequate-large sample sizes, use of standardised measures, smaller age ranges, use of control groups, high inter-rater reliability of investigators administering neuropsychological tests, investigator blinding, reporting demographic variables as confounders or covariates, strong statistical analysis with post-hoc tests and novel findings.

Five of the 18 studies included in this review scored between 0.6-0.8, giving a score of "moderate" on the Kmet tool (Klajic et al, 2019; Klajic et al, 2020; Patel et al, 2014; Shipster et al, 2003; Chieffo et al, 2010). Common limitations of these studies were small sample sizes, no controlling for demographic data, lack of control group, insufficient information in the results section, vague reports of FSIQ e.g., >85, and mixed samples.

Four of the 18 studies included in this review scored <0.6, giving a score of "Weak" on the Kmet tool (Van der Vlugt et al, 2012; Magge et al, 2002; Da Costa et al, 2006; Bolthauser et al, 2003). Common limitations of these studies included very low sample sizes, unclear procedures, no control groups or inappropriate groups, no demographic data reported, no mention of covariates or confounders, use of mixed samples, broad age ranges requiring use of many different tests, unclear inclusion, exclusion criteria, insufficient results reported, overestimation of significance where there was no clinical significance or inappropriate statistical analysis.

Overall, the quality of the studies in this review are mixed. Those in moderate-strong categories are in the majority, however 14 studies are a small proportion to draw out conclusions as the aims of these studies were mixed. Four of the weak studies have been widely cited by researchers despite poor methodological quality.

Table 3.

Study Design, Strengths, Limitations & Quality Ratings

Author (Year)	*Study Design*	*Strengths*	*Limitations*	*Quality Assessment Rating* [a]
Speltz et al (2015)	Cross sectional design with matched pair controls.	Strong Inter-rater reliability of psychometric tests. Matched pairs control group used Longitudinal design Good sample size Robust data analysis plan and results Controlled for demographic variables e.g., SES, gender Use of standardised neuropsychological tools Used 3D radiological CT scans to confirm NSC	Mostly from high SES Mostly Caucasian sample High attrition rate	0.81 (Strong)

Osborn et al (2021)	Cross sectional design with matched pairs controls	Control group used Standardised measures based on age of participant used and pro-rated Matched pairs used Used 3D radiological CT scans to confirm NSC Adequate sample size	High SES of control group	0.83 (Strong)
Klajic et al (2019)	Cross sectional design	Small age-range Inter-rater reliability in testing Statistical analysis reported Full results of WISC battery published Age is high enough to predict adult outcomes and use the same tests Used 3D radiological CT scans to confirm NSC Substantial demographic data	Over estimation of frequency of ASD and ADHD due to bias of participants being tested for it. Relatively low sample size. No control groups	0.61 (Moderate)

Cradock et al (2015)	Cross sectional design Between group differences of sex. Between group differences with matched pairs of healthy controls.	Unique study looking at sex differences Strong inter-rater reliability of testing Standardised neuropsychological measures used Control group used Robust and thorough data analysis Controlled for confounders Used 3D radiological CT scans to confirm NSC	Mostly from high SES which influences academic performance Lamboid sample was excluded due to low size	0.95 (Strong)
Van der Vlugt et al (2012)	Cross sectional design	Moderate sample size Used 3D radiological CT scans to confirm NSC Statistical analysis reported	No control group No confounders controlled for No demographic data Use of dated terminology e.g. “mental retardation” Did not separate results by age group- range was too large Correlational design was user to infer causation Vague definitions used to diagnose ASD, ADHD, CD, ODD	0.36 (Weak)

Alperovich et al (2021)	Cross sectional design. Between group comparison with healthy matched pair controls.	Rigorous methods and analysis Good sample size Demographics reported Used 3D radiological CT scans to confirm NSC	Selection bias of participants which could lead to higher estimated of FSIQ. Groups were not directly comparable on some accounts so were not truly "matched" pairs.	0.91 (Strong)
Magge et al (2002)	Cross sectional with between group comparisons with normative data as controls.	One of the first studies of its kind at the time Used normative data for comparisons Used 3D radiological CT scans to confirm NSC	Sample size was too low to infer any viable conclusions Poor statistical analyses used No demographic data No control for confounders Potential for selection bias	0.27 (Weak)
Patel et al (2014)	Cross sectional design with between group comparison of surgery types.	Controlled for SES Strict exclusion criteria Good sample size Use of standardised neuropsychological measures	Lacked details on reporting demographic variables	0.72 (Moderate)

		Used 3D radiological CT scans to confirm NSC		
Chuang et al (2021)	Cross sectional design with between groups comparison of reoperated versus non-reoperated children.	Robust and thorough methodology Novel comparison of re-operated and once operated participants Use of standardised neuropsychological measures Adjusted results for confounders Statistical analyses reported Used 3D radiological CT scans to confirm NSC	Risk of bias in samples 13 in re-operation group- however this may reflect how seldom this occurs.	0.81 (Strong)
Klajic et al (2020)	Cross sectional design	Novel use of Conner's CPT-3 measure for attentional difficulties. Statistical analysis reported Moderate sample size	Mixed sample No control group	0.62 (Moderate)

		Used 3D radiological CT scans to confirm NSC		
Shipster et al (2003)	Cross sectional design between group comparison of age ranges.	Use of standardised neuropsychological measures Moderate sample size Factors affecting scores discussed Used 3D radiological CT scans to confirm NSC Use of different tests dependant on age range	No separation of sagittal and metopic subtypes which may contribute to differences	0.73 (Moderate)
Wu et al (2020)	Cross sectional design. Between group comparisons of right versus left Unicoronal NSC. Between group comparisons	Post hoc power analysis used and resulted in adequate power Double blinding of testers Use of standardised neuropsychological measures Gave overview of subtypes of Unicoronal Robust data analyses Use of covariates e.g. SES, maternal education, breast feeding	Use of abbreviated neuropsychological measures Potential selection bias due to high SES	0.92 (Strong)

	with normative population data as controls.	Used normative population data for comparisons Used 3D radiological CT scans to confirm NSC		
Bellew & Chumas (2011)	Prospective cohort design with between group comparisons or operated versus non-operated.	Looked at children with mild SS only Longitudinal design Use of control group Adequate sample size Strict inclusion exclusion criteria Statistical analysis reported Used 3D radiological CT scans to confirm NSC	Griffiths mental scale used for 5 year olds, focuses on motor skills and not higher-order domains.	0.83 (Strong)
Chieffo et al (2010)	Cross sectional design with matched pair controls	Used an array of standardised neuropsychological tests Control group used Demographics reported Statistical analysis reported	Possible confounders in time between evaluation and age of surgery being too short.	0.61(Moderate)

		Used 3D radiological CT scans to confirm NSC		
Da Costa et al (2006)	Cross sectional design. Between group comparisons of suture subtype and between group comparisons with syndromic craniosynostosis.	Data analysis plan was robust Demographics reported Clear statistical plan Used 3D radiological CT scans to confirm NSC	Used a mixed syndromic and NSC sample, many confounders to control for that may have been overlooked Very small sample sizes Lack of detail on cognitive domains reported	0.55 (Weak)
Bolthauser et al (2003)	Cross sectional design with between group comparisons of healthy matched pairs and	Some indication of results of FSIQ and cognitive domains in comparison to control Control group used Demographic data reported Used 3D radiological CT scans to confirm NSC	Attempted to match with healthy siblings but sample was too low No clear inclusion/exclusion criteria Unclear recruitment procedure Unclear results Broad age ranges – requiring use of different neuropsychological tests	0.25 (Weak)

	unaffected siblings.			
Bellew & Chumas (2015)	Cross sectional. Between group comparisons of suture sub-type and age of surgery. Between group comparisons with normative population data as controls.	Replicated earlier studies findings Use of standardised neuropsychological measures Used normative data as comparisons Included covariates of sex, subtype of NSC and age of surgery. Good sample sizes for sagittal and unicoronal Used 3D radiological CT scans to confirm NSC	Potential selection bias Large attrition rate Too few metopic patients to support viable conclusions	0.83 (Strong)
Junn et al (2023)	Cross sectional design. Between group comparisons of suture sub-types	Replicated earlier findings. Use of standardised neuropsychological tests. Assessed children at an older age. Included demographic data Robust statistical analysis Large sample size	High SES, white majority sample Small number of metopic patients in comparison to sagittal	0.84 (Strong)

	Use of radiological CT scans to confirm diagnosis

Note: Cohen's Kappa was calculated between two independent raters which equated to =0.94, indicating strong inter-rater reliability of quality assessment.

SES= Socio-economic status; 3D= three dimensional; CT= computerised tomography.

[a]Quality Assessment Ratings: the key is as follows: strong (>0.8), moderate (0.6– 0.8) and weak (<0.6).

Neuropsychological Outcomes by Suture Sub-type

Table 4. shows the Neuropsychological measures used by each paper. All papers included in this review used standardised neuropsychological tools that were appropriate for school aged children. The most frequently used measures included: WISC-III/IV/IV (n=9); BRIEF (n=4); Beery Buktenica Developmental Test (n=5); WASI (n=5); WF-Academic Skills (n=4).
Other measures included WRAT-4 (n=2); Connor's CPT3 (n=2); WPPSI, CELF, GMDS, and WAIS-IV (n=1). For full descriptions of these tests and what cognitive functions they assess please see **Appendix C.**

Full Scale IQ (FSIQ) was reported in all but two studies (Magge et al, 2002; Bellew & Chumas, 2011). The remaining 16 studies reported FSIQ by subtype of NSC. All studies included gave neuropsychological test results of specific cognitive domains, aside from one (Van der Vlugt et a, 2012). Each suture subtype has been discussed with FSIQ results, then results of cognitive domains. Ranges of FSIQ have been reported from studies by reporting the results of the lowest FSIQ average to the study with the highest FSIQ average. Only one study included people with IQ's below 70, indicating an intellectual disability (Van der Vlugt, 2012). A summary of areas of the brain and suture subtype functioning that may be affected according to this reviews findings are in **Figure 3.**

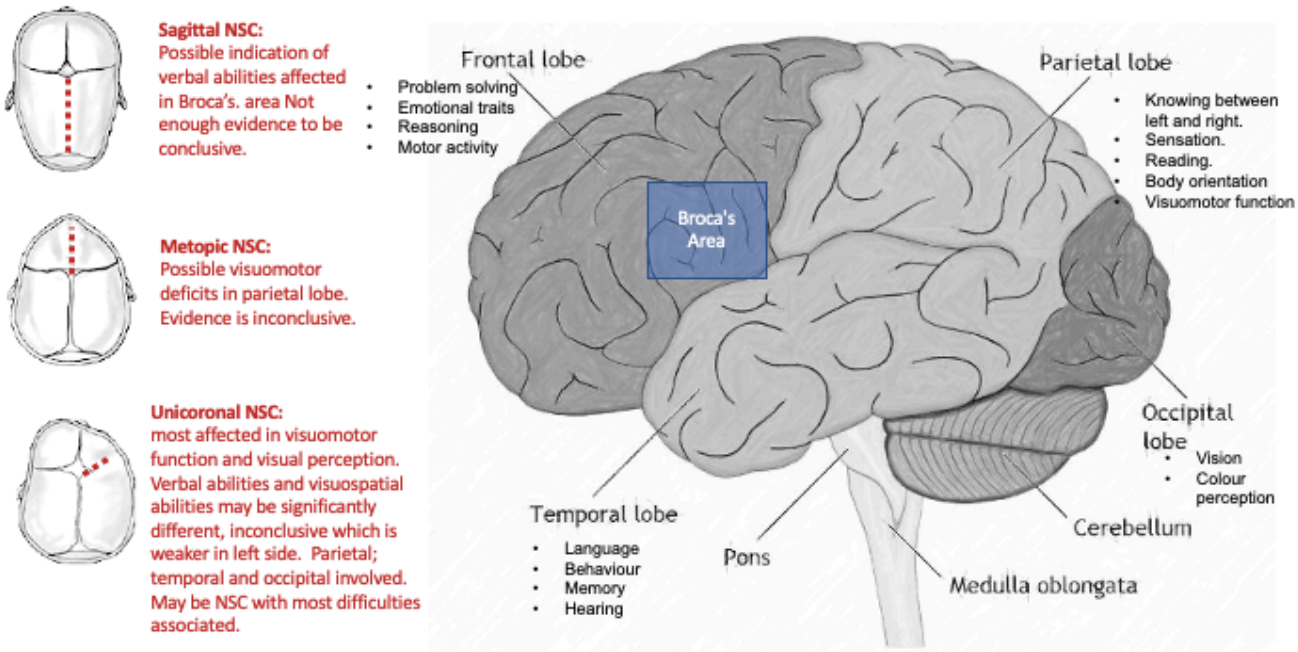


Figure 3. *A diagrammatic summary of areas in the brain that may be affected according to different suture subtypes.*

Sagittal FSIQ

13 studies reported FSIQ of school aged children with sagittal NSC. In operated patients these results ranged from 97-112.5 (Klajic et al, 2019; Bolthauser et al, 2003; Junn et al, 2023). In re-operated patients, FSIQ was reported as 109 (Standard deviation (SD)=17.8)) in those re-operated on early <6months old, versus 105.5 (14.7) in 47 participants re-operated on later than 6 months (Chuang et al, 2021). 75 patients with cranial-vault surgery had significantly higher FSIQ (115.9 (15.4)) than those who underwent spring assisted surgery 103.9 (14.4) (Alperovich et al, 2021). Five studies with large sample sizes (35-139 participants) found statistically significant differences in early surgery vs later surgery, with the highest FSIQ in children who underwent operation before 6months- 1yrs of age (Chieffo et al, 2010; Bellew & Chumas, 201; Chuang et al, 2021; Patel et al, 2014; Alperovich et al, 2021). The remaining studies did not report outcomes specific to age of surgery. Shipster et al (2003) found no significant difference between FSIQ if sagittal NSC patients were operated on or not, however if children were operated on when older, this was associated with slightly lower FSIQ scores, but these were not meaningful enough to warrant educational intervention, and the sample size was 14 participants, indicating low power of the study. In regard to sex differences, one study with 75 sagittal NSC patients found when compared on the WISC-IV, girls had higher FSIQs than boys (Cradock et al, 2015).

Sagittal Cognitive domains

Most papers reported that children with sagittal NSC score higher across all domains in comparison with other suture subtypes (Table 3). Klajic et al (2019) found small deviations in domains from normative scores in the population in 41 sagittal NSC cases, but these were not significant in real world settings. Three studies with sample sizes ranging from 16-47 cases, suggested that sagittal NSC patients have more uneven cognitive profiles in which Verbal Intelligence (VIQ) is more affected than performance intelligence (PIQ), meaning children could have difficulties in reading/spelling and speech and language difficulties (Magge et al, 2002; Shipster et al, 2003; Bellew & Chumas, 2015). Chieffo et al (2010) found a minority of

children with visual attention and visuospatial planning deficits in a sample of 35 children with sagittal NSC.

On the WASI-II/III, 10 out 13 studies found average VIQ sores which ranged from 102.1(14.4)-117.7(15.3), and average PIQ scores which ranged from 99.4(15.3)-110.9(13.7) (Alperovich et al, 2021; Magge et al, 2002; Patel et al, 2014; Chuang et al, 2021; Shipster et al, 2003; Chieffo et al, 2010; Da Costa et al, 2006; Bolthauser et al, 2003; Bellew & Chumas, 2005; Junn et al, 2023). VIQ and PIQ scores were higher in patients who had undergone surgery before 6 months of age (Alperovich et al, 2021; Patel et al, 2014; Chuang et al, 2021; Chieffo et al, 2010, Bellew & Chumas, 2015), and who had undergone cranial vault surgery (Alperovich et al, 2021).

Similarly, studies which reported domains of the WISC-III/IV found no statistically significant differences between patients with sagittal NSC and controls, with perceptual reasoning index (PRI) scores ranging between 105 (2.2)- 109.1 (16.2). Working memory index (WMI) scores ranging between 93(2.0)-109.1(16.2) and Processing Speed Index (PSI) ranging between 91.1(2.3)-102.1(13.1) (Klajic et al, 2019; Cradock et al, 2015).

Two studies looked specifically at attentional difficulties using the WISC III/IV and Connor's CPT3 and found no deficits in sagittal participants with sustained attention (Bolthauser et al, 2003; Klajic et al, 2020).

Two studies that used the BRIEF to measure general executive functions found sagittal NSC patients perform in the average to high-average range (Patel et al, 2014; Chuang et al, 2021). Three studies used the Beery-Buktencia Development Test of Visual-Motor Integration (VMI) helps assess the extent to which individuals can integrate their visual and motor abilities. VMI scores ranged from 93.2 (19.51)- 112.2(16.2), which fell into the "average" range, with lower scores for patients who underwent surgery after 12 months of age. (Alperovich et al, 2021; Chuang et al, 2021; Junn et al, 2023).

Finally, two studies used the Weschler Fundamentals- Academic Skills test, which found Reading, reading comprehension, spelling, and maths scores in the "average range", which again were higher for children who underwent early surgery in comparison to no surgery and surgery after 1yrs old (Chuang et al, 2021; Shipster et al, 2003).

Metopic FSIQ

Seven studies reported the FSIQ of metopic NSC in school aged children (Speltz et al, 2015; Osborn et al, 2021; Klajic et al, 2019; Van der Vlugt et al, 2012; Da Costa et al, 2006; Bellew & Chumas, 2015; Junn et al, 2023), and the sample sizes for these studies ranged from 13-48 participants. The FSIQ measured using the WISC-III/IV and WASI for metopic patients ranged from 93.1 (16.5)-110.3(4.2) (Osborn et al, 2021; Da Costa et al, 2006; Junn et al, 2023). Osborn et al (2021) reported 38 children with metopic NSC functioned at a similar level to control groups, and that SES could be a protective factor in this instance. One study reported that girls who have metopic NSC have statistically significantly higher FSIQs than boys with the same condition (Cradock et al, 2015). One study that included children with intellectual disabilities found 7 out of 61 patients with metopic NSC scored below 70 for FSIQ (Van der Vlugt, 2012). There was not enough data in Bellew & Chumas (2015) study in the un-operated metopic NSC patient group to compare whether they scored worse than the operated. A larger scale study recently conducted by Junn et al (2023) found FSIQ was on average statistically significantly lower in metopic patients (100.05 (11.76)) than sagittal (108.32(14.4)) (p=.004), however patients still fell within the average range of FSIQ therefore clinically there may be no difference between these sub-types.

Metopic Cognitive Domains

Eight out of the 17 included studies report neuropsychological outcomes for specific cognitive domains that may be affected by metopic NSC (Da Costa et al, 2006; Bellew & Chumas, 2015; Klajic et al, 2020; Van der Vlugt et al, 2012; Cradock et al, 2015; Klajic et al, 2019 Osborn et al, 2021, Speltz et al, 2015; Junn et al, 2023).

Bellew & Chumas (2015) showed results of the WASI for Verbal Intelligence Quotient (VIQ) and Performance Intelligence Quotient (PIQ) accounting for whether the patients were operated on or not. There was a significant difference in metopic NSC patients who had surgery VIQ =96(26.9) versus unoperated VIQ=87.8(15.8), as well as a significant difference in operated scores for PIQ=96(10.1), versus unoperated PIQ=86.1(15.8). This study also showed that metopic scores in general are higher than Unicoronal NSC scores, but less than sagittal NSC. This study had a low metopic sample of 13 cases; however the finding was repeated by Junn

et al (2023) who found in 39 metopic NSC cases, patients scored significantly lower than sagittal NSC patients in both VIQ and PIQ (p=<.05)

Two studies (Osborn et al, 2021; Klajic et al, 2019) reported results from the WISC-V showing that the WMI ranged from 93.1(15.3)-99.2(2.6) and the PSI ranged from 87.3(14.3)-94 (3.0). One study reported that the PRI scores were on average 103.1(2.6). Osborn et al (2021) found that Socio-economic status (SES) acted as a protective factor in improving scores across these domains, and when removed from the equation, there are small deficits noted on more complex tasks that require more cognitive flexibility, however again these were not clinically significant.

One study with a sample of 23, found metopic NSC patients score worse on measures of attention using the Connors CPT3 (Klajic et al, 2020), however these deficits are not clinically significant and are within 1 standard deviation from the normative population scores. The same authors found that metopic NSC patients have a more consistent cognitive profile across domains than sagittal NSC (Klajic et al, 2019). Conversely, Junn et al (2023) recently found that metopic NSC patients have a statistically significantly more severe neurocognitive profile, in which lower FSIQ score (-8.66 (-13.66,-3.65; p=<.001) and visuomotor domain scores (-9.36 (-13.75,-4.97;p=<.001) were found relative to sagittal and unicoronal NSC.

Unicoronal FSIQ

Six of the 18 included studies have reported the FSIQ of Unicoronal NSC (Speltz et al, 2015; Wu et al, 2020; Cheiffo et al, 2010; Da Costa et al, 2006; Bellew & Chumas, 2015; Junn et al, 2023). Measured by the WISC-IV, in Unicoronal NSC patients, FSIQ ranged from 100.4(10.6)-112.3(17.1) (Wu et al, 2020; Speltz et al, 2015). Chieffo et al (2010) reported that FSIQ for 20% of Unicoronal NSC patients fell in the “high average” range, 28% in the “average range”; 28% in the “low- average range”, and 24% in the “low range”. Bellew & Chumas (2015) found no significant difference in FSIQ of operated versus unoperated patients. One study (Cradock et al, 2015) found similarly to sagittal and metopic NSC patients, in which girls in the Unicoronal NSC group scored significantly higher FSIQ than boys with the same condition. Junn et al (2023) found that metopic NSC patients scored significantly worse (100.05(11.8)) than Unicoronal (102.8(12.61)) on FSIQ, however this difference is clinically insignificant.

Unicoronal Cognitive Domains

Outcomes for specific cognitive domains have been reported in five studies (Speltz et al, 2015; Wu et al, 2020; Da Costa et al, 2006; Bellew & Chumas, 2015; Junn et al, 2023). WASI scores reported that VIQ scores range from 92.3(17.9)- 117.3(18.8); PIQ scores ranging from 86.2 (12.2)- 106.4(16.4). Chieffo et al (2015) reported differences between left anterior unicoronal NSC and right anterior unicoronal NSC. VIQ scores in the "left" sample were significantly lower (92.6) than PIQ scores (105), whereas in the "right" group a more homogenous profile was seen with VIQ scores of =99.5, and PIQ scores of 95.6. In the "left side" group more than 23% of patients had difficulties with reading and comprehension. Wu et al (2020) study replicated Chieffo et al (2015) on a larger sample size and found left sided Unicoronal NSC participants scored significantly higher on VIQ than PIQ. Conversely, Speltz et al (2015) found no significant difference between controls and Unicoronal NSC patients on any cognitive domains or on tasks of reading and spelling in a larger sample of 46 patients.

Wu et al's (2020) study reported VMI-96.5(12.4) which was in the average range. One study between operated versus unoperated showed lower scores in unoperated children with Unicoronal NSC (Bellew & Chumas, 2015). Sub-type comparison studies such as Junn et al (2023) found statistically significant differences in visuomotor integration score (-6.59; CI: -13.81, -3.41; p=0.001) and visual perception scores (-8.76; CI:-13.79,-3.26;p=0.002) in 22 unicoronal patients.

Table 4.

Study Results of Neuropsychological Outcomes in school-aged children.

First Author (Year)	*Measure* [a]	*Suture sub-type (sample size) =FSIQ m(SD)* [b]	*Results of Cognitive Sub-tests* [c]	*Summary of Results* [d]
Speltz et al (2015)	WISC-IV; WRAT-4; TOWRE; CTOPP	Sagittal (76)= 105.8(14.7) Metopic (48) =102.2(17.8) Unicoronal (46) =100.4(16.3) Total FSIQ <69=3.3%	Sagittal: FSIQ: 105.8 (14.7). Math computation: 101.1 (12.8). Reading composite: 109.4(14.7) Spelling: 108.4 (13.4). Total word reading efficiency: 107.3 (13.8). Phonological awareness: 109.3 (14). Rapid naming: 100.2 (11.5) Unicoronal: FSIQ: 100.4(16.3). Math computation: 95.7 (13.4). Reading composite: 100.1(16) Spelling: 101.5 (17.9). Total word reading efficiency: 99.8 (17.0). Phonological awareness: 105.4 (14.7). Rapid naming: 99.5 (11.6)	A good-sized sample of Sagittal NSC participants scored higher on all tests in comparison with other suture types. Overall downward shift in IQ scores and maths computation, but not clinically significant. No clinically significant difference between controls and NSC patients in reading, spelling, total word reading efficiency, phonological awareness, or rapid naming.

			Metopic= FSIQ: 102.2 (17.8). Math computation: 98.7 (14.4). Reading composite: 105.8(18.4) Spelling: 105.0 (14.7). Total word reading efficiency: 104 (17.3). Phonological awareness: 107 (17.8). Rapid naming: 101.1 (13.3)	
Osborn et al (2021) *	WISC-V, NEPSY II, D-KEFS, BRIEF	Metopic (38) =93.1(16.5)	VCI=93.1(15.3); WMI=95.3(19.6); PSI =87.3(14.3)	Children with metopic NSC are generally functioning at a similar level to healthy peers. Smaller deficits noted on more complex tasks that require greater cognitive flexibility. SES could be a protective factor in this. The sample size in this study was on the smaller side.
Klajic et al (2019)	WISC-IV	Sagittal (41)=97[CI 92.4-101.6] Metopic (24) = 99.4[CI93.4-105.4]	Sagittal: PRI =105 (2.0). WMI =93(2.0) and PSI=91.1(2.3). VCI=97.8(2.4) Metopic: PRI= 103.1(2.6); WMI score= 99.9(2.6); PSI=94(3.0). VCI=99.9(3.1)	Small deviations in FSIQ and domains from normative scores in the population, may not be clinically significant in real world terms. Sagittal NSC have a more uneven cognitive profile, metopic was consistent across all domains. Metopic patients may have better working memory than sagittal; however, the sample size of metopic group was smaller.

Cradock et al (2015)	WISC-IV; WRAT-T; TOWRE; CTOPP	Sagittal (75) = 105.8(14.7) Metopic(48) =102.2(17.8) Unicoronal (6)=100.4(16.3)	Female: VCI=104.7(17.4); PRI=109.1(16.2); WMI=104.9(15.4); PSI=102.1(13.1). Male: VCI=99.6(16.3); PRI=103.1(16.9); WMI=99.6(14.6); PSI=97(14.6).	Females significantly outperformed males in cognitive tests across all domains and academic tests of maths, spelling and reading skills. Substantial educational interventions needed for boys with metopic and Unicoronal NSC who scored the lowest. The sample size of this study was good.
Van der Vlugt et al (2012)*	WPPSI (Dutch Version); WISC-IV; WAIS-IV	Metopic (61) =101.3(21) Total FSIQ<70=7	NR	ASD, ADHD, ODD,CD are more prevalent in metopic patients with IQ's less than 85. Those with IQ's above 85 had the same prevalence as normative populations. This study had a good sample size but an overall weak methodology.
Alperovich et al (2021)	WASI; Beery-VMI	Sagittal (75) =109.7(16) Cranial vault surgery=115.9(15.4). Spring assisted surgery= 103.9(14.4)	Cranial Vault Surgery: VIQ=117.7(15.3); PIQ=110.9.(13.7). VMI=112.2(16.2). Spring Assisted Surgery: VIQ=104.5(16); PIQ=102.8 (15). VMI=95.7(9.7)	Patients with cranial vault reconstructive surgery have significantly higher FSIQ's and visuomotor integration than spring assisted surgery participants. Age of surgery before 6 months tend to have the best long term neuropsychological outcomes. Patients with sagittal

				NSC appear to have good long term cognitive outcomes. This is a strong quality study with a good sample size.
Magge et al (2002)	WISC-III; Conners CPT3; WCPT; Beery-VMI,	Sagittal (16) : 110.6	VIQ-113.8; PIQ=105.4	Significant differences between VIQ & PIQ, suggesting likelihood of learning disabilities. 50% had reading/spelling disabilities. The sample size of this study was very low and conclusions should be taken with caution.
Patel et al (2014)	WASI; BRIEF; Beery-VMI	Sagittal (70) =103.6 (11.3) <6month surgery=112.4(11.4); 6-12months surgery=103.7(11.5); >12months surgery=94.8(11.4)	<6months: VMI=107.3(16.6); VIQ=111.82(12.8); PIQ=110.5(10.1). Attention Shifting=55.1(14.7); GEF=54.6(14.8); Working Memory=54.32)12.9) 6-12months: VMI=101.72(13.63); VIQ=102.9(13.7); PIQ=104(11.4). Attention shifting=51.6(11.3); GEF=55.9(17.6); Working Memory=55.6(13.1) >12months: VMI=93.25(19.51); VIQ=92(13.9); PIQ=99.3(8.6). Attention	Surgical intervention for sagittal NSC before 6 months is associated with better long term neuropsychological outcomes. Visuomotor integration results worsen the most if surgery is delayed. The sample size of this study was good and therefore results are well powered.

			shifting=57.4(14.7); GEF=64.8(12.4); Working memory=64.9(12.9)	
Chuang et al (2021)	WASI; WF-AC; Beery-VMI; BRIEF	Sagittal (47) =107.3(16.2) Non-reoperated=105.5(14.7) Reoperated=109(17.8)	Non-reoperated: VMI=102.1(14.4); VIQ=107.2(17.7); PIQ=103.5(13.0). Attention shifting=52.3(14.6); GEF=55.87(17.1); Working memory=54.9(12.2); Inhibition=52.8(12.6). Word reading=100.3(26.1); Reading comprehension=96.3(20.0); Spelling=96.4(20.2); Maths=94.9(15.8). Reoperated: VMI=109.5(19.3); VIQ=110(15.1); PIQ=106.6(17.83). Attention Shifting=50.2(10.0); GEF=50.9(11.4); Working memory=52(10.3); inhibition=50.9(11.8). Word reading=110.5(20.1); Reading Comprehension=106.7(13.2); Spelling=102(20.0); Maths=103.9(12.6).	Reoperation was not associated with worse neuropsychological outcomes. However earlier surgery has better neuropsychological outcomes for patients with Sagittal NSC. There were better visuomotor integration in those who had earlier reoperations, after their 1st operation than those who had later 1st operations. The sample size for this study was adequate.

Klajic et al (2020)	WISC-IV; Connors CPT3	Sagittal (38) =97[CI 92.4-101.6] Metopic (23) = 99.4[CI93.4-105.4]	Sagittal: Response style=52.5(6); Detectability=56.8(8.8); Omissions=56.6(10.2); Commissions= 54.3(7.8); Perseveration= 58.9(13.8); HRT-SD=56.6(13.0); Variability=56.1(13.3); HRT-iC=55.2(9.1) Metopic: Response style=51.7(9.5); Detectability=55.6(8.3); Omissions=54.9(10.8); Commissions= 54.4(8.8); Perseveration= 56.2(10.4); HRT-SD=57(8); Variability=55(8.0); HRT-iC=53.8(9.7)	Age of and type of surgery in sagittal NSC did not affect sustained attention or vigilance. Patients with sagittal NSC have better "hit reaction time" than metopic patients, but this is only one of several measures of inattentiveness. Patients with both metopic NSC scored significantly worse on several measures of inattention, however the differences were within 1SD of the norm and may not be valid in clinical terms. The sample size for this study was smaller than other well powered studies.
Shipster et al (2003) *	WISC-III; CELF-R; WF-AC;	Sagittal (14) =102.6(67-135)	VIQ=102(61-140); PIQ=102.1(68-134) CELF-R: Receptive language=103.8(67-131); Expression=98.6(64-121). British Vocab Scale=98.2(75-132). 6% prevalence of speech and language difficulties (5 males;1female) (CI: 17.7-71).	6/14 patients displayed speech and language difficulties. No evidence of increased cognitive impairment in this age range. Increased rate of exceptionally high FSIQ for patients. There were no significant differences in scores if they had been operated/unoperated on. However, if operations happened to children when they were older, this was associated with a higher likelihood of speech,

				language and cognitive impairments. Conclusions drawn from this study should be taken with caution due to the very low sample size.
Wu et al (2020)	WASI; WF-AC; Beery-VMI; BRIEF	Unicoronal (20) =112.5(17.1)	VIQ=117.3(18.8); PIQ=106.4(16.4). VMI=96.5(12.4); Visual perception=99.5(12.1); Motor Coordination=85.7(16.8). BRIEF: Inhibit=47(5.7); Shift=46.2(7.6); Emotional control=45.7(10.7); Initiate=49.6(11.6); Working memory=49.9(10.3); Plan/organize=50.1(11.5); organization of materials=49.8(8.6); monitor=47.1(8.8); behavioural regulation index=45.6(83); Metacognition index=49.3(9.9); Global executive composite score=52.1(8.2). WF Academic: Word reading= 113.3(17.2); Reading comprehension=101.1(21.7); Reading composite=107.7(19.2); Spelling=105.8(21.2); Numerical operations=98.1(22.7)	Children who had surgery before 6 months had higher scores but not significantly different than after 6 months. Strabismus diagnosis was significantly more common in patients who underwent surgery at a later age (p=0.041). Girls had significantly better motor coordination than boys (p=0.024). Right unilateral NSC had higher spelling scores than left (p=0.017). Left unilateral NSC significantly predicted higher spelling scores on multivariate analyses (R_2=0.650, p=0.033). Patients with left unilateral score significantly higher on VIQ than PIQ, and have better language academic achievement than numerical. This studies sample size was adequate in comparison to other well powered studies.

Bellew & Chumas (2011)	Griffiths Mental Scale	Sagittal (55)=NR	Surgical: GQ=111.2(12.4); Locomotor Scale=120.8(13.3); Personal-Social Scale=107.1(13.8); Hearing & Speech Scale=113.9(20.0); Hand eye coordination scale=107.3(13.1); Performance Scale=109.1(13.1). Non-surgical: GQ=106.4(10.3); Locomotor Scale=107.7(14.8); Personal-Social Scale=101.8(9.4); Hearing & Speech Scale=107.7(17.3); Hand eye coordination scale=101(11.1); Performance Scale=109.1(18.3).	Children with Sagittal NSC who have mild cognitive deficits at infancy, have more significant deficits at aged 5 if they do not undergo surgery. Gross motor development appears to improve the most after surgery. This study had a good sample size.
Chieffo et al (2010)	WISC-R (Italian Version); PPT; BBDT-VMI; RCF; DS; BCT; SSDS; TLT	Sagittal (35) =Average range IQ, 31% above average. Unicoronal (30) = (20% high average; 28% average; 28%	Sagittal: VIQ=111.4; PIQ=99. 17% mild difficulties in Coding & Symbol Search. 2 cases severe selective and sustained attention deficits. Normal range Verbal planning, visual motor skills, working memory.	Children undergoing treatment during the 1st year of life tend to have "normal" intellectual scores in adolescence. Minority of children with sagittal can have visual attention, visuo-spatial planning deficits. Anterior plagiocephaly had verbal fluency and working memory functions in the below average range. These rates are

		low average; 24% low	Unicoronal= Left anterior plagiocephaly severe difference in VIQ (92.6) vs PIQ (105). Right plagiocephaly- homogenous profile: VIQ(99.5) & PIQ(95.6). 10% mild deficits in working memory; hand eye coordination visual perception and visual attention skills- right anterior plagiocephaly. 13% mild deficits in rapid reading tests in anterior plagiocephaly. 23% difficulties in reading comprehension. Writing skills- 7% below average- errors in reading speed decoding and scanning printed text.	higher than control and statistically significant with verbal fluency tests (p=.002) and almost significant for reading competence (p=.007). Sagittal: difficulties in working memory, attention, and planning. provides some evidence for lower-than-average outcomes long term. This study had an adequate sample size.
Da Costa et al (2006)*	WISC-III; LIPS-R	Sagittal (6) =104.7(15.8) Unicoronal (6) =104.3(14.7) Metopic (3) =110.3(4.2)	VIQ=104(13.8); PIQ=104.9(18.0)	Children with NSC of all types have score in the "average" IQ range. The results from this study should be taken with caution due to the extremely low sample sizes.

Bolthauser et al (2003) *	WISC-III	Sagittal (14)=112.5	VIQ: “Normal” =13; “Low” =1 ; PIQ: “Normal”=13; “Low”=1	Children and adolescents with sagittal NSC have insignificant deficits on attention, processing speed, learning and memory. Patients tend to score more in high average, high and exceptionally high IQ ranges. This study had a very low sample size and therefore conclusions drawn from authors should be taken with caution.
Bellew & Chumas (2015)*	WISC-IV; WASI	Sagittal (47 total) operated=99.9(17.9) Sagittal unoperated=101.9(16.4) Unicoronal (15 total) operated=89.5(15.4) Unicoronal unoperated=90.8(16.4) Metopic (13 total) operated=95.8(20.7)	Sagittal: Surgery pts: VIQ=104.5(19.79); PIQ=95.3(15.78). Non surgery: VIQ=103.4(15.5); PIQ=99.4(15.34) Unicoronal: Surgery pts: VIQ=95(17.58); PIQ=86.2(12.28); Non surgery: VIQ=92.3(17.9); PIQ=90.8(14.45); Metopic: Surgery pts: VIQ=96(26.85); PIQ=96(10.12); Non surgery pts: VIQ=87.8(15.84); PIQ=86.1(15.57).	Highest FSIQ occurring in children with Single suture craniosynostosis who had surgery before 6 months (108.7) vs lowest at >19 months (88.6). VIQ>PIQ in children with NSC who fall in normal range for intelligence (with a larger sample size). But these are not clinically significant results. 68.1% of SS NS showed the VIQ>PIQ discrepancy. Surgery resolves locomotor difficulties in infancy as they do not persist at school age. SS children had highest FSIQ and normal distribution. Females may have PIQ>VIQ and males VIQ<PIQ. The VIQ and PIQ discrepancy is subtle in comparison to norms. Sex, type of NSC and age of surgery have effects on results.

		Metopic unoperated-77(NR)		The sample sizes for Sagittal patients were good, however smaller sizes were seen in the unicoronal and metopic patients to the point some results could not be reported.
Junn et al (2023)	WASI; BBDT-VMI	Sagittal (139) =108.32(14.4) Metopic (39) = 100.05(11.8) Unicoronal (22) = 102.8(12.61)	Sagittal: VIQ= 109.42(15.76); PIQ=105.6(14.6); VMI=101.6 (13.6); Visual Perception=103.8(12.4); motor coordination=90.5(15.6) Metopic: VIQ=101.4(10.4); PIQ=99.3(13.7); VMI=92.4(12.1); Visual perception=95.9(11.2); Motor coordination=84.2(15.4) Coronal: VIQ=106.7 (14.1); PIQ=99.7(13.7); VMI=95.0(10.2); Visual perception=94.9 (12.8); Motor coordination=85.1(15.4)	Authors found statistically significant differences between metopic and sagittal in in FSIQ (p<.001), VIQ, PIQ and VMI(p=<.05). Metopic patients scored worse in these areas, despite still scoring in the "average range". This study had a very large sample size for sagittal NSC patients making the conclusions reliable.

Note: This table shows the results of various neuropsychological tests split by each paper, suture-subtype with sample sizes and subsequent full-scale IQ, specific cognitive sub-test results and a written qualitative summary of results, with comments on sample sizes.

* Indicate larger studies in which data that met the current reviews inclusion criteria was able to be extracted.

[a] WISC-III= Wechsler Intelligence Scales for Children-Third Edition; WRAT-R= Wide Range Achievement Test Revised; TOWRE= Test Of Word Reading Efficiency; CTOPP=Comprehensive Test of Phonological Processing; NEPSY-II= Developmental Neuropsychological Assessment- Second Edition; D-KEFS= Delis-Kaplan Executive Function System; BRIEF=Behaviour Rating Inventory of Executive Function; WASI= Weschler Abbreviated Scale of Intelligence; WPPSI= Weschler Preschool and Primary Scale of Intelligence; WAIS-IV= Weschler Adult Intelligence Scale-Fourth Edition; BBDT-VMI= Beery-Buktenica Visual-Motor Integration; Conners CPT3= Conners Continuous Performance Test-Third Edition; WF-AS= Weschler Fundamentals -Academic Skills; CELF-R=Clinical Evaluation of Language Fundamentals Preschool-Revised; PPT= Purdue Pegboard Test; RCF= Rey Complex Figure test; DS=Digit Span; BCT= Bells Cancellation Test; SSDS=Symbol Search Digit Span; TLT= Tower of London Test; LIPS-R= Leiter International Performance Scale-Revised; WISC-IV= Weschler Intelligence Scales for Children- Fourth Edition; WISC-V=Weschler Intelligence Scales for Children -Fifth Edition.

[b] Data is reported as mean (standard deviation); mean [confidence intervals]; % in FSIQ ranges i.e. average, low average, low; FSIQ=Full Scale Intelligence Quotient; NR=not reported; GEF= "general executive functioning"; GQ= general quotient; NR= not reported; pts=patients;

[c] Data is reported as mean (standard deviation); split into qualitative ranged "low, average, high"; % of sample with difficulties, FSIQ= full scale intelligence quotient; VCI= Verbal Comprehension Index; PRI= Perceptual Reasoning Index; PSI= Processing Speed Index; WMI= Working Memory Index VIQ= Verbal Intelligence Quotient; PIQ= Performance Intelligence Quotient.

[d] Written summary of results and conclusions drawn by authors. ASD=Autism Spectrum Disorder; ADHD= Attention Deficit Hyperactivity Disorder; CD= Conduct Disorder; ODD= Oppositional Defiant Disorder; p=(level of significance); R_s = percentage of variance in the outcome explained by the predictor variables, scores close to 1 indicates the predictor explains high variance in the predicted outcome.

Discussion

Summary of main findings

Overall, the moderate-strong quality evidence gathered in this review indicated that many school-aged children with NSC may not have differences in cognition that require specialist intervention. Specifically, Sagittal NSC had a few moderate-strong quality papers suggesting very little impact on neuropsychological outcome at school-age (Speltz et al, 2015, Klajic et al, 2019; Alperovich et al 2021, Patel et al, 2014; Shipster et al, 2003, Cradock et al, 2015; Bellew & Chumas, 2015; Junn et al, 2023). Five strong quality papers have suggested metopic NSC may be the most negatively affected in terms of FSIQ and visuomotor domains (Speltz et al, 2015; Osborn et al, 2021; Klajic et al, 2019; Cradock et al, 2015; Bellew & Chumas, 2015), whereas a small number of papers suggest left sided unicoronal patients may struggle with verbal intelligence more than right sided (Wu et al, 2020; Bellew & Chumas, 2015; Speltz et al, 2015; Cradock et al, 2015). The sample sizes for sagittal patients were significantly higher than both metopic and unicoronal patients, and this is reflective of the prevalence rates of the subtypes, in which sagittal makes up approximately, 44% of NSC cases (Mathijssen et al, 2016), followed by metopic and unicoronal. Therefore, the conclusions drawn from studies on sagittal subtypes are stronger than metopic and unicoronal sub-types.

Developments in evidence

This is the first systematic review that focussed on neuropsychological outcomes in school-aged children with NSC. Earlier systematic reviews (Knight et al, 2014) were concerned with the developmental trajectory given the adverse developmental functioning reported in infancy, pre-school, and some school aged reports (Kapp-Simon et al, 2005; Ruiz-Correa et al, 2007). Knight's review highlighted that school-aged children display similar general intellectual ability to controls, but higher rates of speech and language difficulties were present. As well as deficits in visuospatial skills, memory, and attention.

The current review has expanded upon Knight's conclusions. More studies with larger samples have been published since Knight's review and found school aged children are scoring similarly to age matched controls. The studies which reported deficits in visuospatial skills (Cheiffo et al, 2010), memory and attention (Botlhauser et al, 2003; Cheiffo et al, 2010) and academic performance (Magge et al, 2002) all scored "moderate-weak" in the Kmet tool. Therefore, the findings could not be taken as significant, despite these concerns being raised in the Knight et al (20214) paper. This review also breaks down the differences between suture-subtype and therefore provides some further evidence of differences between sub-types that may need further investigation i.e., metopic FSIQ and visuomotor domains and differences between left and right sided unicoronal NSC.

Further developments in this review includes finding sex differences, with girls performing better than boys across all suture subtypes (Craddock et al, 2015; Wu et al, 2020). This is a different finding to Knight's paper that found no association with gender on intellectual functioning in school age. The results are in line with some studies finding a gender split in favour of females in the general/unaffected population. Possible reasons for this may include hormonal maturation theories in which females' brains have been viewed to mature quicker than males and therefore they may score higher on tests at school-age (Miller & Halpern, 2014). The reasoning is still unclear and research into biopsychosocial explanations for children with NSC may be warranted. Evidence to date remains scarce regarding sex differences, however parents and teachers may wish to assess whether boys with NSC, more specifically Unicoronal NSC, require special intervention.

Knight's (2014) study also commented on the state of literature in school-aged outcomes being methodologically poor, and it was clear in this review that since then the scientific rigour of studies has improved, meaning the results from papers since 2014 have greater reliability.

Limitations of the evidence

There are several important points to acknowledge when reviewing the evidence of outcomes in NSC. Below, the debate regarding age of surgery, type of surgery or having surgery at all is

critiqued from a socio-cultural lens, and validity of findings for other ethnicities and those from lower-socioeconomic backgrounds is discussed.

The evidence in this review appears to be inconclusive on whether operated or unoperated children perform better at school age. This supports current NICE guidance (Mathijssen, 2015) that emphasise surgical treatment for neuropsychological purposes is not necessary to aid better cognitive outcomes. Surgery occurs more so for moderate-severe NSC cases on functional and cosmetic grounds, which as discussed previously, may affect cognitive functioning due to "insult" on the brain for surgical intervention. The studies in this review have advocated for earlier surgery, however the social context of families is important to consider. The intersection of socioeconomic status and ethnicity may play a role in creating barriers to accessing resources, putting some families at a disadvantage from receiving early, good healthcare, and this may delay surgery. An added factor that may influence age of surgery is that surgeons in the USA are paid by number of operations completed. So, it may be in some clinician's financial interest to advocate for getting surgery done earlier or having surgery done at all, which introduces bias in these conclusions.

There is not yet a definitive conclusion on which surgical strategy is preferred, and this is largely dependent on the severity of the NSC case. Furthermore, clear definitions of surgical techniques are often lacking. This is a complex area to draw conclusions from due to factors such as surgeon training, surgical style/techniques and the processes employed by different centres which are all difficult factors to control for in studies.

Patel et al (2019) found that Caucasian and then African ethnic groups both showed predominately higher prevalence rates of NSC than other groups in the USA. African children had a higher prevalence of Unicoronal NSC in comparison to other groups (Patel et al, 2019), but also this could be due to undiagnosed sagittal and metopic NSC (Sacks et al, 2019). There may be cultural factors influencing this, in which clinicians' unconscious racial bias and appraisals of the appearance of other ethnicities may influence whether children are diagnosed or access services. Clinicians in the field should be prompted to develop strategies that support diversity and inclusivity when it comes to these biases. It was unclear from current research what effect the intersectionality of SES and ethnicity has on children with NSC. Shlobin et al

(2022) reported that NSC prevalence rates are similar globally, yet research is focussed on high income countries rather than middle-low income, and the effects of this on neuropsychological development are unknown, yet crucial to identify.

The evidence to date also raises questions about bias and differences between statistically significant findings and clinically meaningful findings, in which many studies were subject to type I errors. Authors reporting statistical differences are urged to report on whether they interpret these results as problematic for the child, and whether educational intervention was necessary.

An area of little discussion in the papers included are the psychological and family dynamic effects on FSIQ. None of the studies controlled for or assessed depression and anxiety which are common conditions that may negatively affect testing performance and give inaccurate results (Naglieri et al., 2003). Children with NSC may be exposed to more bullying and discrimination given the cosmetic outcomes, leading to increased levels of low self-esteem and this can negatively impact academic performance (Riklin et al, 2020). Discussing the impact of psychosocial factors and whether this played a role would have given more information about the results gained. Parental mental health, family dynamics, drug and alcohol abuse may all also contribute to how a child is performing in school and data reporting this could have been useful to help explain why some people may perform better than others.

Review Limitations

The studies included in this review used validated and standardised neuropsychological tools only, meaning a few studies that could have added to this review were eliminated. Only peer reviewed papers published in the English language were used, which may have excluded some relevant studies, and is reflective of the population studied in NSC being mainly Caucasian and higher SES participants. The database SCOPUS was not used which may have led to recently published papers being missed. Some studies were unavailable to include due to lack of access to full texts.

Recommendations

In general, research in school aged children is still new and scarce. More studies replicating the current findings will strengthen the evidence shared in this review. Furthermore, studies may want to start shifting attention to lowered SES and non-Caucasian samples to see if the results of cognitive testing on these children are different. Some of the results have particularly noticed that boys may perform worse academically than girls and research directed on this to inform more robust conclusions will be helpful. Studies may want to also focus on those children who are significantly struggling in school academically and researching the factors that are linked to this to identify patterns. More research into specific cognitive domains may be warranted by more thorough reporting of sub-test scores in the results. Finally, authors are urged to consider bias regarding surgical decision making, identification of NSC in other ethnicities and when reporting significant results as clinically meaningful.

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Service Improvement Project

Title:

"Expanding psychology provision for older adults with fear of falls in a major trauma setting"

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Date: Sept 2021

Word count: 4890

Proposed Journal: Psychology & Ageing (Appendix E)

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Abstract

Aims: This service improvement project aimed to increase access to psychological support for older adults admitted to the Major Trauma Centre (MTC) who have a Fear of Falls (FOF). This entailed working in conjunction with MTC physiotherapists to promote the use of cognitive behavioural therapy (CBT) strategies and developing a psychoeducation resource for older adults.

Methods: This project was carried out in three phases: Phase 1 involved scoping of the literature and current interventions used by physiotherapists and their response to proposed interventions. Phase 2 consisted of the development of resource materials including a psychoeducation workbook for older adults with FOF to use in the MTC and designing and implementing a staff training session on working psychologically with FOF. Phase 3 involved an informal evaluation of the materials developed using a questionnaire on confidence and knowledge of FOF pre and post training and qualitative feedback on the psychoeducation workbook.

Results: Findings from phase 1 revealed limited inpatient interventions for FOF in older adults in the United Kingdom. Staff were motivated to attend training and have more access to resources such as psychoeducation. In phase 2, a psychoeducation workbook and training session were developed. In phase 3, staff rated their confidence and knowledge as being higher post training; main differences included psychological explanations of FOF and introduction of cognitive restructuring strategies. Staff gave positive feedback on the use of a psycho-educational workbook and felt it would be a useful resource across inpatient wards.

Discussion: Future directions of this project should look at formal evaluations over longer time points to assess the impact of psychoeducation material and training with both physiotherapists and the older adult population admitted to the MTC.

Introduction

Service Context

The Oxford Major Trauma Centre (MTC) is a specialist network that provides care to individuals in the Thames Valley area. The service stretches across the lifespan to support those who have had serious injuries to limbs that are life threatening or life changing. The team is comprised of surgeons, nurses, physiotherapists, occupational therapists, psychiatrists, psychologists, and therapy assistants. The psychological medicine team consists of a psychiatrist, consultant clinical psychologist, and trainee clinical psychologist. The team offers psychological support to adults and older adults (over 65 years old) in both an inpatient and outpatient capacity.

Major trauma centre models were implemented in response to statistics that showed major trauma care and outcomes in the UK were much worse than similar high-income countries (Olive et al, 2022). Centres across UK regions have formed since 2012, and the model has proved successful by increasing odds of survival by 19% (Olive et al, 2022). This also means the number of those living with disability has increased substantially, and the psychosocial effects of this are widespread. Major trauma can have negative effects on people's sense of self, social relationships with friends and family, work and finances. As a result, psychological disorders are prevalent in this population and a significant number of survivors of major trauma often experience acute stress reactions, post-traumatic stress disorder, body image concerns, depression, and other anxiety disorders (Olive et al, 2022).

In the UK in the 1990's the mean age of patients suffering major trauma was 36.1 years with under 25's making up the largest proportion of admissions. By 2015, the under 25's made up the smallest proportion of admissions and there was a threefold increase in the proportion of over 75s- at around 27% (Kehoe et al, 2015). This may be due to increased longevity and an associated increase in exposure to possibilities of injury. Furthermore, the mechanisms of injury from low falls (falls less than 20ft) was 4.1% in the 1990's and in 2015, such falls were

responsible for 39.1% of all major trauma cases. Older adults who have had an injury because of major trauma may consequently experience many physical and psychological difficulties (Neville et al, 2020). Particularly, lower limb injuries, which can be from falls, may result in older adults experiencing a "fear of falls" (FOF) (Tinetti & Powell, 1993). FOF can cause a general lessening of confidence in performing activities of daily living, an increase in social dependence, prolonged use of medications and a lengthier hospital stays which inevitably increases overall healthcare costs (Church et al, 2015).

In the community the prevalence of FOF is estimated to be between 20-60% in older adult populations (Scheffer et al, 2008). Psychologically, there is a strong relationship between having a FOF and suffering from depression and anxiety which can also further exacerbate the symptoms of FOF due to increased activity restriction and social isolation which are already prominent risk factors of depression in older adult populations (Gagnon et al, 2004; Anderssson et al, 2006). There is evidence to suggest that individuals suffering from FOF during a hospital stay usually will continue to have FOF once they are discharged into the community (Parry et al, 2020). Furthermore, there is a higher prevalence (up to 88%) of FOF in older adults who are hospitalised due to physical trauma (Neville et al, 2020). It is vital to provide an intervention at the inpatient level for older adults who may be suffering from FOF, by working with both patients and staff teams.

Service Improvement

The demand for clinical psychological input was high, yet with one clinical psychologist and a trainee available, the resource was limited. Initial discussions within psychology noticed referrals were commonly for working aged adults who had been in high-speed collisions. When brought to the wider multi-disciplinary team, it appeared issues of unconscious bias with ageism may have been a factor in this (Wyman et al, 2018). Given the high older adult population in major trauma, it was suggested that this was a particular group to focus on expanding psychological provision to. Disseminating psychological knowledge and skill to the wider MDT, making use of this from a service improvement perspective could be a cost-effective solution to provided holistic care to older adults with FOF.

Psychological Understanding of FOF

FOF is usually conceptualised as an anxiety disorder maintained by unhelpful coping behaviours and fearful cognitions (Peeters et al, 2020). Psychological explanations of FOF draw upon cognitive and behavioural theories. These indicate that individuals presenting with high levels of fear when carrying out mobility related activities may experience negative thoughts and images which may increase levels of fear experienced. This is then coupled with unhelpful coping behaviours that the individual may engage in to alleviate the fear (i.e., avoidance and safety behaviours), but inadvertently these exacerbate the negative thoughts by not allowing the individual to learn that their fear may be a catastrophised reaction (Salkovskis, 1999).

Interventions for FOF

People with FOF may engage in self-defeating thinking styles such as pessimism, catastrophising, being consequence orientated and having low falls related efficacy (Pauelson et al, 2018). Cognitive behavioural therapy (CBT) could assist in altering maladaptive thinking patterns and start to engage patients in more adaptive behaviours so help alleviate mood and reduce anxiety/fear involved with mobilising.

Liu and colleagues (2018) conducted a systematic review of trials that used cognitive behavioural therapy (CBT) as an intervention for FOF in older adults. They found strong evidence that CBT in both group formats, and 1to1 therapy had equally high efficacy, with effects lasting up to 12 months post treatment in reduction of FOF symptoms (Liu et al, 2018). Specifically, in this review the main components of change included the use of cognitive restructuring and promotion of mobility through behavioural strategies including exposure and goal setting (Lui et al, 2018). Lim et al (2022) suggested that cognitive restructuring and behavioural strategies alone were not sufficient in eliciting change in older adults with FOF, and that well integrated psychoeducation is likely to boost the therapeutic effects of a CBT

intervention. The current literature on the specific experiences of older adults with FOF is limited to narrative studies; for example, Beh et al (2019) found that older adults admitted to hospital who had a FOF presented with activity avoidance, excessive help seeking and slowed pace. They also found doing more exercises and having education around FOF were perceived as effective interventions (Beh et al 2019).

Physiotherapists provide interventions to develop, maintain and restore maximum movement and functional ability. They have expertise in function and activity-based interventions. Physical interventions such as balance exercises coupled with CBT approaches have been found to reduce FOF symptoms in older adults (Scogin et al, 2008). Foster and Delitto (2011) suggested that positive reinforcement and enhancing personal control, self-efficacy whilst reducing fear of movement can be relatively easily incorporated in physiotherapy. However, whilst doing so, also eliciting and addressing fearful cognitions and low mood is an area that may require additional training (Foster & Delitto, 2011).

Project aims/objectives

The current project was split into three phases. The overarching aim was to implement psychoeducational resources for older adults in major trauma. Furthermore, to provide training to improve the care older adults receive by developing a biopsychosocial intervention with physiotherapy on FOF in major trauma inpatient settings.

Phase 1- Scoping:

- Scoping of FOF literature in major trauma/inpatient settings in the United Kingdom (UK) for psychological provision provided in services for older adults. (i.e., evidence-based practises, adapted inpatient interventions, use of validated and reliable outcome measures)
- Developing and carrying out a scoping survey to explore current activity, response to interventions and specific suggestions from physiotherapy when working with FOF. Furthermore, the researcher shadowed FOF cases and when surveys were not

appropriate due to time restrictions and carried out a semi-structured interview using survey questions as a prompt.

Phase 2 – Development of Materials:

- Development of a FOF psycho-education self-help booklet for older adults on inpatient wards.
- Development of a FOF staff training session on CBT interventions that can be adapted on the major trauma inpatient wards.

Phase 3- Service Response:

- Conducting preliminary informal quantitative and qualitative evaluation of the psycho-education workbook and staff training session via a short survey developed by the researcher.
- Service recommendations gained from a survey and group feedback at the end of the training session for further change and considerations for the service.

Phase 1: Scoping

Methods Part I: Scoping FOF literature

Design and Procedure

This literature review was conducted to explore current psychological provision for FOF in the UK for older adult inpatients, to identify key concepts, theories, evidence base, and identify gaps in the literature. This was with a view to inform the resources that would be developed for this project.

Results

The psychological evidence base in in-patient settings for FOF was surprising low in the UK, and non-existent in major trauma settings. The initial findings are discussed for each scoping topic in Table 1.

Table 1.

Findings of Scoping literature for FOF in older adult inpatients

Scoping Topics	Findings
Definitions of FOF	Peer reviewed papers had used varying definitions of FOF Psychological models such as CBT used different explanations i.e. fear avoidance model vs traditional CBT models e.g. for panic.
Outcome Measures for FOF	No inpatient FOF outcome measures have been developed or validated. Majority of measures used in community older adult samples. Poor validity in the measures used in the community (Greenberg, 2012).
Evidence-based interventions	Lack of structured definitions of FOF and outcome measures to describe FOF, resulted in low evidence base of CBT applied to FOF.

Evidence indicated CBT to have good efficacy in treating FOF in older adult in the community.

Limitations in community programmes were identified in terms of cost and long-term implementation, as well as heavy reliance on psychology.

Self-help psycho-education resources were identified in some NHS trusts for community older adult samples.

Case report data shown effectiveness of adapted-CBT in inpatient settings (Ohyagi et al, 2020).

Possible Interventions

A possible solution based on the scoping exercise was training non-psychologists to incorporate psychological interventions within their sessions. Physiotherapists were identified for this due to the cross-over into their remit with assisting with mobilising. There have been a number of studies that have found good outcomes in training health professionals in specific elements of CBT for physical health difficulties e.g., chronic lower back pain (Foster & Delitto, 2011) and diabetes management (Graves et al, 2016).

In addition to this, a CBT intervention in the form of self-help is another solution. Past research has shown self-help CBT resources e.g. CBT-insomnia, had good effects on the treatment of arthritis in older adults (Rybarczyk, 2011). Furthermore, Landreville et al (2021) found lay trainers given CBT training for guided self-help on generalised anxiety disorder in older adults offered an effective intervention for reduction of anxiety symptoms. CBT programmes for FOF that are targeted to the population of major trauma older adults that integrate psychoeducation, cognitive and behavioural techniques can provide a highly utilised, cost-effective resource to use on the ward for physiotherapy staff.

Methods- Part II: Scoping with Major Trauma Physiotherapy

Design & Procedure

The study proposal was submitted to Oxford University Hospital Clinical Governance and received approval as a quality improvement project (Appendix E). A mixed methods design was used. Due to the context of major trauma settings, a Rapid Qualitative Evaluative Method (RARE) (Trotter et al, 2001) was used as a guidance to capture current activity (i.e. services already being delivered to older adults with FOF, and needs of a particular population) to inform service development. This approach was especially useful due to COVID-19 effects on the inpatient wards by allowing efficient use of time, cost effectiveness and within the scope of this project.

Physiotherapists and therapy assistants on the wards were approached by the researcher and verbally informed of the scoping exercise for the project and either completed a scoping survey or completed the survey as a semi-structured interview during joint work with the researcher. Participants were given the choice of completing a survey or interview depending on how much time they had. The researcher wrote down the responses to the interview under the same headings for the questions in the survey.

Staff who were approached were given a verbal overview of the service improvement project, the aims of the scoping exercise and how their data would be used (i.e. anonymously and they had a right to withdraw at any moment and the data will be destroyed). Those who wished to partake gave verbal informed consent for their responses to be used in this project.

Scoping Survey for Physiotherapists

A short self-report survey was developed (Appendix F). Items were established by discussion between researchers on what was important to capture, bearing in mind ease of answering questions, short completion time and opportunity to provide further comments to explore responses in more detail. The survey's aims were to capture 1) current self-evaluation of confidence and knowledge of recognising symptoms and working with patients with FOF using 3-point Likert scales 2) responses in the form of Yes/No 2-point Likert scales to possible interventions proposed from Phase 1- Scoping I and 3) provide space for further exploration on why answers were given and what could be helpful to improve confidence and knowledge when working with this population.

Closed ended questions were used to rate knowledge and confidence working with older adults with FOF using a 3-point Likert scale (Very confident/ Somewhat Confident/Not Confident). 3-point scales were chosen due to ease and simplicity for busy physiotherapists to decide and were a more reliable and valid account of their experience than a Yes/No 2-point scales (Komorita et al, 1965). 2-point Likert Scales were used for proposed interventions to capture consensus on simply whether or not this intervention seemed helpful/useful for the service.

Participants

In total seven participants, five physiotherapists, and two therapy assistants gave feedback on the scoping survey. This covered a wide range of experience ranging from 10 years to a few months. 5/7 of the sample were female.

Analysis

Descriptive statistics were used to report results of quantitative items. Qualitative data was analysed using a thematic analysis (Braun & Clarke, 2017). This is in line with guidance from Braun and Clarke (2013) stating 6-10 participants were sufficient for small scale qualitative research. Appendix G describes details of the thematic analysis.

Part II: Results

5/7 physiotherapists felt "very confident" when recognising whether a patient could be presenting with symptoms of FOF. 3/7 Physiotherapists felt "not at all confident" and 4/7 felt "somewhat confident" when asked how confident they felt in helping a patient with FOF on the wards. All 7 physiotherapists thoughts that psychoeducational materials and staff training would be helpful.

Qualitative results

The researcher analysed survey feedback and written responses from semi-structured interviews. Data was coded and grouped into categories. Coding was carried out by the researcher and codes were generated and refined as each new participant survey/interview was analysed. Three themes were identified to encapsulate the feedback, which were, professional qualities, current interventions, and challenges in working with FOF.

Theme 1: Professional Qualities

Subtheme 1- Confidence:

One participant commented *"recognising fear or anxiety is not the problem, more so what to do when its recognised, is what is more complicated" p1).* Others commented that *"we have a pretty good idea what we're doing because we see it so much, that said I don't think there would be a disadvantage of knowing more from psychology" (p5).*

Subtheme 2- Level of Experience:

Another participant felt the knowledge in experienced physiotherapists was greater than less experienced staff *"they will probably struggle on the wards more if someone ends up distressed or dysregulated" (p3).* Another participant similarly felt knowledge around FOF especially was lacking in less experienced staff *"the newer assistants could really benefit*

from some work around understanding it and what to do with it, our older ones just get on with it"(p2).

Subtheme 3- Knowledge:

Others mentioned lack of knowledge around how a psychologist would treat FOF *"I don't really know why it happens or how the person becomes like this, I'd be really interested to know more so we have that sound basis of information" (p7).*

Theme 2: Current Interventions

Subthemes 1 Physical approaches:

There was a general consensus in all staff sampled that exposure to the exercise as the most effective method of managing FOF in older adult inpatients. One staff member commented: *"the swivel technique is used if they are really scared, because it is quick and suddenly, they are sitting up and realise nothing bad happened" (p3).* Others commented that *"sometimes you just go for it and do it for them so they can see they're not in pain, but it can take a while for them to admit that" (p6).*

Subtheme 2- Psychological Approaches:

Furthermore, smaller and achievable goals, positive reinforcement, and reassurance were also regularly used interventions, *"we do try to break down things if the person looks like they might not manage" (p2).* Another commented *"we try to be as positive and lively as possible to make it feel more comfortable but can't be like that all the time sometimes we just have to get on with it because we need to get on" (p1).*

Theme 3: Challenges working with FOF

Subtheme 1- Not knowing what to do:

The majority of staff reported around not knowing what to do with someone who is showing heightened levels of distress during sessions. One participant responded *"Don't know how far to push someone who is screaming. Really uncomfortable for us, to keep patient in the moment and motivated" (p3).*

Subtheme 2- Not knowing what to say:

Another participant also commented not knowing how to speak to someone with FOF, reflected there was a heavily medicalised method of speaking which is not always helpful, *"there is a difference between how psychologists speak and how we speak, and we know that, but we don't know what language to use that could be helpful" (p7).*

Feedback on Resources Proposed

Qualitative responses were gathered for the development of psycho-educational resources. The scoping exercise revealed that staff thought that a psycho-educational workbook for patients and a training session would be beneficial. One staff member reported ***"****this would be really good for us to give to patients so they can read about it in their own time to develop an understanding". "We often don't have time to explain these things but can pick up from what they've read so we can tell them about it during the session" (p1)*. Other responses of feedback on what to include in training included: anxiety management skills, *"Techniques on how to manage at the time or things to say sound like they could be of use to alleviate the distress" (p3); "gaining a deeper understanding from psychological perspectives" (p4).*

Phase 2- Development of Materials

The aims of this phase were to develop the following:

- To develop a psychoeducation workbook for older adult inpatients on understanding and managing fear of falling.
- To develop and implement physiotherapist staff training on adapted CBT for FOF.

Adapted CBT

The materials developed were strongly based on CBT for FOF in the general population. However, models of CBT formulation that conceptualise mental health difficulties in older adults have been modified to include added complexities commonly seen in this population.

Laidlaw's conceptualisation of CBT included the factors of cohort beliefs, socio-cultural context, transition in role investment and physical health (Laidlaw, 2004). Added to this are the associated complexities of the context i.e., a major trauma inpatient ward. This may include acuity of injury, heightened pain, unfamiliar surroundings, lack of autonomy, and limited access to psychological support. Any interventions therefore would need to account for 1) added complexities in older adults 2) seeing these factors through the context of major trauma. This is to ensure the provision provided is appropriate for this specific population. Please see the discussion for further information and Appendix H for a detailed account of the adaptations to consider and how they were applied within the psychoeducation workbook and physiotherapy staff training. Please see Appendix I for details on the developmental procedures.

Resource Outcomes

Table 2 shows the overview of contents of both the psychoeducation workbook and training session. The Psychoeducation Workbook can be found in Appendix J.

Table 2.

Overview of Contents of psychoeducation workbook and training session

Psychoeducation workbook	Training Session
Psychoeducation of FOF in older adults	Psychoeducation of FOF in older adults
Prevalence and effects	Prevalence and effects
Vicious Cycles: Thoughts/feelings/emotion/behaviour links	Vicious Cycles: Thoughts/feeling/emotion/behaviour links
Imagery and grounding	Cohort beliefs and other considers for older adults

Fear Hierarchy	Exposure using Fear Hierarchy
Goal setting	Imagery and Grounding
Thought challenging diary	Role Play applying change methods learnt
Compassion and validation of experiences	Goal setting
Case study- applying knowledge to someone else	Thought Challenging
	Case discussions

Phase 3: Service Response

Aims

The aims of this phase were to explore the physiotherapists response to materials developed in phase 2 materials. Specifically, the following aims were:

- To gain qualitative feedback on the Psycho-education workbook.
- To explore changes in confidence and knowledge before and after the staff training session
- To gain qualitative feedback on staff training, including what changes are most likely to be beneficial for the service, what further recommendations physiotherapy staff have.
- To highlight service recommendations based on the qualitative feedback

Methods

Design & Procedure

This was a mixed methods design. Upon liaising with lead in-patient physiotherapists for the MTC, a staff training session for FOF was organised. The session was organised by utilising the Continuing Professional Development (CPD) session for Physiotherapists to maximise attendance. Staff were informed this was a part of a service improvement project at the beginning of the training and what the aims were. They were asked to complete anonymous pre and post workshop questionnaires. Those who wished to not give this data did not fill in a survey, staff were told they had the right to withdraw at any time. Researcher email and contact details were provided.

The researcher delivered a two-hour training session in person at the John Radcliffe Hospital. During the last 30min, discussion focused on eliciting feedback regarding the psychoeducation workbook which was handed out amongst staff and overall feedback on the training session itself. The researcher noted down qualitative feedback in the discussion to form a part of the service response. The attendees were given training handouts to take away with them which were adapted from the slides.

Measure

A self-report training survey (Appendix K) was developed including both quantitative and qualitative items. Pre- and post-survey repeated the questions around how "confident" or "knowledgeable" staff felt about working with FOF. Answers were given using a 3-point Likert Scale "very" "somewhat" "not at all". The post-survey included qualitative items to elicit more in-depth feedback following training about 1) workbook 2) training 3) realistic implementation of CBT skills 4) further feedback on what could be useful on the ward. The aims of the survey were to capture preliminary feedback on the proposed interventions.

Participants

Ten physiotherapists attended this training and nine completed the pre- and post-training questionnaires. Similarly, to the scoping survey, the experience ranged widely from three months to 10 years' worth of experience in the role. 2/9 participants were therapy assistants. 7/9 were female.

Analysis

Descriptive statistics were used to report from pre and post training responses in confidence. No formal qualitative analysis was used for the written and verbal feedback as this was not within the scope of this project. However, responses were categorised through the questions asked.

Quantitative Results

The quantitative pre and post results can be found in Table 4. The findings indicated a general increase of confidence and knowledge post training in comparison to pre training.

Table 4.

Pre and post training scores in confidence and knowledge

	Training Survey					
Question	Pre-Training			Post-Training		
	Very	Somewhat	Not	Very	Somewhat	Not
1[a]	1	7	1	7	2	0
2[b]	0	5	4	3	6	0

3[c]	4	5	0	7	2	0

Note: N=9

[a]Question 1- How confident do you feel recognising signs of FOF in an older adult?

[b]Question 2- How knowledgeable do you feel about the psychological explanations underpinning FOF?

[c]Question 3- How confident do you feel working with an older adult who has FOF?

Qualitative Feedback

All nine physiotherapists gave qualitative feedback. Feedback was recorded from the post-training discussion and qualitative written section in the post-training survey. Table 5. Shows the feedback given for specific questions.

Table 5.

Service response to training and psychoeducation.

Category	Physiotherapy Response
Training Feedback	Training was well received by the physiotherapists *"Useful to understand the reasoning behind fear of falls, many techniques to use and good to understand why they work" (p1).* Staff felt a lot of behavioural strategies i.e. exposure for example, was already being implemented, the validation of these was good for their own confidence *"Validating a lot of what we do behaviourally on the wards" (p3).*
Realistic Implementation	Modifying language- there was a difference between how psychologists speak and how medical staff speak. *"Incorporating CBT terminology to our sessions could result in more*

	effectiveness" (p4). Staff generally felt that the language used in training was useful to explain processes to patients, and ideas on how to gently challenge their unhelpful thoughts without invalidating their experience. Relaxation techniques- this was deemed the most useful in fast paced settings *"square breathing, visualisation and imagery, music and apps could all be useful advice prior therapy starting" (p2)* Challenging unhelpful thoughts – Staff felt that thought challenging could be a useful new skill to implement. *"making clear to the patient the change in thoughts before and after the activity is helpful in really sending home the message and that is what we could do more explicitly*" (p9). Another staff member commented *"the CBT approach to challenging thoughts could help with FOF and lots of. Other types of anxieties" (p2).*
Psycho-education workbook	*"Great idea- should be given to all patients across the hospital who have a fear of falls" (p8)* *"This is very helpful- should be given routinely (p3)* *"The workbook is a good idea for prior information in getting started, it should work well on the wards" (p9)* *"Very helpful piece of work- "pre-reading before and after sessions would be beneficial with patients" (p2)* *"Mindful it will only be applicable to those who can read or have family members" (p1)*

Further Recommendations	Training to MDT- some staff commented that *"teaching to more junior staff" (p1)* and other MDT professionals would be useful to spread the information, as they may spend a lot of time with patients *"It would be good for their confidence and skill development"(p8)* Dementia and cognitive difficulties- this was the most agreed upon theme of feedback for further training, to include a section on managing challenging behaviour in older adults with cognitive disorders. *"Including how to work with patients with dementia or delirium who will not benefit from the workbook or thought-challenging" (p1)*

Discussion

Main findings

The main findings in in this study were as follows: Phase 1 -scoping the literature and scoping staff survey with physiotherapists helped form the basis for development of resources and intervention. The main results from this showed that there was a lack of prior interventions for FOF in older adult inpatients, no validated outcome measures in inpatients and varying definitions used to describe FOF in the evidence base. The scoping surveys showed staff being somewhat confident in recognising and working with FOF, and a desire from staff to learn more and have more resources to access for their patients. Phase 1 formed the basis for developing materials in Phase 2, which were the psychoeducation workbook and a staff training session, which was based on CBT interventions of anxiety disorders, coupled with adaptations for older adults in a major trauma context using Laidlaw's (2004) formulation

model. Phase 3 entailed preliminary informal evaluation of the resources developed. There was a general increase in self-reported confidence and knowledge post-training in comparison to pre training. The psycho-education workbook received positive feedback and staff felt this was a cost-effective resource to use within major trauma settings. The training session provided validation for current behavioural interventions being used, but also gave more insight into why they work, how to link them with cognitive restructuring and the use of relaxation techniques for anxious patients.

These results are consistent with previous studies which found training staff in psychosocial strategies was highly effective and increased the use of the biopsychosocial model of care (Driver et al, 2019). However, this research is mostly on chronic pain and diabetes management, there is limited literature where physiotherapy colleagues have been given CBT skills training in FOF for older adults. In keeping with prior research, physiotherapist colleagues were already knowledgeable about use of goal setting, positive reinforcement and which were the most used in practice (Driver et al, 2019); this relates to feedback where physiotherapists would be keen to use more cognitive strategies where appropriate.

Implications

To our knowledge, this project was the first of its kind that created a provision for FOF specifically for older adults who have endured major trauma injuries. The approach used in this study was an inductive method, which collected data using various methods and from various sources e.g. survey, semi-structured interview, group feedback to create resources that could help this population and also the clinicians who work with them. This approach was appropriate for this setting due to the fast-paced environment, COVID-19 impact on wards making it more difficult to get people together for feedback and making use of creative ways to expand psychology provision that is realistic to implement on major trauma inpatient wards. The project's over-arching aim was to create resources in a cost-effective way, making use of current resource and having realistic outcomes for both patient and clinician. The preliminary results from the resources developed have alluded to this being the case. Training sessions are a formal part of the physiotherapy teams contracts therefore the ability to organise

and implement training is a cost effective and time-sensitive way to disseminate psychological knowledge. The training being made available online is also an effective way for staff to go back to refresh their knowledge and train/up skill new staff members. Staff were able to reflect on information shared and apply this to their own experience by feedback on what is realistic for the service. As aforementioned, using cognitive strategies in addition to behavioural strategies can result in more meaningful change for patients.

Developing a psycho-education workbook is a cost-effective method in providing psychological care to inpatients, which is in line with previous studies who have replicated this in groups with inflammatory bowel disease (Hunt et al, 2020) and depression (Sadler et al, 2018). Coupled with training based on information in the booklet, both physiotherapists and patients will have a shared understanding between them. Therefore, it is hoped that conversations on the wards between physiotherapists who have attended training and patients who have been reading the workbook can develop a shared language. This was another piece of feedback that gave indication that use of "psychological" language could also be a key mechanism for change. This could be through the use of validation and less medical jargon. MTC wards also have an advantage of having the option to consult with psychology, which, coupled with training and the workbook provides a better package of psychology provision.

Limitations

This study benefitted from the use of an inductive approach, mixed methodology. It produced a range of clear practical outcomes in helping staff and patients but had a number of limitations. It was helpfully pointed out in feedback that many older adults with dementia or delirium would be excluded from benefitting from the workbook, and provision on how to manage patients regarding these added complexities (i.e., working effectively with behaviours that challenge would be welcomed by staff). No formal evaluations of the workbook or training could be carried out in a longitudinal basis to see if this has had positive effects on physiotherapy skills and older adult populations in the MTC. These limitations were beyond the scope of this project.

The surveys themselves were self-report and therefore do not necessarily match with how well a physiotherapist could work with FOF despite rating themselves as “very confident”. Use of semi-structured interviews gave more in-depth answers, however there is a risk of researcher bias that could influence the answers given, and the answers recorded by the researcher themselves. Furthermore, there may have been a response bias and social desirability shown by physiotherapists, as only two options were given by the researcher i.e., psychoeducation for patients and staff training. Due to COVID-19 there was added pressure and lack of time that could be sought from professionals for the scoping exercise. Perhaps a focus group could have been organised at the end of a CPD session to gather from information from more staff members.

Future Directions

Formal quantitative/qualitative evaluation of the workbook on the inpatient wards, including patient feedback and response to workbook using validated outcome measures would be a useful next step. Formal evaluation of staff training over time to examine what changes have been implemented if any and what could help the implementation of these changes on a longer-term basis. Validating an inpatient FOF measure with older adult inpatient population could also be useful in helping identify FOF and repeating these measures to see if there are any changes in patients who receive FOF intervention. Training did help in recognising signs of FOF without the use of an outcome measure. However, this does not dispute the importance of validating such measures in these settings for future use. Furthermore, the use of observation and joint working to consolidate the training learnt could further develop the skills gained and this could assist in future evaluations. The data on major trauma wards were national data, use of local data for Oxford MTC specifically could be useful to look at whether FOF causes delayed discharge and on a long-term basis if resources an intervention were implemented whether this could cause a change in delayed discharge. A lay summary of this project can be found in Appendix L.

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Theory Driven Research Project

Title: Eating disorder symptom severity and differences in cognition (Dysfunctional Assumptions & Core Beliefs)

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Date: May 2023

Word Count: 4911

Proposed Journal: Eating Behaviors

Internal Supervisor: Dr Myra Cooper

Please note: this project has been written up to follow guidance from the "Eating Behaviors" journal (a link to the online guidance Appendix P).

Abstract

Aims: Current cognitive behavioural conceptualisations of eating disorders (EDs) place an emphasis on dysfunctional assumptions (DAs) relating to shape, weight, eating and size, and give little attention to addressing longitudinal or predisposing cognitions such as core beliefs. The current study aimed to compare the role of DAs and core beliefs in an adult female sample grouped into "low ED symptoms" and "high ED symptoms". Further exploration focused on the content of the core beliefs, specifically "self-loathing" and whether this uniquely contributed to high ED symptoms, even when potential covariates were controlled. Finally, it was investigated whether participants' qualitative responses were in line with our current understanding of the contents of these beliefs.

Method: A mixed method cross sectional method was employed in a non-clinical sample. The high group (n=82) and low group (n=77) completed demographic measures, measures of ED symptoms, DAs, and core beliefs relevant to EDs, as well as measures of potential covariates. A further content analysis was conducted to ascertain participant self-beliefs.

Results: Mixed method ANOVAs, post hoc t-tests and regression analyses were used. There was a significant difference between high and low ED symptom groups on DAs and negative self-beliefs (NSB's), with the high symptom group reporting higher scores on DAs and NSBs than the low ED symptom group. There were significantly higher DAs than NSBs in the high ED group compared to the low group. Further analyses revealed that DAs accounted for more variance in ED symptom severity than core beliefs. The secondary analyses revealed all core belief subscales were higher in the high ED symptom group compared to the low ED symptom group revealed no significant interaction between different core belief subscales in the low and high groups. However, when self-loathing was analysed, it explained a small but significant amount of variance in symptom severity, over and beyond other sets of core beliefs. The content analysis revealed that self-loathing statements were significantly stronger in the high symptom group and matched those found in the "self-loathing" subscale of the measure.

Conclusions: The hypotheses were partially supported. DAs explained greater variance in ED symptom severity than negative core beliefs in this sample. This supports current understanding

about the vital role of DAs in EDs. However, self-loathing beliefs were unique in explaining some variance in ED symptoms. This study was limited by using a non-ED sample and did not control for comorbidities. Future studies may focus on investigating self-loathing further as a potentially key core belief in relation to ED symptoms.

Keywords: Eating disorders; core beliefs; dysfunctional assumptions, cognitive behavioural theory.

1. Introduction

1.1 Cognitive & Behavioural Theories

Fairburn's (2008) transdiagnostic cognitive behavioural theory has widely shaped our understanding of the causes and maintenance of eating disorders (EDs). The model suggests that "dysfunctional assumptions" (DAs) that cause over-evaluation of body size, shape, weight and eating patterns are essential in the maintenance of EDs, please find the model in **Figure 1.** The theory also states four additional processes that interact with the core psychopathology and additionally may maintain the presenting difficulties i.e., clinical perfectionism; core low self-esteem; mood intolerance and interpersonal difficulties (Fairburn, 2008).

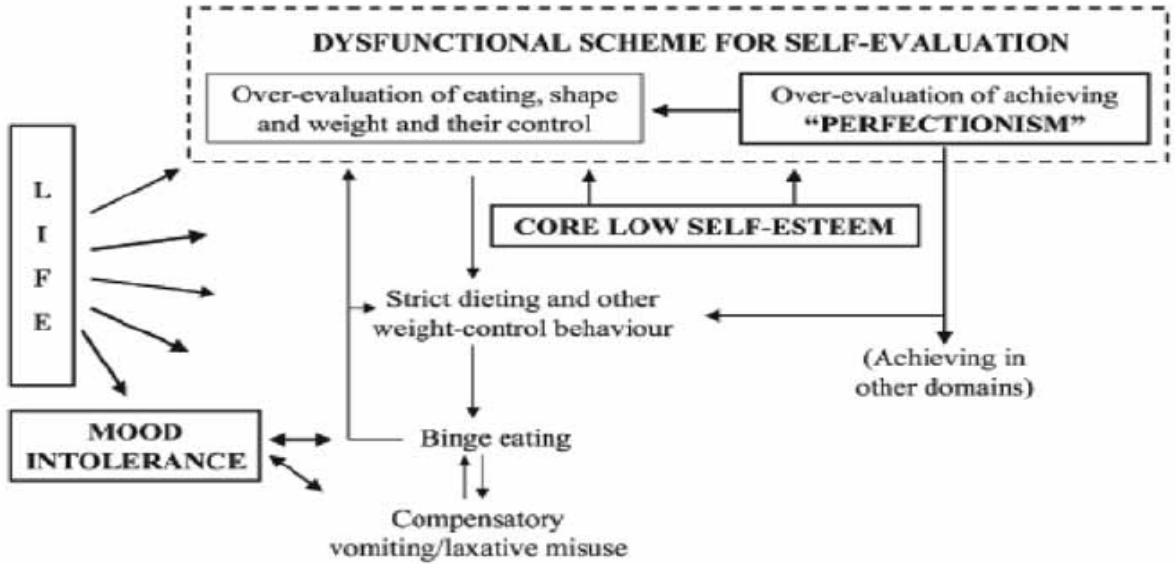


Figure 1. *Fairburn's (2008) transdiagnostic model of eating disorders.*

This theory and subsequent intervention cognitive behavioural therapy-enhanced (CBT-E) has been widely used across the world and has several studies evaluating its efficacy in the understanding and treatment of EDs. Atwood & Friedman (2020) conducted a systematic review of the efficacy of CBT-E and found that it is associated with up to 30.8% remission at 12-month follow-up and showed effectiveness in increasing Body Mass Index (BMI) in patients with anorexia nervosa (AN) and reducing ED driven behaviours e.g., calorie counting and body checking. However, the model, whilst successful for many adult clients, may be lacking effectiveness regarding more chronic patients, i.e., those with high levels of co-morbidity and high level of risk to self (Crow et al, 2002; Meyer, Waller & Waters, 1998).

Furthermore, a systematic review by Linardon et al (2017) on the efficacy of CBT for bulimia nervosa and binge eating disorder found that 66.7% remission at the end of treatment decreased to 42% by three months follow-up and that attrition rates ranged from 20-54%. Indeed, remission and recovery rates for bulimia nervosa are not greater compared to other psychological therapies (Fairburn et al, 2015), whilst follow-up data indicate that an estimated 1/3 of individuals with bulimia nervosa continue to meet diagnostic criteria after CBT (Waller et al, 2014).

1.2 Core Beliefs in EDs

A specific and growing critique of the current CBT conceptualisation of EDs is that the model's emphasis on DAs relating to shape, weight, and size, gives little attention to addressing longitudinal or predisposing factors such as core beliefs (Jones et al., 2007; Vitousek & Hollon, 1990). Empirical studies have identified the importance of core beliefs in the psychopathology of EDs (Leung, Waller, & Thomas, 2000; Waller, Dickson, & Ohanian, 2002). Leung et al. (2000) found that more pathological pre-treatment core beliefs were associated with less change in bulimic attitudes and behaviours after CBT. Maladaptive thinking styles in EDs have also been found to remain even after the DAs about weight, shape and size have been altered (Mountford & Waller, 2006). Treatment may therefore require intervention with DAs that maintain the ED as well as addressing change at the core belief and schema level.

Individuals with EDs tend to show "general self-schemata" characterized by longstanding negative self-evaluation (Jones, 2007). This is in line with Youngs' (1990) schema theory, which suggested addressing maladaptive core beliefs about the self and world is vital in treating chronic patients. The schemas or "core beliefs" refer to self-defeating beliefs that develop because of dysfunctional interactions with significant others in childhood; these act as a template for processing later thoughts, feelings, and relationships (Cooper & Hunt, 1998).

Whilst it is well established that negative core beliefs and EDs are associated, there is still little known about the content of the core beliefs. Bruch's (1962) model describes patients with anorexia experiencing an "overwhelming sense of ineffectiveness" with anorexia as a way of compensating for these underlying deficits. The therapeutic work therefore is based on addressing the "failure in self experience" and repairing the deep-seated sense of dissatisfaction and helplessness. Skarderud (2009) describes Bruch's theory as a "descriptive and theoretical model defining AN and severe eating disorders as "self-disorders", with emphasis on developmental deficits in the organisation of the psychological self. From a cognitive and behavioural point of view, the role of schemas and core beliefs are therefore essential in understanding the "self" in EDs. Theories with a limited focus on core belief cognitions may undermine awareness of central aspects of the psychopathology of EDs (Skårderud, 2009).

Waller et al's (2000) research on treatment for bulimia nervosa found patients presented with core beliefs such as "I'm worthless"; "I'm stupid"; "I'm ugly"; "I'm different", and that these were particularly difficult core beliefs to shift using classic cognitive restructuring techniques. These beliefs were described as "emotionally based" and had a different felt sense compared to other negative core beliefs (Cooper & Hunt, 1998). Cooper, Todd & Wells (1998) found beliefs in EDs such as "I'm a failure", "I'm worthless", "I'm weak", "I'm disgusting", and "I'm all alone", suggesting an array of negative beliefs ranging from harsh criticism to abandonment schemas. The current empirical research on content suggests a particularly harsh view of the self and world. A few measures have been developed to assess the content of these beliefs in detail; they are discussed below.

1.3 Measures of Core Beliefs in EDs

Cooper et al (1997) developed the Eating Disorder Belief Questionnaire (EDBQ) to measure DAs and negative self-beliefs (NSBs). NSBs are another term for core beliefs and often used in ED research. The scale consists of 10-items, is short and quick to administer. However, one critique is that is does not provide a measure of all core beliefs that may be associated with EDs. Types of core beliefs in the Young Schema Questionnaire (YSQ) (Young & Brown, 2005) may suggest additional themes, however the YSQ itself lacks specificity in its ability to distinguish ED patient's vs depressed patients (Waller et al, 2001).

In response, Fairchild and Cooper (2010) developed the Eating Disorder Core Belief Questionnaire (ED-CBQ). Cooper and Cowen (2009) found that beliefs of "self-disgust" "self-hatred" and "self-loathing" were particularly prominent in ED patients when compared to solely depressed patients. These themes were not reflected in the YSQ or EDBQ. The ED-CBQ provides a multidimensional measure with five subscales, to help identify the core beliefs most related to ED symptoms. In particular, the self-loathing subscale was a unique predictor of ED symptoms, when anxiety and depression and low self-esteem were controlled (Fairchild & Cooper, 2010).

1.4 Rationale

More research is required into the role of core beliefs and DAs in ED populations. "Self-loathing" beliefs may be uniquely associated with EDs, and this concurs with Bruch's (1962) theory that EDs are a disorder of deep-seated dissatisfaction with the self. Research to date has not explored the perspective of those with high levels of ED symptoms on the content and meaning of self-loathing, as well as the relative importance of DAs and core beliefs.

1.5 Study Aims and hypotheses

For the current study we will use a non-clinical sample to investigate two levels of cognitive representations: (1) Dysfunctional Assumptions (DAs) about weight, shape, size and eating (2)

Core Beliefs. The role of these different cognitive representations will be compared in a high severity ED symptom group and low ED symptom group. Core beliefs or NSB's will be measured using the EDBQ and the multidimensional ED-CBQ to explore the role of self-loathing. We will also explore through a qualitative component how participants describe the experience of the self, to gain more knowledge of the content of beliefs in the words of participants with high levels of ED symptoms. In **Figure 2**, it is highlighted which areas of Fairburn's transdiagnostic model are being evaluated in this study and the core belief element that is being added to the model for further exploration, emulating a longitudinal CBT formulation.

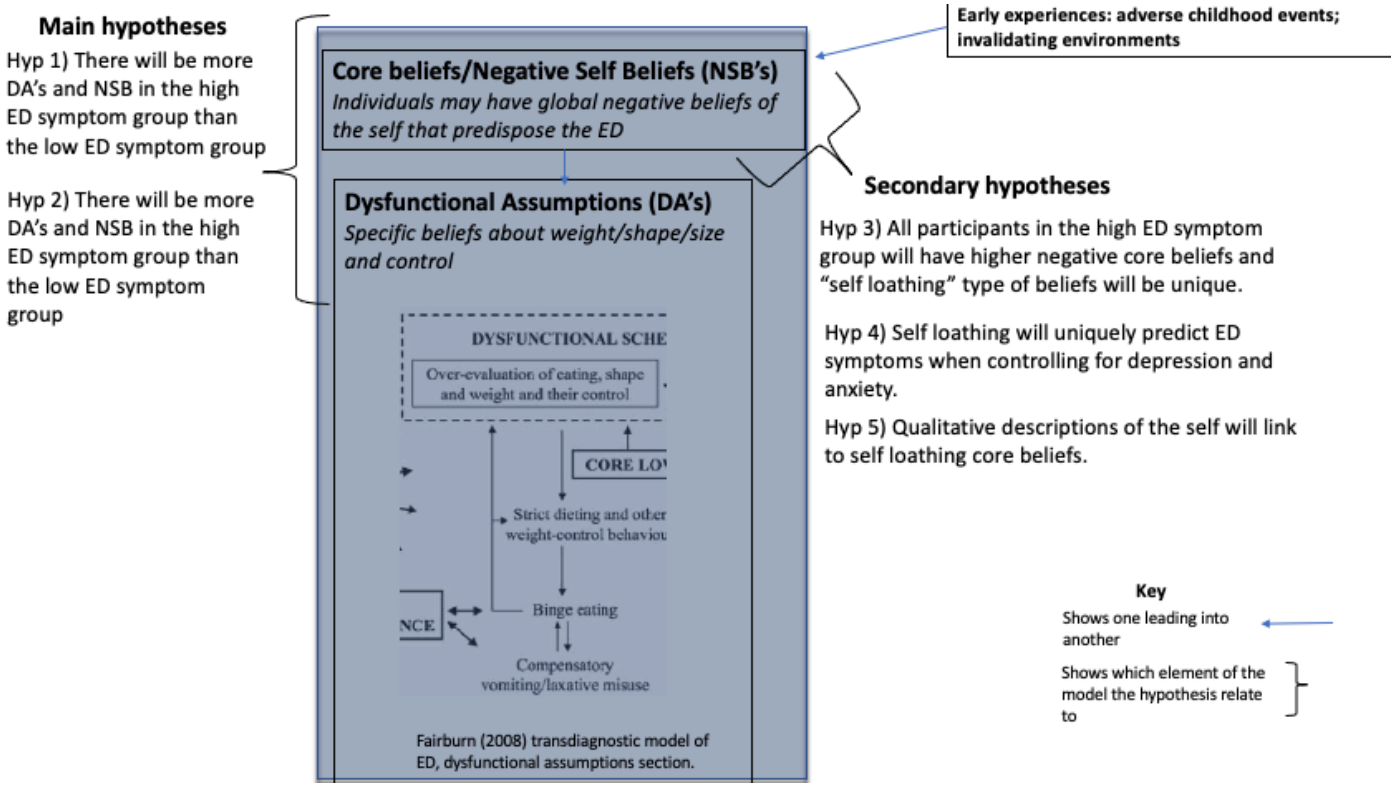


Figure 2. *A longitudinal CBT formulation model showing core beliefs and dysfunctional assumptions and the related hypotheses for each component of the model.*

1.5.1 Main Hypotheses

- We hypothesise that there will be more DAs and NSBs (EDBQ) about eating, weight, shape, and size in the high ED symptom group in comparison to the low ED symptom group.

- In addition, that there will be an interaction between ED symptom groups and the EDBQ sub-scales, such that the high ED symptom group will have more DAs than NSB compared to the low ED symptom group.

1.5.2 Secondary hypotheses for exploratory purposes

Using the ED-CBQ (Fairchild & Cooper, 2010):

- We hypothesise that all participants in the high symptom ED group will score higher on all five-subscales, and that uniquely "self-loathing" core beliefs will be significantly higher in the high ED symptom group in comparison to the low ED symptom group, including when relevant covariates (anxiety and depression) are controlled.
- Self-loathing core beliefs will predict unique variance in ED symptoms when potential covariates are controlled.

1.5.3 Qualitative hypothesis

- To further inform us of the content of the core beliefs, we will qualitatively assess individual responses in both high ED and low ED symptom groups. This will be done by asking participants to describe how they feel about themselves using one word. We hypothesise that these statements of "self" will link to the core beliefs of self-loathing.

2. Methods

2.1 Design

This study employed a mixed methods cross sectional questionnaire design. Data were collected between December 2022-January 2023. Ethical approval was obtained from the University of Oxford Central University Research Ethics Committee (R83242/RE001).

2.2 Participants

Participants were recruited from the general population using social media. Study advertisements were posted to platforms such as Twitter, Facebook, LinkedIn, and Instagram.

A snowballing approach was used whereby participants were encouraged to share the study with others. Eating disorder groups on Facebook were approached to share the study advert, these were both groups of individuals with EDs as well as parents with EDs, this was to increase the age range of the sample. The advert was also shared on psychology student groups such as The Collective Asian Psychology Taskforce (CAPT), this was to collect a broader ethnic demographic range. A copy of the research poster is available in Appendix T.

To be eligible, participants had to identify as female, be aged 18 years and over, with no upper age limit. The exclusion criteria were no diagnoses of psychotic disorders, organic brain disorders, head injuries or be actively suicidal.

2.3 Measures

A psychometric overview of measures used in this study ca be found in **Table 1**, copies of the EDBQ and ED-CBQ can be found in **Appendix M & N.** The EAT-26 can be found in **Appendix S.**

Table 1.
Overview of standardised measures used.

Measure	Description & Psychometric Properties
Eating Attitudes Test (EAT) (Garner, 1982) (Appendix S)	The EAT-26 (Garner, Olmsted, Bohr, & Garfinkel, 1982) is an abbreviated (26-item) version of the 40-item Eating Attitudes Test (EAT-40; Garner & Garfinkel, 1979), which is a self-report inventory that quantifies features commonly associated with eating disorders. Scores above 20 are indicative of potential eating disturbance. The EAT-26 is highly correlated with the EAT-40 (r= .98; Garfinkel et al., 1982). Koslowsky et al. (1992) found the EAT-26 to be reliable among a non-clinical sample (Cronbach's alpha= .83).
Eating Disorder Belief Questionnaire (EDBQ) (Cooper et al, 1997) (Appendix M)	This is a 32-item self-report measure of core beliefs and assumptions (DAs) designed especially for use among people with eating disorders. It contains four subscales- (1) negative self-beliefs; (2) weight and shape as a means to acceptance by others; (3) weight and shape as a means to self-acceptance; and (4) control over eating. In this study the dysfunctional assumptions were subscale 2,3 and 4 combined and divided by 3, to make comparisons with the negative self-belief's subscale. The factor structure of the EDBQ is replicable and its other psychometric properties are adequate (Cooper et al., 1997). In a further study (Cooper & Turner, 2000), patients with eating disorders scored more highly on all four

	subscales than dieters or female controls, while dieters also scored more highly than controls on subscales measuring assumptions regarding weight and shape.
Eating Disorder Core Belief Questionnaire (ED-CBQ) (Fairchild & Cooper, 2010) (Appendix N)	This is a 32-item scale with 5 subscales: (1) self-loathing, (2) unassertive/inhibited, (3) high standards for self, (4) demanding and needing help and support and (5) abandoned/deprived. The ED-CBQ subscales showed adequate internal consistency and construct (convergent and discriminant) validity ; Fairchild & Cooper, 2010; Hatoum et al, 2022).
Depression and Anxiety Subscale-21 (DASS-21) (Lovibond & Lovibond, 1995)	This is a 21 item self-report scale. The reliability of DASS-21 showed that it has excellent Cronbach's alpha values of 0.81, 0.89 and 0.78 for the subscales of depression, anxiety and stress respectively. It was found to have excellent internal consistency, discriminative, concurrent, and convergent validities. The depression and anxiety subscales of DASS-21 have good correlations with self-rating depression scale and state trait anxiety inventories making it reliable, valid, and easy to administer (Coker at al, 2018).
Work & Social Adjustment Scale (WSAS) (Mundt, 2002)	This is a 5-item self-report scale designed to measure patients perceived functional impairments resulting from a given problem. It has been used to assess changes in social functioning for patients in anxiety and depression. Mundt (2002) reported good internal ($_a$=0.70-0.94) and test-retest ($_a$=0.84) reliability of the WSAS in patients with depression, suggesting that it is a potentially valid and reliable scale.

2.4 Demographic Questionnaire

Using guidance from the Office for National Statistics (ONS) the following demographic questions were asked: Age, whether they were born with female sex, ethnicity, country of residence, other psychiatric disorders (aside from those listed in the exclusion criteria) and weight and height, for BMI calculations.

2.5 Procedure

Data were collected through the software Qualtrics. Participants navigated to the survey using online links attached to the study advertisements. The survey began with an information sheet and consent form. Upon providing consent, they were directed to the demographic questions to see if they met eligibility criteria. Those who met eligibility were directed to the remaining demographic questions and rest of the questionnaires.

The EAT-26 was first administered to later perform a median split on participants into two groups of ED symptom severity. (1) Low ED symptom severity (1 SE below the median) (2) High ED symptom severity (1 SE above the median).

Following completion of the EAT-26, the rest of the standardised measures were administered, and finally a qualitative question was presented at the end as an open text box. At the end participants were directed to the debrief form and the end of the study. Those who did not meet criteria were directed to a specially developed debrief page with links to support the different exclusion criteria.

2.6 Patient and Public Involvement

Due to unforeseen circumstances the expert with lived experience could no longer provide consultation on the project.

2.7 Sample Size

The G*Power programme was used to predict the estimated sample size. For a 2x2 mixed ANOVA with 0.9 power, and 0.05 significance and a medium effect size (0.4) the total sample size needed was 68 participants. This equated to 34 in each high and low group. Previous studies of similar design showed that they had oversampled to account for taking out individuals in the median split (Zickgraf et al, 2019; Reardon et al, 2002), therefore we did the same.

2.8 Data Analysis

Statistical analysis was performed on IBM software SPSS-29. To meet assumptions for parametric tests, normality of all demographic data, EAT groups, EDBQ, EDCBQ were checked with plotted histograms which assessed skewness and kurtosis, as well as the Shapiro Wilk test of normality. The data in this study were normally distributed and therefore parametric tests were used. Descriptive statistics were used to summarise demographic characteristics across the sub-groups. A median split was carried out to allocate participants to a "high" ED symptom (1SE above) vs "low" ED symptom group (1SE below). Missing data management can be found in **Appendix O.**

Primary analysis was carried out on the EDBQ using a 2X2 mixed measures ANOVA. The independent variables were high/low ED symptom groups and dependant variables from the EDBQ: (1) negative self beliefs (2) Weight, shape and eating concerns. This was followed up with post-hoc t-tests and a linear hierarchical regression with EAT-26 scores as the dependant variable.

Secondary analysis was carried out on the EDCBQ. A mixed measures ANOVA was carried out for the EDCBQ with independent variables: high/low ED symptom groups and dependent variables: EDCBQ subscales (1) self-loathing; (2) assertiveness (3) demanding (4) abandoned. This was followed by a linear hierarchical regression with EAT-26 scores as the dependant variable. Please see section *3.3.1-premlinary analysis* of the ED-CBQ to see why the high standards subscale was omitted.

Appendix Q shows the qualitative methods.

3. Results

3.1 Demographic Characteristics

After removing the data sets of those who did not complete the EAT-26 and handling missing data there were 185 participants. The median split was performed, the low symptom group had 77 participants, whilst the high symptom group had 82 participants. Please see **Table 1** for the demographic characteristics of the two groups. The mean and standard deviation of the EAT-26 for the low ED symptom group was 4.85(SD=3.03) and high symptom group was

23.69(SD=10.72). Scores above 20 on the EAT-26 are indicative of disordered eating (Garner et al, 1982), which suggests that the high symptom group on average scored above the clinical threshold for ED diagnoses on this measure.

Table 2:
Demographic Characteristics for Low ED symptom and High ED symptom groups.

Demographic Factor	Low symptom group (n=77)	High symptom group (n=82)
EAT -26, mean (SD)	4.85 (3.03)	23.69 (10.72)
Female from birth, n (%)	77 (100%)	82 (100%)
Age, mean (SD) years	28.73 (5.19)	30.04 (7.94)
Ethnicity, n (%)		
White- English, Welsh, Scottish, Irish, other	54 (70.1%)	56 (68.3%)
Asian- Pakistani, Indian, Chinese, other	17 (22.08%)	25 (30.5%)
Black/African/Caribbean/ Other	1 (1.30%)	0
Mixed ethnicities	4 (5.19%)	1 (1.2%)
Country of residence		
UK & Northern Ireland	69 (89.61%)	64 (78.04%)
Other	8 (10.39%)	18 (21.95%)
Psychiatric Diagnoses, n (%)	5 (6.49%)	19 (23.17)
Eating Disorder [a]	0	2
ADHD	1	4
Anxiety Disorder	2	3
Comorbid anxiety & depression	1	6
Complex PTSD	0	3
Borderline Personality Disorder	1	1

BMI mean (SD)[b]	23.38 (5.36)	25.58 (5.86)
<18.5 BMI, n (%)	6 (8.11%)	23 (31.18%)
>25 BMI n (%)	4 (5.06%)	37 (46.84%)
DASS-21 mean (SD)		
Depression score	24.3 (9.6)	36.8 (17.6)
Anxiety score	21.4 (8.8)	30.2(14.6)
Stress score	30.80 (11.61)	40.46 (14.45)
WSAS	7 (7.7)	16.3 (12.0)

Note: m=mean; SD=standard deviation; n=number of participants; ADHD= attention deficit hyperactive disorder; complex PTSD= complex-post traumatic stress disorder; DASS-21= depression, anxiety and stress scale; WSAS= Work & Social Adjustment Scale.

[a] Reflects the eating disorder diagnosis, specifically these were anorexia nervosa.

[b] Reflects body mass index (BMI), split by number of participants scoring in the underweight range <18.5; and number of participants scoring in the overweight range >25.

3.2 EDBQ

3.2.1 Descriptive statistics

The mean and standard deviations of the EDBQ subscales i.e. "Negative self-beliefs" and "eating, shape and weight control" in both high and low symptom groups can be found in **Table 2.**

Table 3.

Mean and standard deviations of EDBQ

	Low symptom group M(SD)	High symptom group M(SD)
EDBQ Negative Self beliefs[a]	19.70 (19.12)	37.68 (25.14)

EDBQ Eating, shape, weight, control[b]	22.06 (15.56)	45.01 (24.20)

Note: This table shows the mean and standard deviations of the Eating Disorder Belief Questionnaire sub-scales. M=mean; SD= standard deviation.

[a]Negative self-beliefs = negative self-beliefs subscale

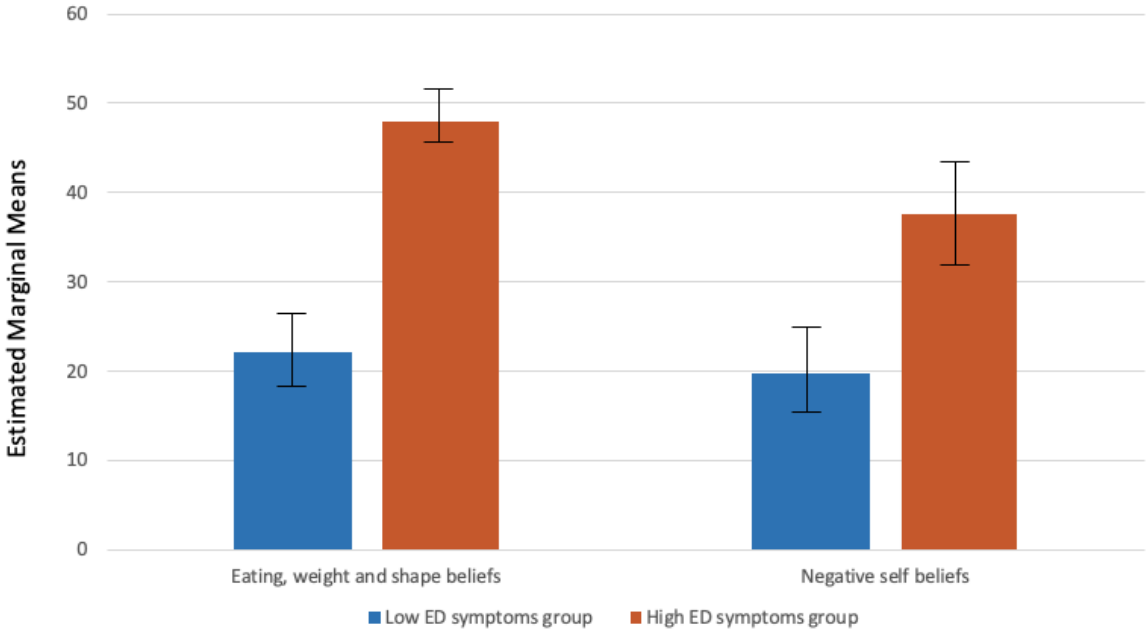
[b]Eating, shape, weight and control= dysfunctional assumptions about eating, shape, weight and controls from the subscales on the EDBQ that have been combined and divided by three to make comparisons possible with the negative self-beliefs scale.

3.2.2 Primary Analysis

A two-way mixed model ANOVA for group (High ED symptom & low ED symptom group) x subscales of the EDBQ (DAs & NSBs) was performed. There was a significant main effect of group $F(1;154)=68.83;p<.001$ and subscales $F(1;154)=14.43; p<.001$. These effects were modified by a group x subscale interaction $F(1,154)=6.03, p<.015$. The high symptom group reported higher scores on DAs, but not NSBs, than the low ED symptom group. This interaction is shown in **Figure 3.**

Figure 3.

Graph showing the significant main effect and interaction between ED groups and subscales.



3.2.3 Post Hoc Tests

Post-hoc analyses were performed for multiple comparisons between groups on the EDBQ subscales.

Paired samples t-tests were carried out on the low and high ED symptom group to compare the means of the DAs and NSBs subscales. The results showed no significant difference between DAs and NSBs in the low symptom group t(74)=-1.12,p=0.27, and a significant difference between DAs and CBs in the high ED symptoms group t(80)=-3.99,p=<.001, with higher scores on DAs than NSBs in this group.

An independent samples t-test compared the means of DAs and NSBs between high and low ED symptom groups. The high ED symptom group scored significantly higher on DAs than the low ED symptom group t (152.2)=-9.70; p= <.001. Similarly the high ED symptom group scored significantly higher on NSBs than the low ED symptom group t(150.10)=-5.07 p=<.001.

3.2.4 Hierarchal Linear Regression

A hierarchical linear regression was performed in order to see if the DAs and NSB's were significant predictors of ED symptoms i.e., EAT-26 scores even when relevant covariates were included. The dependant variable was the total score on the EAT-26. Regression tables from SPSS can be found in **Appendix R.**

In step 1 the following covariates were added: DASS subscales (depression, anxiety, stress) and WSAS. The results of this showed the DASS subscales and WSAS accounted for 32% of the variance in ED symptoms (R^2=0.32, F(4,148)=18.70,p=<.001). None of the DASS subscales or the WSAS were correlated individually with the EAT-26 scores.

In Step 2: the EDBQ was added. The EDBQ subscales added an additional variance of 27% to ED symptom severity (R^2=0.59 F(2,146)=49.33,p=<.001). The DASS-depression subscale became significantly correlated with EAT-26 scores (t=2.40; p=.017) when the EDBQ was added. Specifically, the DAs had a significant correlation (t=.62, p=<.001) with EAT-26 scores. The NSB's did not have a significant correlation with EAT-26 scores (t=-.42, p=.674). This suggests that the DA's were contributing to additional variance in EAT-26 scores, including after controlling for depression, however the NSBs were not.

To further investigate the relationship between DAs, NSBs and depression, correlation analyses between these three variables were carried out with EAT-26 scores as the dependant variable. NSBs accounted for 29.16% of shared variance in EAT-26 scores (r(163)=0.54;p=<.001). DAs accounted for 51.84% of shared variance in EAT-26 scores (r(163)=0.72;p=<.001). A partial correlational analysis was then performed to control for depression scores. Following this, the shared variance with NSBs dropped to 5.29% (r=(162)=0.23; p=.003), whilst the shared variance with DAs dropped to 42.25.% (r(162)=0.65;p=<.001). This supports the regression analyses findings in which higher DAs but not NSBs explain greater variance in EAT-26 scores, even after controlling for depression.

3.3 EDCBQ- Secondary Analyses

3.3.1 Preliminary analysis

A correlational analysis was performed between the five subscales of the EDCBQ. It revealed all the subscales were significantly correlated with one another aside from the "high standards" subscale. This suggested this subscale lacked convergent validity and it was therefore removed from the mixed model ANOVA. This finding was previously reported by Hatoum et al (2022) who found *"apart from High Standards for Self, all other subscales demonstrated good convergent validity, as indicated by significant correlations with the Eating Attitudes Test 26 (EAT-26; r = 0.26 to 0.38, all p < 0.001)".*

3.3.2- Mixed model ANOVA

A mixed model ANOVA for group (High ED symptom & low ED symptom group) x subscales of the ED-CBQ (1) self-loathing, (2) unassertive/inhibited, (3) demanding and needing help and support and (4) abandoned/deprived was performed. There was a significant main effect of group F(1;156)=31.85<.001 and subscales F(1,156)=91.36<.001. These effects were not significantly modified by a group x subscale interaction F(1,154)=1.4,p=0.24.

3.3.2 Hierarchical Linear Regression

Additional exploratory analyses were performed with the individual ED-CBQ subscales to investigate whether they contributed a significant amount of variance to EAT-26 scores. A hierarchal linear regression was carried out with DASS subscales and WSAS entered on the first step, and EAT-26 scores as the primary dependant variable (R^2=0.32, F(4,148)=18.70,p<.001). The second step involved the addition of the remaining four EDCBQ subscales (R^2 =0.33,F(4,145)=1.8,p=<.131) which were not overall significantly associated with EAT-26 score. Nevertheless, a closer investigation of the correlations of specific sub-scales revealed that self-loathing had a small but significant correlation with EAT scores (t=2.05,p=.045).

3.3.3 Self-loathing analyses

Given that the initial prediction was that self-loathing core beliefs would act as a unique predictor of EAT-26 score, a partial correlation analysis was performed on the self-loathing subscale. Self-loathing was correlated with EAT-26 score r=.46, p=<.001. When depression was controlled, the partial correlation was r=.24, p=.001.

As an exploratory process the self-loathing subscale was added alone to the regression model on the final step after controlling for the other ED-CBQ subscales. On the first step the DASS and WSAS variables were entered with EAT-26 score as the dependant variable. As before the equation was significant (R^2=0.32 (4,149)F=18.62,p=<.001). On the second step the three subscales (unassertiveness, demanding, abandoned) which were not significantly associated with EAT scores were added, and this equation was not significant (R^2=0.32 (3,146)F=1.02,p=.39). Finally, self-loathing was added in the third step, and a small but significant association was found (R^2=.018 (1,145)F=4.10;p=.045). This provides some evidence that self-loathing beliefs may be a unique predictor of ED symptom severity.

3.4 Qualitative analyses

3.4.2 Content analysis

The low ED symptoms group had 67 respondents; the high ED symptom group had 72 respondents. Negative descriptions of the self-appeared significantly more in the high ED symptom group (45.8%) than the low group (9%). No descriptions of weight, shape and size were given. The descriptions were commonly themes of worthlessness, shame, self-disgust, and uselessness.

25% of the high symptom group also presented with positive views of the self, which was higher than expected but significantly less than in the low ED symptom group (74.6%). These fit with the hypothesis that the content of core beliefs in the high ED symptom is generally particularly relevant to extreme negativity including self-loathing. Additionally, a set of core beliefs which expressed “uncertainty about the self” were found in 25% of the high symptom group e.g., underwhelmed, ambivalent, unsure, stagnant. These were also more commonly

reported in the high group than the low group (16.4%). Table 4 shows the frequency of terms used to describe the self.

Table 4. *Frequency of terms used to describe the self, split by group.*

Type of belief	High Symptom ED Group (n=72)	Low Symptom ED Group (n=67)
Negative views of self-e.g., worthless, disgusted, useless, failure, ashamed, bad, broken	33 (45.8%)	6 (9%)
Positive views of self-e.g., Okay, good, motivated, successful, confident, proud	18 (25%)	50 (74.6%)
Uncertainty about the self-e.g., trying, ambivalent, unsure, lost, stagnant	18 (25%)	11 (16.4%)
Physical /emotional symptoms to describe self, e.g., anxious, tired, deflated,	4 (5.6%)	0

The results of the content analysis have high similarity to words used on the "self-loathing" sub-scale of the ED-CBQ, and the negative views of self are generally very similar to those described in the EDBQ NSBs sub-scale. The results of the content analysis give further indication that the negative views in those with high levels of ED symptoms are substantially harsh about the self.

4. Discussion

4.1 Main findings

The main hypotheses were partially supported. There were higher levels of DAs and NSBs in the high ED group than the low group, and there was a higher level of DAs than NSBs in the

high ED symptom group. The results of the regression analyses support the finding that DAs make a larger contribution to ED symptom severity than NSBs. These findings support the current CBT understanding that shape, weight, and size concerns are highly relevant in the identification and treatment of EDs (Byrne et al, 2011; De Jong et al, 2020; Agras, 2019; Signorini et al, 2018), and suggest that core beliefs may be most relevant to those with high levels of ED symptoms. Given the sample was non-clinical it is unclear if the same would be found in a clinical sample, for example, it is possible that NSBs might have a greater contribution is the sample was a clinical one. In **Figure 4**. The results of this study are mapped diagrammatically onto the longitudinal CBT formulation.

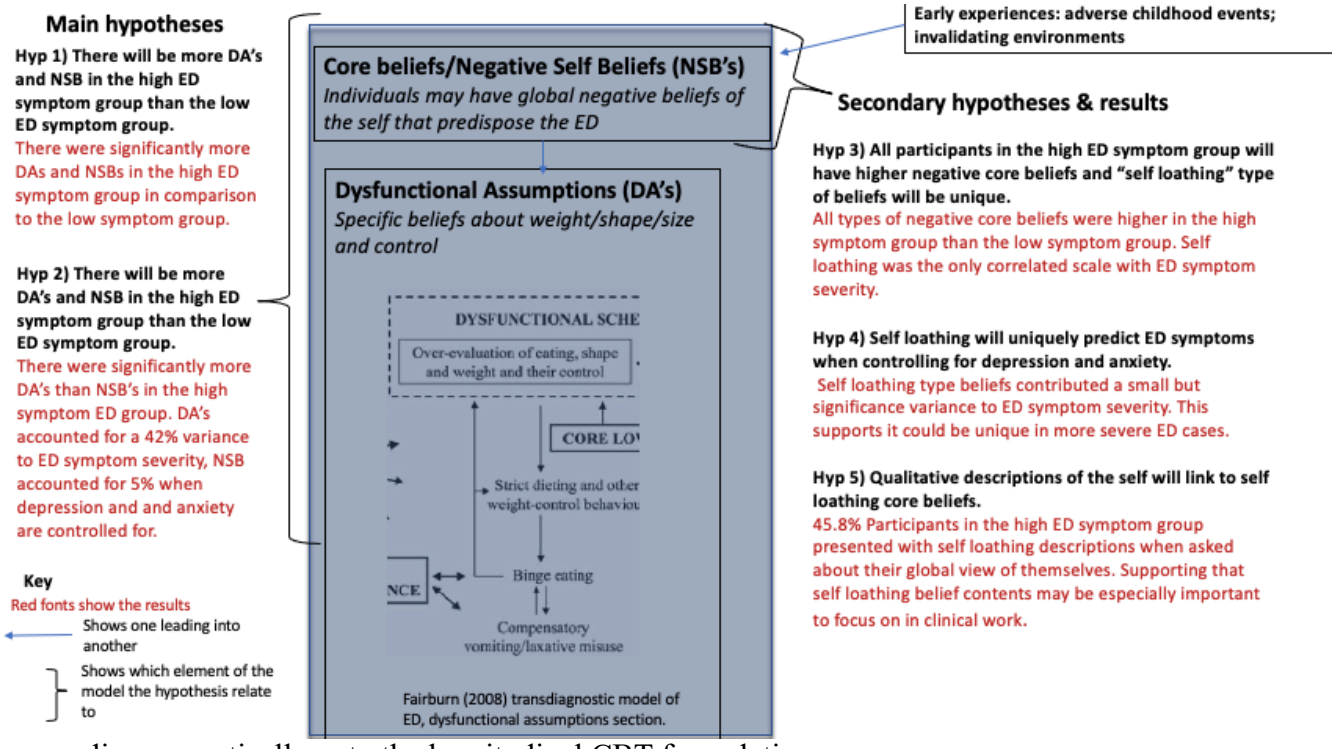


Figure 4. *A diagrammatic summary of the longitudinal CBT formulation and ED dysfunctional assumptions, relative hypotheses for the model and the results from this study.*

The secondary hypotheses which predicted self-loathing core beliefs would predict ED symptoms were partially accepted. The regression revealed the self-loathing sub-scale in the ED-CBQ accounted for unique variance of ED symptoms in the model. However, the significance of this variance was small, and may not be clinically meaningful in real-world

settings. Again, it would be useful to investigate this in a clinical sample. Studies conducted on non-clinical samples using other self-loathing scales have found strong correlations for example, between the EAT-26 and Self Loathing Subscale (SLSS) (Aruguete et al, 2007). Hatoum et al (2020) in a non-clinical sample also found "self-loathing" the most reliable subscale in the ED-CBQ predicting ED symptoms (Hatoum et al, 2020). Interestingly Hatoum and colleagues (2020) also found the high standards subscale scores were equal in both low and high symptom groups, indicating that it may not be appropriate to use this in a non-clinical sample, and that it may not be sensitive enough to differentiate between high ED and low ED symptom severity. However, this contradicts Fairchild & Cooper's (2010) original study. Importantly, within this study, other core belief subscales were higher in the high ED symptom group, supporting the view that there may be a diverse range of core beliefs present in those with ED symptoms (Hatoum et al, 2020; Jones et al, 2007), i.e., self-loathing may not be the only relevant core belief. This required further investigation.

The qualitative data supports the hypothesis that "self-loathing" is important in ED symptom severity. Core beliefs consistent with self-loathing were more common in the high ED symptom group, with 45% falling into a category of "negative views of self" with contents such as "useless, worthless, ashamed and failure". Interestingly, none of the participants described their physical appearance in this question, despite high levels of DAs, and they were able to identify generalizable global core beliefs with minimal prompting. The qualitative data supports Bruch's (1968) theory of EDs as disorders of the self, and subsequent empirical research showing self-loathing is prominent in individuals with high levels of ED symptoms (Arguete et al, 2007; Tasca & Balfour, 2014).

25% of the high symptom ED group reported "positive views of the self" i.e., good, successful, confident. This finding supports Cooper & Proudfoot's (2013) study that revealed individuals with high levels of ED symptoms have the beginnings of positive beliefs, and these may be available to be worked on and developed in therapy. In the current study, the positive beliefs were 74% in the low ED symptom group, together with few negative core beliefs.

A small proportion (5.6%) of the high ED symptom group described the "self" using physical/emotional symptoms such as "anxious, tired, deflated". This could be due to a

misinterpretation of the qualitative item, or perhaps a difficulty in forming a global view of the self, and instead using symptoms to describe how they experience the self. Alongside this, 25% of the high ED symptom group displayed uncertainty about themselves e.g., unsure, ambivalent, lost. Both these categories may reflect a difficulty in describing and identifying feelings/emotions/experiences, as is commonly seen in individuals with alexithymia. Studies have shown strong associations between EDs and alexithymia (Meneguzzo et al, 2022). Further links have also been made with EDs, alexithymia and autistic spectrum disorder (ASD) in which difficulties of impaired of theory of mind and central coherence are found (Huke et al, 2013). However, no one in this sample identified as having ASD, instead ADHD was more prevalent, and research shows that in this population a negative self-concept is more common (Redshaw & Cormack, 2022). Alternatively, difficulties associated with complex PTSD which three participants in this study had, have shown a person may form a fractured sense of self that is difficult to define and conceptualise and may be present (Rorty & Yager, 1996).

4.2 Demographic findings

Despite being a non-clinical sample, the high ED symptoms group presented with extremely high levels of DAs and high scores on the EAT-26. In addition, 31% fell into an underweight BMI category, which might warrant referral and intervention from services. However, only two participants reported having an ED diagnosis, both anorexia nervosa. More strikingly, 47% of the high ED symptom group, fell into an overweight BMI category. ED services in the UK for individuals with higher weight are limited, often leaving patients without access to intervention (McMaster et al, 2022). Hay et al (2022) found that assessment of global ED risk in higher weight individuals scarcely occurs in obesity clinics. These may therefore be only a proportion of at-risk individuals with high BMI's who may fall through gaps in services.

23% of the sample presented with comorbidities in the high ED symptom group. Many of the diagnoses shared have associated dysfunctional eating patterns. For example, studies have found links between binge eating disorder and complex trauma (Impertatori et al, 2016); ADHD and binge eating (Hershko et al, 2018). Others have evidenced links between anxiety, depression, and dysfunctional eating (Bulik 2002; Godart et al, 2002).

The majority of studies on EDs have typically included young women in their 20's of Caucasian ethnicity, demonstrating a lack of inclusion and generalisability of the findings (Flores et al, 2022). The sample collected in this study was diverse in its age range and ethnicity. Ages ranged from 18 -57 years. Research has suggested that women in their late 50's may present with more binge-eating presentations (Smink et al, 2012). This may have explained higher BMI scores found here in this group.

30% of the high ED symptom group, and 20% of the low ED symptom group identified as Asian- Pakistani, Indian and Chinese. Previous research suggests much higher rates of EDs in Asian and south Asian communities in the UK (Button et al, 1998; Goodman et al, 2008), yet in the NHS the referral rates are almost a third less than expected, which is vastly lower than their Caucasian counterparts (Abbas et al, 2010). This study contributes to calls for more emphasis on inclusion of Asian ethnicities in research in the UK who may be struggling to access services for ED. One barrier may be lack of culturally sensitive diagnostic assessment instruments, which is a further area of need (Franko, 2007). Nevertheless, this study has demonstrated that the EAT-26, EDBQ and ED-CBQ are effective in identifying disordered eating symptoms, DAs and core beliefs in Asian ethnicities who can speak English.

4.3 Strengths, Limitations and Summary

The main strengths of this study include a highly diverse sample, showing that cognitive behavioural models, particularly recent adaptations are likely to be applicable to ethnically diverse groups. The current study is also well powered. Future research may want to build on these findings in a clinical ED sample, perhaps investigating differences between types of EDs. Furthermore, more research into the beliefs and DAs in overweight ED samples may be warranted. The current study has several limitations, such as use of a female-only sample, which limits its generalisability. Participants also had multiple comorbid diagnoses that were not controlled for. Overall, however it supports core beliefs as a key component of ED related symptoms and thus EDs.

In summary, the current study replicates previous research on the important role of DAs in cognitive and behavioural models of EDs. It also shows that core beliefs in high ED symptom groups may be highly negative and in line with self-loathing beliefs. This supports a growing body of evidence for the importance of paying attention to role of core beliefs in individuals with severe ED's but for research and clinical purposes.

Executive Summary of the main paper

Background: It is usual for individuals with eating disorders (EDs) to have negative views of their weight, shape, eating habits and size, these are called "dysfunctional assumptions". Current treatment aims to address these dysfunctional assumptions, by shifting them into more positive and rational opinions of one's weight, shape, eating habits and size. This treatment is called cognitive behavioural therapy-enhanced (CBT-E) and has a lot of studies showing its effectiveness in improving EDs. However, increasingly, research has shown CBT-E may not be as effective in people with severe ED symptoms. There is a growing focus on people's views of themselves, rather than just dysfunctional assumptions. People with EDs may have a whole negative view about themselves, these are called "negative core beliefs" and are usually statements such as "I am a failure"; "I am ugly" etc. We were particularly interested in knowing whether people with high eating disorder symptoms had more "self-loathing" types of negative core beliefs. Self-loathing beliefs are an extreme harsh view of oneself and can be related to a person feeling a deep sense of dissatisfaction and disgust at themselves.

Aims: In this present study, we aimed to see how much the dysfunctional assumptions and negative core beliefs differed in two groups. We wanted to know what people thought about themselves and whether the words they come up with, relate to the questionnaires used to assess negative core beliefs. We asked people "describe how you feel about yourself in 1 word?" and analysed the results to see what words were commonly used, and whether they were those typically seen in self-loathing core beliefs.

Methods: We asked adult, female participants from the general population i.e., they did not need to have a diagnosis of an eating disorder, to participate. We asked participants to fill in

online anonymised surveys. We split people into 2 groups: The first group being, people with high eating disorder symptoms, and the second group being people with low eating disorder symptoms.

Results: We found that people with high eating disorder symptoms, had both more negative core beliefs and dysfunctional assumptions than the low eating disorder group. We found that those in the higher group who had more severe eating disorder symptoms, had more dysfunctional assumptions than negative core beliefs. Dysfunctional assumptions predicted more severe eating disorder symptoms than the negative core beliefs in this particular sample of people.

Furthermore, we found that "self-loathing" core beliefs uniquely accounted for some severity in ED symptoms. This means people with self-loathing beliefs may have more severe eating disorder symptoms. This claim is backed up by the words participants shared when describing themselves. 45% of the high symptom group described themselves negatively with words such as "useless; failure; ashamed, bad, broken". Only 9% of the low symptom group reported these negative views of themselves. 25% of the high symptoms group described themselves positively, in comparison to 75% of the low symptoms group who felt more positive about themselves.

Conclusions: People with severe eating disorder symptoms, have a high level of dysfunctional assumptions, which is backed up by a lot of research. They also present with more negative core beliefs. Clinicians may want to pay particular attention to "self-loathing" types of core beliefs in therapy. The limitations of this research are that it was carried out in a female-only sample, and many individuals had comorbid psychiatric conditions such as attention deficit hyperactive disorder, complex posttraumatic stress disorder, borderline personality disorder, depression, and anxiety. The strengths of this research show that cognitive and behavioural theories of eating disorders can be applied to other ethnicities, as 30% of this sample were from Asian ethnicities, and to a larger age range, from 18-65 years old. The majority of studies in this field have a focus on white woman in their early 20's. Future research should investigate replicating this study in a sample of individuals with diagnosed eating disorders to see whether

the negative core beliefs and self-loathing beliefs in particular are highly relevant in a diagnosed sample of patients.

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Connecting Narrative

Coming into the doctorate I had a wide variety of interests. Therefore, the projects I have chosen are not linked by field or special interest, rather that they cover the lifespan and are connected by adding knowledge to clinical practice for groups with complexity. I am very aware of the gap between research and clinical work, therefore I wanted my projects to provide guidance, food for thought and areas of improvement for clinicians. The process was challenging, and I had difficulties with the various steps to follow at the beginning. Across the three years, I can see how my approach to writing has changed, and subjectively feel there has been a vast improvement in my ability to communicate and synthesise research and written work.

Systematic Review of literature

I found this project the most difficult due to the overlap into the medical field and my own limited knowledge about craniosynostosis when I started. Many studies were conducted by medical consultants, and often the use of medical jargon was so widespread it could become overwhelming, a feeling I am sure is shared by any lay person who wants to access this information. I wanted my review to be as accessible as possible for clinicians and parents who are interested. Therefore, I made a point to simplify the concepts discussed as much as I could without losing the scientific rigour of a systematic review and the medical complexities of the condition. I felt having a different approach to interpreting the results form a psychological perspective put my review at an advantage. This allowed me to discuss the intersectionality of different identities and potential bias introduced within this field. It was apparent in these studies that Caucasian, middle-upper class children were the most researched, and the data showed limited schooling intervention is needed. Without mentioning family dynamic, ease of access to good care from those from different backgrounds, the research is all limited in its generalisability. I felt disheartened and sometimes frustrated at the lack of acknowledgment from authors about this. But it more so fuelled my passion in pointing out these topics of considerations in hopes that it could be acknowledged in the future.

Service Improvement Project

This work had not been done before in a major trauma setting and creating provision from the ground up was a challenging task. This project was carried out in the height of COVID-19 during lockdown and extreme burden on hospital staff. Time and resource were scarce therefore I had to be creative in my approaches and rely on my inter-personal skills to collate data for questionnaires and interviews. I especially enjoyed working with an ex-service user who provided feedback and direction on what would be useful for patients in the wards.

A noticeable theme in my project was a potential discriminative practice in major trauma settings. Referrals received for working aged adults in high-speed collisions and potential PTSD symptoms were the most common, however the psychological impact of falls appeared to be less seen as a traumatic incident by clinicians. This could indicate discriminative practices relating to ageism in medical environments about older adult mental health. Like the systematic review I felt privileged to be able to give a psychological person-centred perspective of care for these individuals who are often forgotten.

Theory Driven Research project

My special interest in eating disorders formed back when I was an assistant psychologist in an acute- female inpatient ward. Many of the women admitted were displaying dysfunctional eating habits, such as bingeing or restriction, alongside suicidality and self-harm. The common theme for me was a clear self-hatred or disgust in the self. This got me interested in "complex" patients, and the role of core beliefs and how our early experiences can impact our view of the world and trajectory of mental health difficulties. I wondered why CBT-E was so widely used when its efficacy was similar to that of other therapies and was interested to know if more attention needs to be drawn on the role of core beliefs and how this influences the dysfunctional assumptions.

It was important to me that the sample was diverse. In my community criticism and expectations to achieve educationally, appearance wise and submit to patriarchal standards is extremely heightened, and this was reflected in the sample therefore I felt this was a real strength of the project. It also pointed out that people with high BMIs may suffer from the exact same dysfunctional assumptions, yet in my experience underweight people are more readily referred and seen in eating disorder services. I felt the sample provided an interesting array of results demographically with special considerations to be made for people who are seen as hard to reach.

Acknowledgements

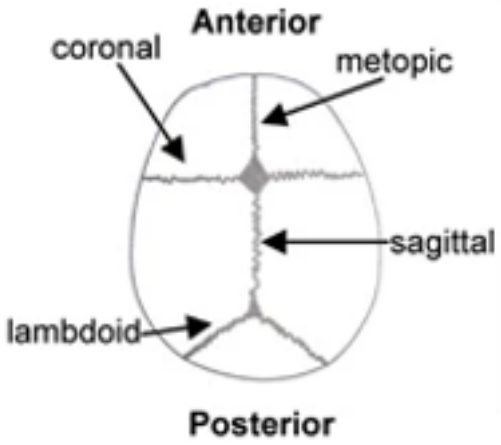
Firstly, I would like to acknowledge the research supervisors who have been instrumental in this process. Thank you to Dr Fiona McFarlane, Dr Samuel White, Dr Reena Vohora, Dr May Quarmby for their patience, support, and guidance in helping me complete these projects, and Professor Paul Salkovskis for his research expertise. Thank you to the assistant psychologists Syed Shah and Katherine Duncan for assisting in second rating. In particular, I'd like to thank Dr Myra Cooper who helped me form an understanding of my learning style and provided thorough positive reinforcement which motivated me to keep going. I would also like to thank my course tutor Dr Matthew Knight, who has been a significant source of practical and emotional support throughout these three years.

Thank you to my friends in the 2020 cohort for being a kind and supportive group. Also, shout out to my two closest friends Holly and Ava, you've provided me with endless laughter throughout these 3 years.

Finally, I would like to thank my mother, who was the person that inspired me to pursue clinical psychology, who pushed me to achieve my potential and I am forever grateful to be able to follow in her footsteps. I would like to thank my father for working hard to provide me with the opportunities and privileges to reach this point in my career, and my brother for his playfulness and humour that I needed when times were tough. Thank you to our lovely little puppy Brucie, who is a valued member of the family and has brought us all closer together. Last, but certainly not least, I want to say thank you to my partner Heshw, who has been an invaluable presence in my life, thank you for keeping me afloat and being my biggest supporter.

Appendices

Appendix A- Images of Non-syndromic craniosynostosis



(Johnson & Wilkie, 2011)- *approval sought from authors on 10th and 11th May, 2023 via email from Andrew Willkie and David Johnson for use in appendices.*

Appendix B- *Glossary of Terms/phrases*
(In alphabetical order)

- Abnormal brain growth- occurs because of the fused sutures, causing the brain to grow in the areas where the skull can expand. For example, in sagittal NSC, children distinctly may have a "boat shaped" head because the brain is growing forward and backwards, and not from the side.
- Attention- is not a unified concept. Broadly it is the ability to flexibly control limited computational resources, and is heavily linked to awareness, vigilance, saliency, executive control, and learning.

- Biological factors- these refer to factors that biologically may impact the neuropsychological outcomes e.g., sex, ethnicity and type of NSC.
- Cognitive domains- According to the DSM-5 this includes six domains of cognitive function: complex attention, executive function, learning and memory, language, perceptual-motor control, and social cognition.
- Cognitive difficulties- this phrase implies that the individual has difficulties in a certain domain e.g., attention.
- Congenital abnormalities- a wide range of abnormalities of body structure or function that are present at birth. NSC is usually not associated with any congenital abnormalities.
- Cranial Vault Surgery- also called cranial vault remodelling/reconstruction. It involves reshaping of cranial bones when a suture closes prematurely.
- Craniofacial Disorder- a broad term that describes malformations of the face and skill that occurs from birth, disease or trauma. NSC falls under this category.
- Developmental Factors- this refers to factors that may have affected the neuropsychological outcomes as the infant was developing e.g. age of surgery, age of evaluation, type of surgery, whether they were operated on or not.
- Environmental Factors- these refer to factors in the infant's environment that may have impacted their neurological profiles e.g. socio-economic status, country of residence, family dynamics.
- Full Scale Intelligence Quotient – Usually reported by the WASI, WAIS or WISC
- Intracranial Pressure – means there's a build-up of pressure around the brain.
- Insult- refers to whether the brain has undergone an injury which usually occurs in surgery or due to NSC consequences.
- Learning Disability- several studies in this had varying definitions of learning disability. E.g. Magge 2002 referred to "reading learning disability" which may have implied dyslexia. Majority of studies excluded patients of IQs less than 70, so by the current definition of an "intellectual disability" this was rarely reported.

Appendix C- *Neuropsychological Tests, definitions of categories and domains assessed.*

Neuropsychological Test	Description
Wechsler Intelligence Scale for Children (WISC)	This is a battery of tests for children between the ages of 6-16. It generates a full-scale IQ (FSIQ) that represents a child's general intellectual ability. It provides 5 primary index scores: Verbal Comprehension Index (VCI); Visual Spatial Index (VSI); Fluid Reasoning Index (FRI); Working Memory Index (WMI) and Processing Speed Index (PSI).
Wechsler Abbreviated Scale of Intelligence (WASI-II)	This is a test of general intelligence or FSIQ designed to assess some specific and overall cognitive capabilities. It can be administered to anyone from the age of 6-85 years of age. It is a shortened version of a WAIS and WISC. It includes a battery of four subtests. It provides estimates of Verbal Intelligence Quotient (VIQ) by combining vocabulary and similarities subtests. Performance Intelligence Quotient (PIQ) are derived from block design, matrix reasoning subtests.
Beery Buktenica Visual-Motor Integration (Beery VMI)	The purpose of this measure is to determine whether a child demonstrates age appropriate visual-motor integration skills. Including visual perception, fine motor skills, dexterity and vision and perception. The age ranges from 2 -99 years old.
Wechsler Fundamental: Academic Skills (WF: AS)	A brief achievement test that measures broad skills in the area of reading, spelling and math computation. In contains four sub-tests:

	word reading, reading comprehension, spelling, and numerical operations. Reading composite scores are derived from combining reading comprehension, and word reading. The test can be used in schools to identify children at risk of failure or a guide to identify areas of difficulties. Age ranges are in both children and adults.
Behaviour Rating Inventory of Executive Function (BRIEF) *Please note this is not a standardised neuropsychological test. But a behavioural measure of executive function.	This is an assessment of executive function behaviours at school and home. The age ranges are 5-18 years old. Observational measures are filled in by parents and teachers. These then form two scales: 1) behavioural regulation- inhibit, shift and emotional control 2) Metacognition- initiate; working memory; plan/organise; monitor; organization of materials. 3) Global executive composite – overall executive functioning
Conner's Continuous Performance Test-3 (Conner's CPT-3)	This is a task orientated computerized assessment of attention-related problems in individuals aged 8 years and older. Indexes are formed from the respondent's performance on inattentiveness, impulsivity, sustained attention and vigilance.
Wechsler Preschool and Primary Scale of Intelligence	For children aged 2.5-7.25 years old. The WPPSI uses composite scores to assess general intellectual ability and cognitive

	functioning based on their test performance and current age. Core sub-tests are required for computation of Verbal, Performance and full-scale IQ. Processing Speed quotient can be derived from children aged 4-7 years and General Language Composite can be determined for children in 2-7 years.
Griffiths Mental Development Scale	Suitable for children at birth to 6 years of age. Assesses language and communication- expressive/receptive and use of language to communicate socially. Hand eye coordination- fine motor skills, dexterity and visual perception skills. Gross motor skills- balance, postural control, gross body coordination.
Wide Range Achievement Test (WRAT)	Measures an individual's ability to read words, comprehend sentences, spell, and solve math problems. The age ranges from 5 to adulthood. A composite score with reading is available.
Clinical Evaluation of Language Fundamentals Preschool-Revised (CELF-R)	A test of language abilities between aged 3-16 years old. Pinpoints a child's language and communication strengths and weaknesses. 9 sub-tests: sentence structure; word structure; expressive vocabulary; concepts and following directions; recalling sentences; basic concepts; word classes; recalling sentences in context; phonological awareness.

Wechsler Adult Intelligence Scale (WAIS)	Intelligence test designed to measure cognitive ability and full-scale IQ in adults and older adolescents. Verbal IQ: Sub-indices are verbal comprehension (VCI) ; working memory (WMI) Performance IQ: sub-indices are the perceptual organisation index (POI) and processing speed index (PSI).

Appendix D- Journal Guidelines-

Journal of Craniofacial surgery guidelines

https://edmgr.ovid.com/scs/accounts/ifauth.htm

Appendix E- Quality improvement project approval & Journal Guidelines

Journal- Psychology and Ageing - Prepare manuscripts according to the *Publication Manual of the American Psychological Association* using the 7th edition. Manuscripts may be copyedited for bias-free language (see Chapter 5 of the *Publication Manual*). APA Style and Grammar Guidelines for the 7th edition are available.

Clinical Improvement Module Notification

Number:	**6897**
Page:	**03 - Approved QI**
Title:	**Training physiotherapists in CBT strategies for fear of falling in older adults on a Major Trauma inpatient ward**
Request Date:	**04/05/2021**
Target Date:	**01/09/2021**
Start Date:	**/ /**

Appendix F- scoping survey

Physiotherapy Scoping Survey

1. How confident do you feel in recognising if a patient has a fear of falling?

Not at all confident Somewhat Confident Very confident

Please give further comments below for why you gave that answer and what could be changed to improve it?

2. How confident do you feel helping a patient mobilise if they have a fear of falling and become distressed/anxious?

Not at all confident Somewhat Confident Very Confident

Please give further comments below for why you gave that answer and what could be changed to improve it?

3. Would it be helpful to have psycho-education resources for patients about fear or falls?

Yes No

4. Would you find it helpful to attend a training session by psychology on understanding and working with FOF?

Yes No

5. Please comment on what you find difficult (if anything) about working with older adults with a fear of falling?

Appendix G- thematic analysis procedure

Thematic Analysis

The first phase of "familiarisation" of the data was achieved by the researcher conducting surveys and structured interviews using survey questions for those who could not do the survey due to time restraints. The researcher read the responses and the second phase of

"coding" involved collating and coding quotes taken from the data. "Searching for themes" was achieved by looking for similarities between the codes and grouping codes together. The themes were then reviewed by the researcher and themes that emerged were related to the coded extracts. Themes that were similar and did not provide additional information about the data were collapsed together. The "defining and naming themes" section was achieved by the researcher once the previous methods were done. Subthemes were elicited through reviewing themes with similarities under a main heading.

Appendix H

Table 3.

Considerations & Adaptations made in Psychoeducation Workbook and Staff Training for CBT in older adults with FOF in Major Trauma

Factor to Consider	Psychoeducation Workbook	Physiotherapy Training
Cohort Beliefs Cohort beliefs are those beliefs held by groups of people born in similar years or similar time periods (Neugarten & Datan, 1973) In older adults beliefs about mental health difficulties and suffering injury to cause long term disability can directly influence their	The introduction section is designed to normalise the experience of FOF for older adults by providing normalisation of the experience after suffering from major trauma and how a large proportion of the population may have this fear. It also aims to instil hope and validate the experience by promoting compassion, kindness and	Coinciding with the booklet the training also refers specifically in slide 30 "awareness of FOF in older adults". The content aims to make physiotherapists aware of the cohort beliefs about disability and mental health older adults may stigmatise themselves from engaging with any psychological intervention or the beliefs about injury and disability can spark beliefs of unworthiness in society.

own core beliefs about themselves and the world. The stigma of mental illness as a personal failure is an especially strong belief in older adult generations.	empathy to challenge common narratives in older adults that minimise or pass judgement over disability and mental health difficulties.	Sharing Facts and figure's to normalise the experience can be useful for them to pass on. Working with these beliefs with kindness and compassion to not further invalidate the experiences and feeling of isolation. Use of psychological language can assist with this, examples of validating statements vs invalidating statements are given in the training.
Socio-cultural context- "the internalisation of societal beliefs about ageing and older people, including the persons own attitudes towards ageing". Older adults in the MTC may present with beliefs that are presented from society which can be ageist, in which older adults could be "burdensome" to the economy and others.	Similar adaptations made to those in cohort beliefs. About validating, empathising and providing solutions. Internalised ageism has shown to decrease self-efficacy and self-esteem, and may in turn affect motivation to change. Normalising, validation and compassion are key themes throughout the booklet to address the context.	Similar considerations to those in cohort beliefs. It is addressed in teaching the beliefs about disability and internalised ageism experienced by older adults as a result of societal views. This can act as a barrier to making changes. Again normalising and validating experiences is useful.
Transition in Role Leading a fulfilling, purposeful life and being able to engage in activities	Major trauma can exacerbate the difficulties in coping with the transition to older adulthood. The role changes not only from being relied upon as a member of	It is suggested in the training for physiotherapists to find out more about the patient's life to deliver more person-centred care. Reminding them of long-term goals outside of hospital

that bring joy and meaning is important. Older adults who role has changed is a factor they. must navigate to adapt to age related changes.	the family, but also now needing to be actively cared for. This will be difficult for many older adults. It is important for older adults to still feel valued by doing meaningful activities. This forms a strong basis for engaging in CBT for FOF to get back to engaging in those meaningful activities. This is further adapted for a ward setting, where going outside is not possible. The workbook takes a stance to empower the older adult but taking FOF related difficulties into their own hands, providing a sense of autonomy in an environment where that can be lost. Whilst long term goals are important, it is important they are aware that a lot can be achieved within the hospital setting itself.	e.g., playing with grandkids, going out for events, can motivate the older adult to engage in activities suggested on the ward, in order to be able to engage in the activities that bring them joy.
Intergenerational Linkages Often disputes between the older adult and family members from younger generations are often based around difference of values. This can be especially	The psychoeducation workbook suggests working with family members if possible. This could provide information to family members who may of different generations themselves, providing a consistent understanding of FOF, which	Psychoeducation about older adult cohort beliefs and socio-cultural context in the training is provided. Giving staff who will likely be from younger generations more insight and understanding of the perspective the older adults' presentations may come from. Doing this can be a good tool for

prominent in hospitals where physiotherapists will be almost always will younger than the patient and the values between the two may differ.	allows patient and family member to work collaboratively. Intergenerational differences of opinion are minimise as the workbook is directive in how FOF is maintained and what can be done about it.	helping validate and empathise with views that may not necessarily match with their own.
Physical Health- Major Trauma centre context. Severe injury, leading to long term disability or near-death experience.	Ensuring that not too many skills are shared in the booklet. Comprehensive, easy to read, explaining the processes behind FOF in a simple way. Hospital based examples. Including physiotherapy role and examples. Providing information at the level of a lay person accessing psychological care.	Hospital based examples. Providing skills that can be used quickly and adapted upon wards. Providing information at the level of a non-psychologically trained clinician. Easy to understand for physiotherapy audience.

Appendix I- Developmental procedure

Consultation from the MTC clinical psychologist and others in the research team contributed to the development of the materials. The Directorate Patient Information Lead (DirPIL) and coordinator (DirPIC) for Major Trauma were contacted for more information. Guidelines were obtained about developing psycho-education materials (please refer to appendix D for the 'Patient Information Policy' and 'How to Guide for clinical patient information"). These documents highlight the process for the development of new patient information resources. Figure 1. Shows a brief outline of the stages of development. More details can be found in Appendix D.

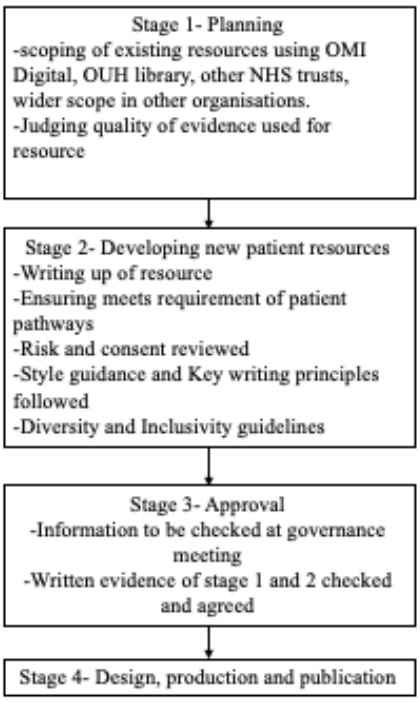


Figure 1.

Stages of Development to develop psycho-education workbook

Appendix J- Psychoeducation Workbook(please note this is still under review by OUH for publication).

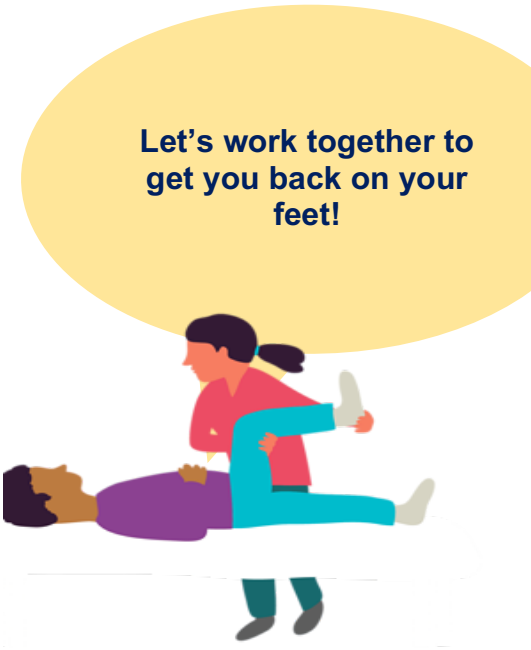
Understanding & Managing Fear of Falling

A Cognitive Behavioural Therapy Workbook for Hospital Inpatients



About this Workbook

This booklet is for individuals who have suffered an injury after a fall/accident that has resulted in difficulties with walking. You may find that you are expected to start walking sooner than you thought and this can cause fear and anxiety because you do not want to end up falling and causing further injury and pain. You may start to develop what is known as a "fear of falling".
With advancing age, fear of falling can become a serious concern. Some people worry about what might happen to them if they fall, even if they haven't had a fall before.



Common things you might be due to fear of falling, could be avoiding/disengaging with physiotherapy and nursing, relying heavily on others to carry out exercises, and believing very strongly that we cannot walk again and will fall/get hurt.

Research shows that individuals aged 65+ who have a fear of falling in hospital, can have this fear when they go back to the community which affects their ability to carry out activities of daily living. This results in a reduced quality of life. Therefore, it is important to start working on these fears whilst you are in hospital, to give yourself a good chance of being confident in the community after your injury.
This booklet uses a Cognitive Behavioural Therapy approach, to help individuals manage fear of falling. It links together thoughts, feelings, behaviours a person might have that results in fear of falling. This approach is being used because it has been shown to be effective with helping people overcome their fears.

Contents

Introducing Mrs G
The Effects of Fear of Falling
The Psychological Effects of Fear of Falling
What keeps the fear going?
How to Overcome Fear of Falls
- Awareness
- Relaxation techniques
- Imagery
- Challenging worrying thoughts
- Challenging ourselves and building goals

Top Tips- Facing your fears
Kindness Compassion & Empathy
Helping Mrs G

How to use this workbook

As you will be in hospital when reading this workbook, it may be helpful to read in sections. This gives you time to understand and reflect on the information shared.
It may also be helpful to ask someone else e.g., staff member, family member or friend to read with you, or for you.
Remember it takes time to manage fear of falling, it is important to allow yourself space to think about your own experiences and consider how this workbook can best help you as an individual.



Introducing Mrs G

Mrs G is a 76 year old lady who suffered severe injuries following a fall in a shopping centre, where she slipped on a wet surface. When others alerted the ambulance, it took a while for the ambulance to come. Mrs G was in a lot of pain and was very scared about what will happen to her. She felt alone and helpless.
When Mrs G came to hospital, she underwent hip and knee surgery. After the surgery she was told that she should be able to walk again properly in a few weeks' time. Mrs G was still in a lot of pain and felt shaken up after the fall.
The Physiotherapists came to visit Mrs G one morning to start her therapy to get her back on her feet. As soon as she saw them, she started to feel nervous, her muscles in her body tightened up, she started to feel hot and sweaty. The physiotherapists were explaining what will happen, but Mrs G was distracted by her own thoughts "I don't want to do this"; "What if I fall again". She also started to see images of herself falling in the shopping centre and being in pain. Mrs G missed what the physiotherapists were about to do, and they started to move things around her to get her move to the side of her bed. Mrs G started shouting "No!" "I don't want to do this"; "I'm not ready". Her body was tense and therefore sensitive to any movement, so she felt more in pain. The physiotherapists did not want to make Mrs G upset therefore told her they would try again later.
Mrs G felt relieved that they were leaving, but nervous that they would be coming back. All she thought about that day was "when will they come back?" and she was anxious all day.
Mrs G is experiencing a fear of falls.

At the end of this workbook, you will come back to Mrs G and see if there is any advice you can offer her from the booklet on how to manage her fear of falling.

The Effects of Fear of Falling

Short Term

Feeling shaky and distracted by worrying "What if" thoughts e.g. "What if I fall again?"

Concentration and attention is all on falling, so it reduces the ability to complete tasks at hand e.g. our physiotherapy session.

Muscle tension increases, making it harder to walk naturally. Which puts you at future risk of falling and becoming injured.

Friends and family start to get worried about how you cope outside of hospital, which could affect relationships.



Long Term

You may have to stay in hospital away from friends and family for longer to meet mobility goals before getting discharged.

Avoiding activity might make you out of shape, which can also make walking harder , which adds to anxiety about walking.

You might not be able to engage with people as much as you want to e.g., going out with friends/family, attending events.

Fear of falling can ultimately isolate you from others, decrease your confidence and self esteem and put yourself at higher risk of suffering from depression.

"Visually seeing the outcome of the fall in your head and remembering the pain after the fall. I stayed in all the time so I would not feel that experience again. I felt like my life was over and I was never going to be able to enjoy it again". -Debbie (63) previous patient

Facts & Figures

- People have reported fear of falls can lower their quality of life signicantly
- People can have a fear of falling even if they have never fallen before.
- People who have fallen before are more at risk of developing a fear of falling.
- There are higher rates of depression and anxiety in people who have a fear of falling.
- Up to 85% of people aged 65 and above can have a fear of falling in hospital.
- A fear of falling results in more likelihood of falling.

The Psychological Effects of Fear of Falling

The Emotional Effects

Having a fear of falling can cause you to feel out of control of your body. This can lead to feelings such as anxiety, helplessness, sadness or anger. It is normal to experience these emotions and express them. Avoiding negative emotions can delay our response and we might experience these emotions more strongly for a longer time. Alternately over-focusing on these emotions can debilitate your ability to see rationality when it comes to trying out exercises after your surgery.

The Physical Effects

There are certain physical sensations you might notice when you start to feel anxiety due to fear of falling, below are a few common ones:

- Shaky/Stiff Legs
- Irregular Breathing
- Stomach dropping
- Increased heart rate
- Sweating



These symptoms are uncomfortable to experience, but they are not physically damaging to a person's body. They are just the body's way of reacting when it thinks we are in danger and tries to keep us safe.

The Worrying Thoughts

You may find yourself having worry-filled thoughts about falling. When you are anxious, you can start to think more negative thoughts than positive E.g. "I will not be able to get up after I fall" or "I can feel my legs are wobbling, it won't be safe for me to walk".
These thoughts worsen anxiety symptoms and might even affect the way you feel (emotions) and how your body reacts (physical effects).



Behaviours we use to cope

Sometimes people act in certain ways to help them feel safer. These behaviours are so common they have been given specific names, such as:

1) Safety behaviours- Behaviours that are carried out to reduce anxiety and try to keep us safe in the short term. e.g., excessively seeking reassurance from others,

excessively holding onto things whilst moving around. However, as you will be in hospital some of these behaviours will be expected at first.

2) Avoidance behaviours- Entirely avoiding situations that require you to get up or walk, declining therapy that aims to get you back on their feet.

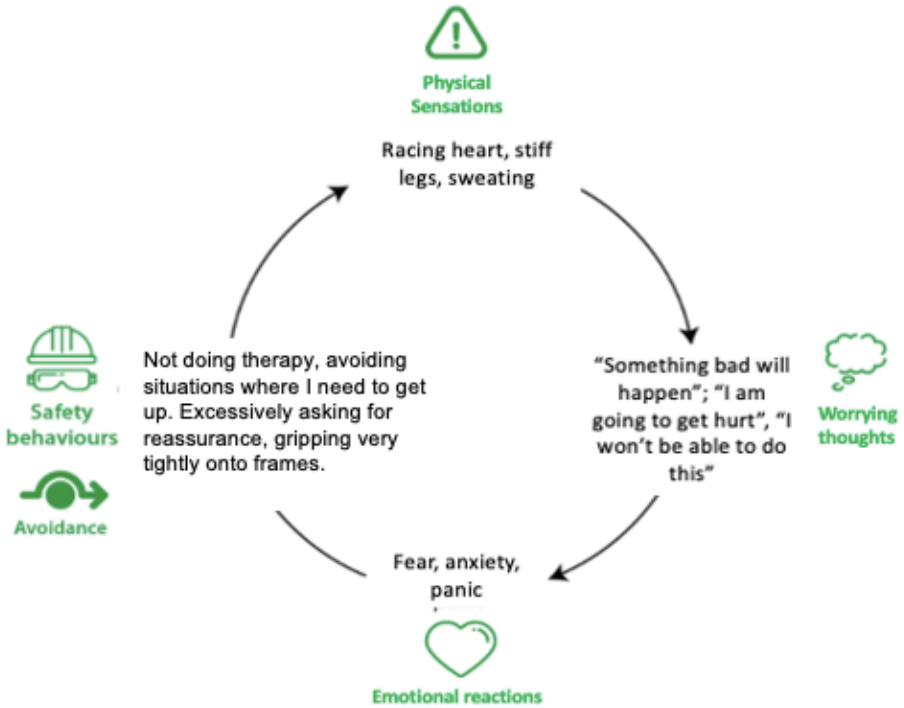
Unfortunately, whilst you may think these behaviours are keeping you safe and might cause short term relief, they are unknowingly feeding into your fears by not learning that you can do it.

What keeps the fear of falls going?

Together the emotions, physical effects, worrying thoughts and coping behaviours result in a **vicious cycle of fear.** See below a common scenario of how someone may get stuck in this cycle.

The physiotherapists are due at 2pm to help you start getting back on your feet. The task is helping to move you from the bed to the chair. So, you can sit up.

You enter a cycle of fear such as this one below. As you can see the physical sensations, worrying thoughts and emotional reactions are all feeding into one another causing a lot of fear and you respond with



behaviours that may give you short term relief.

"The physiotherapists see that you are scared, may not want to engage with them, and decide to leave it until the next session. You feel relieved initially but anxious at the thought of them coming again and also disappointed that you were not able to get your session done. You start to wonder if you will ever get back to doing the things you enjoy again, like going for walks?"

How to overcome a fear of falls

Awareness

Everyone's experiences are different, however in this booklet the common experiences people go through in hospital might be ones you identify with. Having an awareness of your own vicious cycle of fear is a good first step to doing something about it.
You can go through this booklet and highlight/circle the elements you identify with and come up with some of your own that will be unique to your experience.
Below you can write down your own personalised experience:

1. What emotions to do I experience when I think about walking or if I am asked to walk? *E.g. panic, fear, anxiety, sadness, hopelessness, vulnerability, anger, frustration.*

2. What are my sensations do I feel in my body when I experience fear of falling? *E.g. heart racing, sweaty, stiff legs, dry mouth, stomach dropping*

3. What are the negative thoughts and/or images that come into my head when I imagine walking *E.g. "I can see myself falling over and lying in pain"; "The physiotherapists are going to drop me"; "I won't be able to do this"; "I am helpless"; "I'll never get back to normal again".*

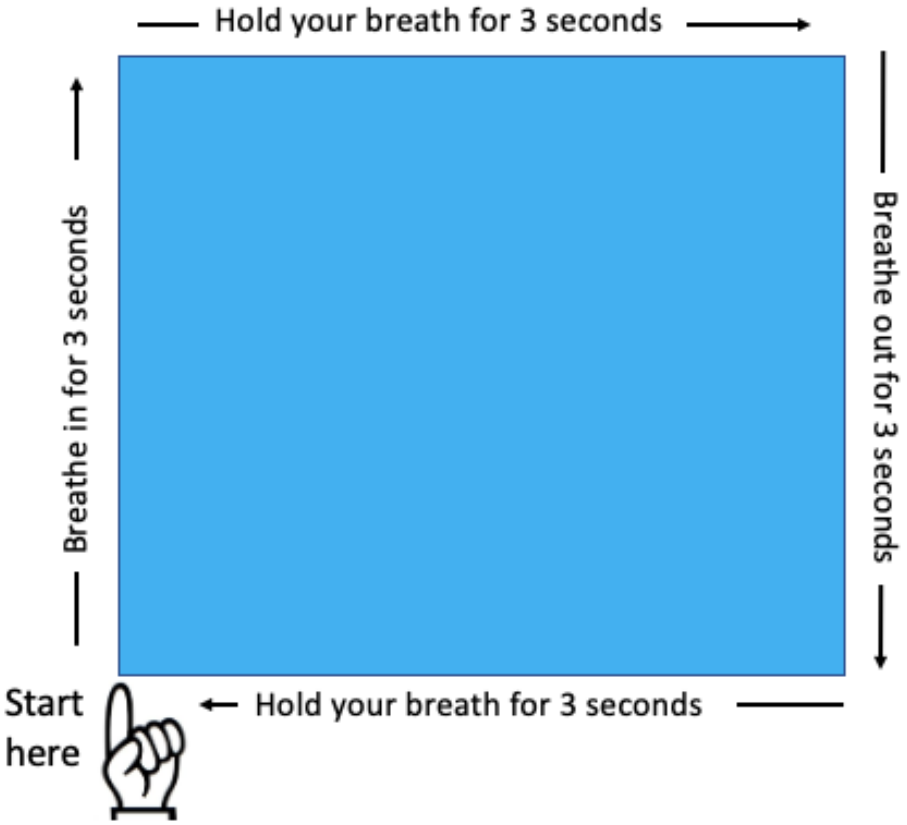
4. What are the behaviours I use to cope, that keep the fear going? *E.g. avoid doing physiotherapy; grabbing onto others out of fear I will slip; shouting before I start moving which increases my bodily sensations of fear; refusing to do an exercise.*

Relaxation Techniques

The physical sensations experienced when we are anxious can cause us to feel even more tense. To manage this tension, it can be helpful to practice relaxation. You can try this out every day in the morning and evening in hospital to prepare you for the day, and to ease your mind for the night. You might want to try it before and after your physiotherapy sessions.
You may wish to try the following exercise:

Square Breathing- completing a deep breath.

- Start on the left side of the square and breathe in for three counts as you trace the first side of the square with your index (first) finger.
- Hold your breath for 3 seconds as you trace the top of the square.
- Breathe out for 3 seconds as you trace down the right side of the square.
- Hold your breath again for 3 seconds as you trace the bottom side of the square.



Using Imagery

When trying to walk, people may picture falling or getting injured again. These images can be enough to spark fear, unpleasant bodily symptoms, and make you want to avoid the activity altogether. You can use imagery to combat these unpleasant bodily sensations during your sessions.

1. You can use your **imagination** to combat these worrying images. Imagine the activity/movement going well. What are you doing? what does it feel like? Do you feel better for having tried?

Or

2. **Create a safe place**. This could be a scene from a past vacation, it could be a room in your home or a time where you felt the most relaxed . Take your mind to this scene when you notice the fear

arise and describe it in extensive detail using your five senses. Try to do this in preparation for your physiotherapy sessions. You can ask staff members to do this with you.

E.G. Waterfalls in Lake District
Sight- “I could see misty waterfalls running through green hills”
Hear- “I could hear the roar of the water hitting running down the cliff and hitting into a lake”
Smell- “I could smell nature, tree’s, wood, grass”
Touch- “I could feel the texture of moss, dampness and wetness on the rocks, moisture on my fingers”
Taste- “I could taste air and water”



Challenging Worrying Thoughts

Why do we have worrying thoughts?

All humans experience worrying thoughts because it is our brains way of keeping us safe and out of danger.

Worrying about your therapy sessions or exercises requiring you to move is beneficial for you, because it keeps you safe and lessens your anxiety. There is short term relief.



The Consequences of Worrying Thoughts



There are costs to listening and behaving as your worrying thoughts want. You may end up over-estimating the risks involved in an activity, and each time you listen to your worrying thoughts, you end up confirming that your worrying thoughts were true.

In reality, the worrying thoughts are stopping you from learning the activity may not be as dangerous as you may think.

If your worrying thought is saying "If you do the activity for longer this time, you will fall and seriously injure yourself further". This is just your brain protecting you and it does not mean it is a fact. In the long run these worrying thoughts can grow bigger and start to control several areas of your life e.g., stopping you from outings in the community.

You can try to challenge your worrying thoughts, so that they do not end up controlling your every action.

Challenging Worrying Thoughts

Weigh up the Cost Vs. Benefit

When you catch yourself having worrying thoughts about walking and falling, to try weigh up the benefits of listening to the thought. Vs the costs of listening to it. As you can see in the example below, the costs outweigh the benefits significantly.

Costs:

- I will not be able to do things for myself
- It will take me longer to get out of hospital
- It will take me longer to get better
- This might negatively affect my life in the community
- I won't feel confident about doing things
- My family and friends will worry about me

Benefits:

- I won't fall
- I won't be in more pain
- I won't injury myself further
- I will be safe from harm



Thought Challenging Worksheet – Costs Vs. Benefits

On the next page you can try to go through some of your own worrying thoughts and write down the benefits of listening to the thought and costs of listening to it. You can also rate how strongly you believe the thought before and after you assess the cost vs. benefit. You can do this with a member of staff, family member or by yourself. Practise this as much as possible, try to identify what are your worry thoughts. You can challenge them in the moment with help from others.

Here you can practice challenging your own worrying thoughts:

Worrying thought	How strongly do I believe this? (0-100%)	Benefits of this thought?	Costs of having this thought?	How strongly do I believe this thought now?

Challenging Ourselves and Building Goals

Alongside challenging thoughts, people can start to test out their fears to see if they are true. This will help prove to themselves that the fear they have may not be completely accurate.

STEP 1: Awareness of the usual methods to cope with fear of falling

Below you can circle or add some of your own unhelpful behaviours, and practise not doing them during your next activity and see what the outcome is.

- Asking for reassurance
- Avoiding engaging in therapy
- Screaming or shouting before the activity has occurred because we are scared. This can increase our physical sensation of fear.
- Looking for things to go wrong
- Saying to yourself and out loud “it will all go wrong”

STEP 2: Building our Goals

Ask yourself, if you did not have a fear of falling what would you be doing? E.g., taking a few steps independently.
Using the answer from the first question, as our ultimate goal of what we want to do despite the fear. We start to build up a Fear hierarchy and place our ultimate goal at the top as our most feared situation. We will discuss this in our next section.



STEP 3: Ranking your fears using a Fear Hierarchy

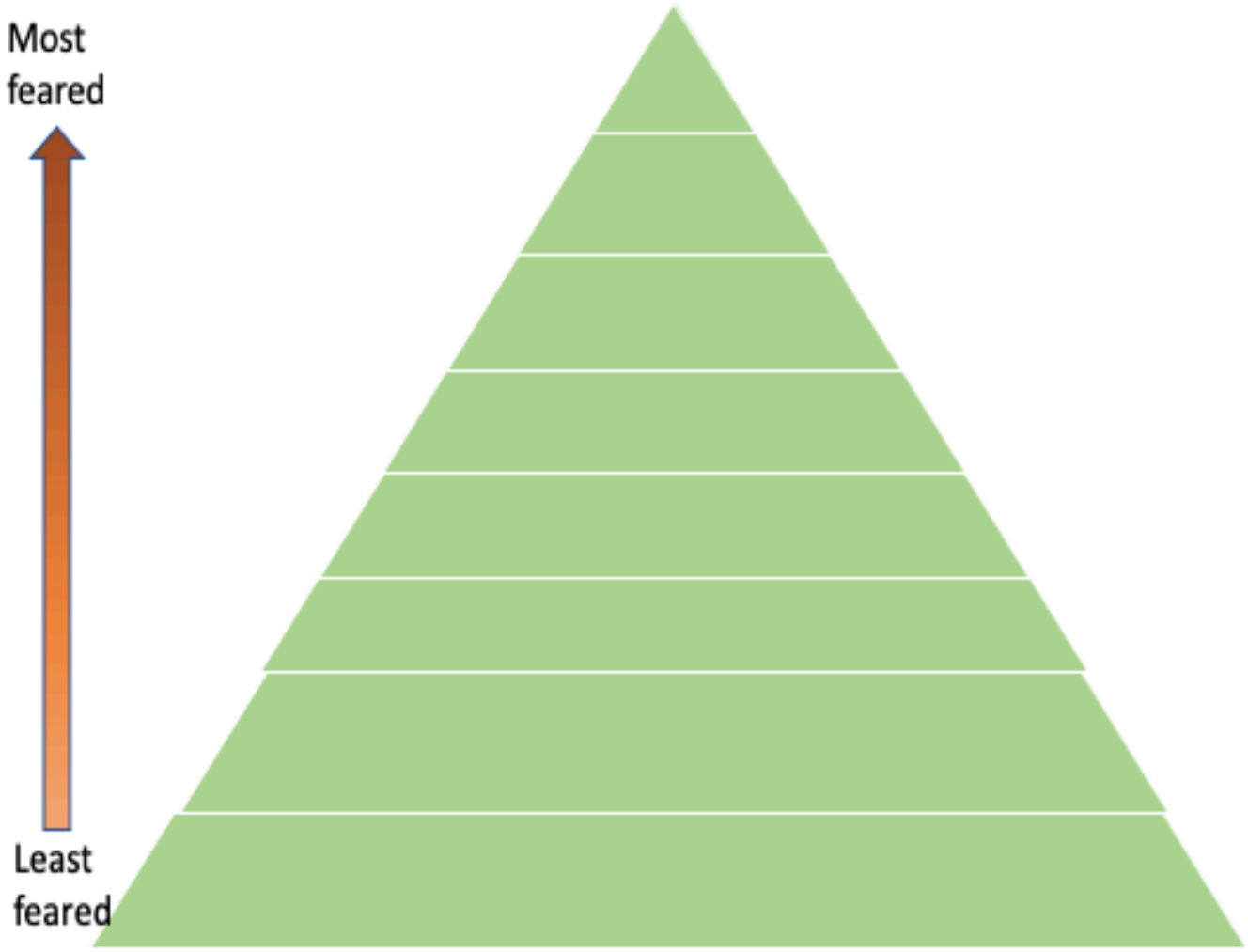
Fear Hierarchy
Try ranking your least feared to most feared situations when it comes to walking and falling. E.g.



Using our fear hierarchy, we can treat each fear as a goal and work our way from least feared goals to most feared. With the help of physiotherapists, family or friends you can focus on planning each goal. Each situation might require planning, use the plan in Step 4 below to identify goals to help you work on situations that might worry you.

As we work our way up the hierarchy, you will start to become more confident and see that the tasks you thought you could never do, are now possible.

You can fill in your own Fear Hierarchy here:



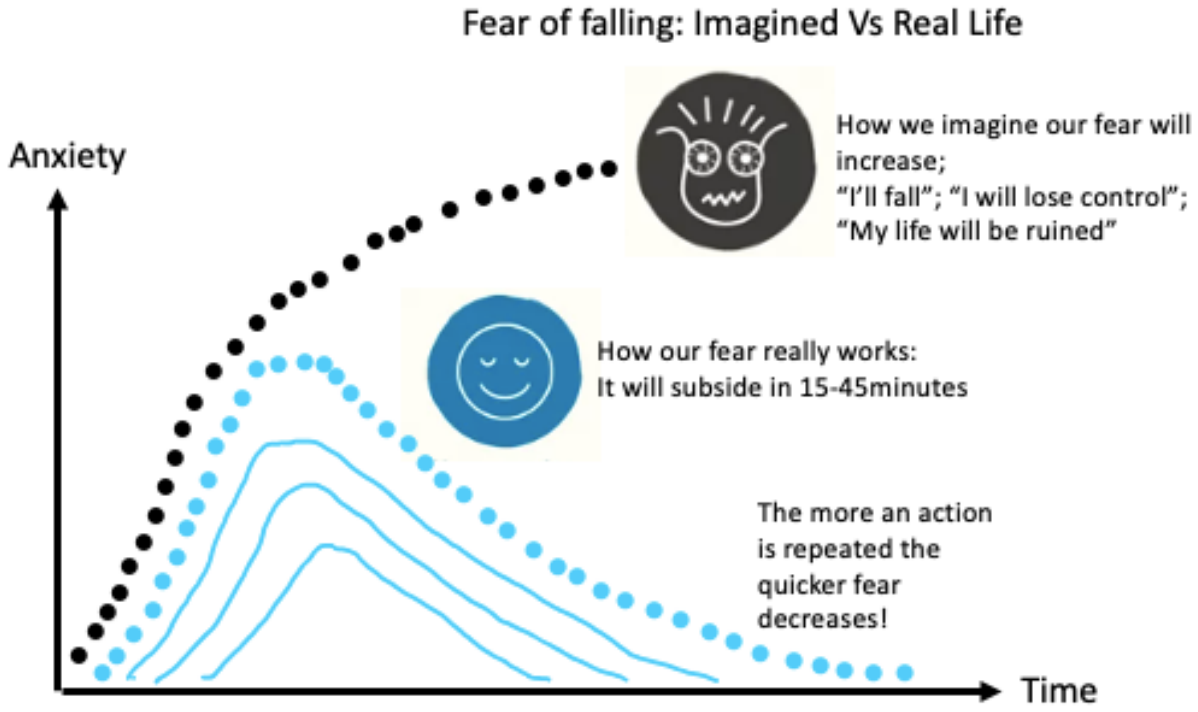
STEP 4: Planning your physiotherapy sessions

Below you can rank your fears in order- from lowest to highest. To help you rank this, you can give the fear a rating. 0 being no fear and 10 being the most fear we have ever experienced. For each fearful situation, there might be steps needed in order to make it happen e.g. WHO, WHAT, WHEN, WHERE. Below you can add in more detail how to plan for that situation.

Fearful Situation/ Goal	**Level of fear (0-10)**	**Plan** Who will help; What will we be doing?; Where this will happen?; When will this happen? How long this will happen for?

Top Tip when Facing your Fears

Expect some anxiety
It is likely you will experience anxiety and discomfort at any step of the goals. That is why it is important to start small and work your way up. This gives you a chance to adapt to the anxiety and not feel overwhelmed. The only way to get used to these feelings is to experience them and not push them away.
It might be tempting to avoid situations if we feel uncomfortable but try to stay until the anxiety goes down. As frightening as the feelings are, they are not dangerous, and they do subside. On each attempt, you should try to face as much fear as you can stand and just try to “ride out” the anxiety – like surfing a wave.
The diagram below shows what we imagine it is like when we experience fear of falling versus what it is actually like if we stayed in the situation.



Kindness, Compassion and Empathy

Having a fear of falls can be an isolating experience. Other's may not understand, and you may also not understand why this is happening. It is important that during your experience of learning about and managing fear of falls, that you treat yourself with kindness, compassion and empathy.

Here are some helpful statements you can say to yourself:
"What I am going through is hard, but I am trying my best"
"Some days will be better than others, and that is okay"
"It is okay if I don't feel okay right now, the feeling shall pass"



Helping Mrs G

Now it's your turn to help Mrs G. who you met at the start of this workbook. In the boxes below you can right down some ideas to help Mrs G manage her fear of falling.

What physical sensations of fear could Mrs G feel?
What can she do to manage these?

What worrying thoughts do you think Mrs G had?
What can she do to manage these?

What behaviours did Mrs G use to cope?
What can you suggest for her to overcome these behaviours of coping?

What kind, compassionate and empathetic things can you say to Mrs G to support her through this?

Appendix K Staff Training Survey

FOF Training Questionnaire 1- pre training

Please circle the 1 answer that best fits with your experience.

1) How confident do you feel in recognising if someone is exhibiting signs of fear of falling?

Very confident Somewhat Confident Not confident

2) How knowledgeable do you feel about the psychological explanations underpinning fear of falling?

Very knowledgeable Somewhat knowledgeable Not knowledgeable

3) How confident do you feel about working with a patient who has a fear of falling?

Very confident Somewhat Confident Not confident

FOF Questionnaire 2- post training

Please circle the 1 answer that best fits with your experience

1) How confident do you feel in recognising if someone is exhibiting signs of fear of falling?

Very confident Somewhat Confident Not confident

2) How knowledgeable do you feel about the psychological explanations underpinning fear of falling?

Very knowledgeable Somewhat knowledgeable Not knowledgeable

3) How confident do you feel about working with a patient who has a fear of falling?

Very confident Somewhat Confident Not confident

4) Please provide some feedback for how you found the training.

5) What bits of the training do you feel can be realistically implemented into your practice? (If any)

6) Please provide any initial feedback on the fear of falls workbook: (i.e. how realistically it can be implemented, how we can try to disseminate it)

7) Please provide further feedback on the resources and training and what further recommendations can be made?

Appendix L

SIP Lay Summary

Major Trauma is a severe mechanism of injury that can cause death or severe disability. In the 1990's it was seen as a young-male form of injury due to association with high-speed accidents and violence. However, over the last two decades there has been a vast increase of older adults presenting to the service. There are now more older adults than working aged adults accessing major trauma centres around the UK. Low falls (falls under 4ft) has been especially noted as a common method by which trauma occurs to an older adult. Injuries to a person's lower limbs affects mobility, and often people can feel shaken up afterwards, sometimes people go on to develop "fear of falls" (FOF). This is classed as an anxiety disorder that affects our ability to mobilise due to fear of further injury or pain, resulting in individuals avoiding therapy to get better or becoming extremely anxious.

There has been a lack of psychological care available to older adults who may go on to experience a Fear of Falls (FOF). There can be many reasons for this, however the lack of psychological care can result in the FOF staying with the person until discharge, and this can severely affect a person's quality of life in the community. There is a strong association with depression and anxiety in older adults who have a fear of falls.

This project was developed to aim to increase access to psychologically informed interventions for older adults, by developing a self-help workbook targeted at alleviating FOF symptoms. The project also worked closely with physiotherapists by training them in cognitive behavioural therapy skills for FOF.

The materials were developed and shared with physiotherapy staff and feedback on confidence and knowledge about FOF was also reported by physiotherapists. In general, there was an increase in confidence and knowledge about FOF after the training session. Furthermore, there was positive feedback for the psychoeducation workbook, which was developed closely with the training so that patients and staff could share similar language when talking about FOF.

The next steps are to formally evaluate the psycho-education workbook and training with staff and patients to ensure that these resources are helpful and being actively implemented in the hospital.

Appendix M- Eating Disorder Belief Questionnaire

Instructions:

Listed below are different attitudes and beliefs which people sometimes hold. Please read each statement carefully and decide how much you agree or disagree with the statement. Base your answer on what you emotionally believe or feel, not on what you rationally believe to be true. Choose the rating which best describes what you usually believe or what you believe most of the time rather than how you feel right now. Write the number in the box before the statement.

Rating Scale:

0 10 20 30 40 50 60 70 80 90 100

I do not usually believe this at all

I am usually completely convinced that this is true

1		I'm unloveable
2		If my flesh is firm I'm more attractive
3		I'm ugly
4		I'm useless
5		I'm a failure
6		If I eat a forbidden food I won't be able to stop
7		If my stomach is flat I'll be more desirable
8		If I lose weight I'll count more in the world
9		If I eat desserts or puddings I'll get fat
10		If I stay hungry I can guard against losing control and getting fat
11		I'm all alone
12		If I eat bad foods such as fats, sweets, bread and cereals they will turn into fat
13		I'm no good
14		If I eat normally I'll gain weight
15		If I eat three meals a day like other people I'll gain weight

Myra/BeliefsQuestionnaire

16		If I've eaten something I have to get rid of it as soon as possible
17		I'm not a likeable person
18		If my hips are thin people will approve of me
19		If I lose weight people will be friendly and want to get to know me
20		If I gain weight it means I'm a bad person
21		If my thighs are firm it means I'm a better person
22		I don't like myself very much
23		If I gain weight I'm nothing
24		If my hips are narrow it means I'm successful
25		If I lose weight people will care about me
26		If my body shape is in proportion people will love me
27		I'm dull
28		If I binge and vomit I can stay in control
29		I'm stupid
30		If my body is lean I can feel good about myself
31		If my bottom is small people will take me seriously
32		Body fat/flabbiness is disgusting

Items loading on each of the four factors

Factor 1: Negative self beliefs

Items:	1	3	4	5	11	13	17	22	27	29

Factor 2: Acceptance by others:

Items:	8	18	19	20	21	23	24	25	26	31

Factor 3: Self acceptance

Items:	2	7	9	12	30	32

Factor 4: Control over eating

Items:	6	10	14	15	16	28

Appendix N- Eating Disorder Core Belief Questionnaire

Eating Disorder Core Belief Questionnaire

Instructions

Listed below are a number of different words. People sometimes think these words describe how they feel about themselves as a person. Please read each word carefully and decide how much you feel each word describes how you feel about your own self. Base your answer on what you emotionally believe or feel to be true, not on what you rationally believe to be true. Choose the rating which best describes what you usually believe/feel or what you believe/feel most of the time, rather than how you feel right now. If you are unsure of the meaning of a word you may miss it out. Work as quickly as you can. Don't spend too long on each word - your first impression is the most important. Place a cross or tick in the box that best describes your response.

		Feels very much untrue	Feels moderately untrue	Feels slightly untrue	Feels neither true nor untrue	Feels slightly true	Feels moderately true	Feels very much true
1	Abandoned							
2	Betrayed							
3	Complaining							
4	Conscientious							
5	Demanding							
6	Deprived							
7	Disgraceful							
8	Evil							
9	Filthy							

10	Focused							
11	Goal oriented							
12	Ill tempered							
13	Immature							
14	Inhibited							
15	Inhuman							
16	Manipulative							
17	Meek							
18	Meticulous							
19	Misunderstood							
20	Nasty							
21	Needy							
22	Painstaking							
23	Perfectionistic							
24	Persistent							
25	Poisonous							
26	Possessive							
27	Putrid							
28	Repugnant							
29	Repulsive							
30	Reserved							
31	Self-disciplined							
32	Selfish							
33	Submissive							
34	Superficial							
35	Suspicious							

36	Unassertive							
37	Undemonstra-tive							
38	Unemotional							
39	Unreflective							
40	Vile							

Scoring:

Subscale 1: Self-loathing = items (7, 8, 9, 15, 20, 25, 27, 28, 29, 40)/10

Subscale 2: Unassertive/inhibited = items (14, 17, 30, 33, 36, 37, 38, 39)/8

Subscale 3: High standards for self = items (4, 10, 11, 18, 22, 23, 24, 31)/8

Subscale 4: Demanding/needing help and support = items (3, 5, 12, 13, 16, 21, 26, 32, 34, 35)/10

Subscale 5: Abandoned/isolated = items (1, 2, 6, 19)/4

Appendix O- Missing Data Management

SPSS -29 was used to find and manage missing data. Firstly, a descriptive analysis was performed on each variable to see frequencies of missing data. A strict method was adopted for the EAT-26 and the oversampling allowed us to remove inaccurate total EAT-26 scores to give a true representation of the scores. Therefore, participants that had not completed more than 4 items were deleted. For the remaining questionnaires participants with more than 5 items missing on a measure were deleted. 223 participants answers were saved from Qualtrics, and 185 were left after deletion occurred.

Missing values were created for participants with less than 5 items missing across all the measures. The imputation method used was replacing a missing value with a series mean of the indicator. This was performed on SPSS-29.

Appendix P- Eating Behaviors Journal Guidelines

Eating Behaviors Journal Guidelines- please note a link has been provided as this document is over 17 pages.

Website link:
https://www.elsevier.com/wps/find/journaldescription.cws_home/621271?generatepdf=true

Appendix Q- Qualitative Method

The "one word to describe yourself" question was analysed using a content analysis. This was to ascertain the frequencies of different beliefs participants had shared. The defined units were the frequency of individual words that occur within set categories being "positive-neutral beliefs"; "negative beliefs"; "uncertainty about the self"; physical/emotional descriptions of the self". Two researchers then independently coded the data. Inter-coder reliability was measured using Cohen's Kappa (Cohen, 1960). Miles and Huberman (1994) suggested inter-coder agreement of 80% and above on 95% of the data is acceptable.

A content analysis was carried out to explore themes between each group in a "single word" used to describe themselves. The researcher went through each word, extracted themes, and allocated them into groups based on the content/meaning of the word. A second rater went through all the word lists and entered these into categories separately. A Cohen's kappa rating of 0.82 was achieved indicting high inter-rater reliability (Cohen, 1960). Four categories of words were formed (1) negative views of the self (2) positive views of the self (3) uncertainty about the self (4) physical/emotional symptoms used to describe the self.

Appendix R- Regression analysis tables of EDBQ & EDCBQ

EDBQ regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal[b]	.	Enter
2	EDBQ_TotalWeightShapeControl, EDBQnegselftotal[b]	.	Enter

a. Dependent Variable: EATTOTAL

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.579[a]	.336	.318	10.45634	.336	18.701	4	148	<.001
2	.777[b]	.604	.587	8.13263	.268	49.329	2	146	<.001

a. Predictors: (Constant), DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal

b. Predictors: (Constant), DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal, EDBQ_TotalWeightShapeControl, EDBQnegselftotal

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8178.887	4	2044.722	18.701	<.001[b]
	Residual	16181.584	148	109.335		
	Total	24360.471	152			
2	Regression	14704.084	6	2450.681	37.053	<.001[c]
	Residual	9656.386	146	66.140		
	Total	24360.471	152			

a. Dependent Variable: EATTOTAL

Coefficients[a]

Model		Unstandardized Coefficients: B	Unstandardized Coefficients: Std. Error	Standardized Coefficients: Beta	t	Sig.	Collinearity Statistics: Tolerance	Collinearity Statistics: VIF
1	(Constant)	1.738	2.585		.672	.502		
	WSAS_Total	.255	.143	.219	1.777	.078	.296	3.375
	DASS21_Dtotal	.208	.107	.256	1.949	.053	.261	3.832
	DASS21_ATotal	.229	.117	.236	1.959	.052	.310	3.225
	DASS21_STotal	-.076	.115	-.085	-.667	.506	.275	3.639
2	(Constant)	-5.233	2.176		-2.404	.017		
	WSAS_Total	.003	.117	.003	.029	.977	.270	3.701
	DASS21_Dtotal	.211	.088	.259	2.405	.017	.234	4.281
	DASS21_ATotal	.077	.092	.080	.842	.401	.302	3.316
	DASS21_STotal	-.025	.089	-.028	-.279	.781	.273	3.664
	EDBQnegselftotal	-.019	.045	-.037	-.422	.674	.360	2.775
	EDBQ_TotalWeightShapeControl	.357	.038	.617	9.509	<.001	.646	1.548

a. Dependent Variable: EATTOTAL

EDCBQ regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal[b]	.	Enter
2	EDCBQ_UnassertiveTotal, EDCBQ_SelfLoathingTotal, EBCBQ_DemandingTotal, EDCBQ_Abandonded[b]	.	Enter

a. Dependent Variable: EATTOTAL

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2	Sig. F Change
1	.577[a]	.333	.315	10.41199	.333	18.615	4	149	<.001
2	.604[b]	.365	.330	10.30152	.032	1.803	4	145	.131

a. Predictors: (Constant), DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal

b. Predictors: (Constant), DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal, EDCBQ_UnassertiveTotal, EDCBQ_SelfLoathingTotal, EBCBQ_DemandingTotal, EDCBQ_Abandonded

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8072.018	4	2018.005	18.615	<.001[b]
	Residual	16153.020	149	108.410		
	Total	24225.039	153			
2	Regression	8837.440	8	1104.680	10.410	<.001[c]
	Residual	15387.599	145	106.121		
	Total	24225.039	153			

a. Dependent Variable: EATTOTAL

b. Predictors: (Constant), DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal

c. Predictors: (Constant), DASS21_STotal, WSAS_Total, DASS21_ATotal, DASS21_Dtotal, EDCBQ_UnassertiveTotal, EDCBQ_SelfLoathingTotal, EBCBQ_DemandingTotal, EDCBQ_Abandonded

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.930	2.554		.756	.451		
	WSAS_Total	.253	.141	.218	1.799	.074	.306	3.270
	DASS21_Dtotal	.206	.105	.256	1.963	.052	.264	3.791
	DASS21_ATotal	.229	.115	.237	1.992	.048	.317	3.152
	DASS21_STotal	-.078	.111	-.088	-.704	.482	.288	3.471
2	(Constant)	2.986	3.371		.886	.377		
	WSAS_Total	.202	.147	.174	1.377	.171	.274	3.650
	DASS21_Dtotal	.175	.107	.217	1.635	.104	.248	4.031
	DASS21_ATotal	.184	.117	.190	1.580	.116	.302	3.313
	DASS21_STotal	-.057	.115	-.063	-.491	.624	.262	3.813
	EDCBQ_SelfLoathingTotal	1.943	.959	.192	2.026	.045	.488	2.049
	EDCBQ_UnassertiveTotal	-.618	.916	-.059	-.674	.501	.580	1.725
	EBCBQ_DemandingTotal	-1.089	.962	-.105	-1.132	.260	.508	1.967
	EDCBQ_Abandonded	.813	.742	.104	1.096	.275	.491	2.038

a. Dependent Variable: EATTOTAL

Appendix S- EAT 26

Eating Attitudes Test (EAT-26)©

Instructions: This is a screening measure to help you determine whether you might have an eating disorder that needs professional attention. This screening measure is not designed to make a diagnosis of an eating disorder or take the place of a professional consultation. Please fill out the below form as accurately, honestly and completely as possible. There are no right or wrong answers. All of your responses are confidential.

Part A: Complete the following questions:

1) Birth Date	Month:		Day:		Year:		2) Gender:	Male	Female		
3) Height	Feet :		Inches:					□	□		
4) Current Weight (lbs.):			5) Highest Weight (excluding pregnancy):								
6) Lowest Adult Weight:			7: Ideal Weight:								

	Part B: Check a response for each of the following statements:	Always	Usually	Often	Some times	Rarely	Never
1.	Am terrified about being overweight.	□	□	□	□	□	□
2.	Avoid eating when I am hungry.	□	□	□	□	□	□
3.	Find myself preoccupied with food.	□	□	□	□	□	□
4.	Have gone on eating binges where I feel that I may not be able to stop.	□	□	□	□	□	□
5.	Cut my food into small pieces.	□	□	□	□	□	□
6.	Aware of the calorie content of foods that I eat.	□	□	□	□	□	□
7.	Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.)	□	□	□	□	□	□
8.	Feel that others would prefer if I ate more.	□	□	□	□	□	□
9.	Vomit after I have eaten.	□	□	□	□	□	□
10.	Feel extremely guilty after eating.	□	□	□	□	□	□
11.	Am preoccupied with a desire to be thinner.	□	□	□	□	□	□
12.	Think about burning up calories when I exercise.	□	□	□	□	□	□
13.	Other people think that I am too thin.	□	□	□	□	□	□
14.	Am preoccupied with the thought of having fat on my body.	□	□	□	□	□	□
15.	Take longer than others to eat my meals.	□	□	□	□	□	□
16.	Avoid foods with sugar in them.	□	□	□	□	□	□
17.	Eat diet foods.	□	□	□	□	□	□
18.	Feel that food controls my life.	□	□	□	□	□	□
19.	Display self-control around food.	□	□	□	□	□	□
20.	Feel that others pressure me to eat.	□	□	□	□	□	□
21.	Give too much time and thought to food.	□	□	□	□	□	□
22.	Feel uncomfortable after eating sweets.	□	□	□	□	□	□
23.	Engage in dieting behavior.	□	□	□	□	□	□
24.	Like my stomach to be empty.	□	□	□	□	□	□
25.	Have the impulse to vomit after meals.	□	□	□	□	□	□
26.	Enjoy trying new rich foods.	□	□	□	□	□	□

	Part C: Behavioral Questions: In the past 6 months have you:	Never	Once a month or less	2-3 times a month	Once a week	2-6 times a week	Once a day or more
A	Gone on eating binges where you feel that you may not be able to stop? *	□	□	□	□	□	□
B	Ever made yourself sick (vomited) to control your weight or shape?	□	□	□	□	□	□
C	Ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?	□	□	□	□	□	□
D	Exercised more than 60 minutes a day to lose or to control your weight?	□	□	□	□	□	□
E	Lost 20 pounds or more in the past 6 months	Yes □		No □			

* Defined as eating much more than most people would under the same circumstances and feeling that eating is out of control

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The EAT-26 items form three subscales: 1) Dieting, 2) Bulimia and Food Preoccupation, and 3) Oral Control. The subscale scores are computed by summing all items assigned to that particular scale:

Dieting scale items: 1, 6, 7, 10, 11, 12, 14, 16, 17, 22, 23, 24, 26.
Bulimia & Food Preoccupation scale items: 3, 4, 9, 18, 21, 25.
Oral Control subscale items: 2, 5, 8, 13, 15, 19, 20.

1) Your Eating Attitudes Test (EAT-26) is: ___

A score at or above 20 on the EAT-26 indicates a high level of concern about dieting, body weight or problematic eating behaviors. Because your score is above 20, you should seek an evaluation by a qualified health professional to determine if your score reflects a problem that warrants clinical attention. However, please keep in mind that high scores do not always reflect over-concern about body weight, body shape, and eating. Screening studies have shown that some people with high scores do not have eating disorders. Regardless of your score, if you are suffering from feelings which are causing you concern or interfering with your daily functioning, you should seek an evaluation from a trained mental health professional.

EAT-26 SCORE	Scoring System for the EAT-26					
	Always	Usually	Often	Sometimes	Rarely	Never
Score for questions 1-25	3	2	1	0	0	0
Score for question # 26	0	0	0	1	2	3

Add the scores for each item together for a total score.

Appendix T- Study advert/ Research Poster

