IJDSHS

INTERNATIONAL JOURNAL OF DISABILITIES SPORTS & HEALTH SCIENCES

Volume: 6 Issue:1 February 2023

e-ISSN 2645-9094 TURKEY

Volume:6 Issue: 1 February 2023

International Journal of
Disabilities Sports and Health Sciences

e-ISSN: 2645-9094

EDİTOR IN CHİEF

Assoc. Prof. Dr. Nevzat DEMİRCİ, Mersin University, TURKEY
ijdshs@gmail.com
ijdshs.editor@gmail.com

TECHNİCAL EDİTOR

Prof. Dr. Murat YAKAR, Mersin University, TURKEY

Volume:6 Issue: 1 February 2023

International Journal of
Disabilities Sports and Health Sciences

e-ISSN: 2645-9094

ADVİSORY BOARD

Volume:6 Issue: 1 February 2023

International Journal of
Disabilities Sports and Health Sciences

e-ISSN: 2645-9094

International Journal of Disabilities Sports and Health Sciences (IJDSHS) is an international scientific peer-reviewed journal, published Biannually in electronic format. The articles in this journal are published **OPEN ACCESS (OA)** exclusively in English **International Journal of Disabilities Sports and Health Sciences has been indexed in SCOPUS and EBSCOhost™ as of 2022, and in HW Wilson Education Fulltext as of June 2022.** Detailed information on preparation of the manuscript is described in the Instruction for Authors. Ethical Committee Approval in Research: "**ETHICAL COMMITTEE APPROVAL**" must have been obtained for all disciplines, this approval must be specified and documented in the article.

• "**iThenticate**" document is mandatory for article submission (Maximum15%).

Editor-in-Chief : Assoc Prof. Nevzat DEMİRCİ

You can receive an **ORCID iD** number from https://orcid.org/register.

PUBLICATION FREQUENCY

The IJDSHS accepts the articles in English and is being published 2 times (June and December) a year.

CORRESPONDENCE ADDRESS

Journal Contact: ijdshs@gmail.com

Editor: ijdshs.editor@gmail.com

Volume:6 Issue: 1 February 2023

International Journal of
Disabilities Sports and Health Sciences

e-ISSN: 2645-9094

INDEX COVERAGE

Scopus

Since 1898 WILSON H.W

EBSCOhost

Academic Resource Index ResearchBib	ASOS indeks	BASE Bielefeld Academic Serch Engine	CiteFactor Academic Scientific Journals	Cosmos Indexed for Cosmos Impact Factor
DRJI	ESJI Eurasian Scientific Journal Index www.ESJIndex.org	Google Scholar	INTERNATIONAL Scientific Indexing	I2OR
idealonline	OpenAIRE	ROAD DIRECTORY OF OPEN ACCESS SCHOLARLY RESOURCES	ROOTINDEXING JOURNAL ABSTRACTING AND INDEXING SERVICE	RG
SIS	Northumbria University NEWCASTLE	OUCI Open Ukrainian Citation Index	J-Gate INDEXED	Crossref

Volume:6 Issue: 1 February 2023

International Journal of
Disabilities Sports and Health Sciences

e-ISSN: 2645-9094

CONTENTS
Volume 6 – Issue 1
ARTICLES

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

RESEARCH ARTICLE

Comparison of Sports Injury Anxiety in Athletes Doing Sports on Different Surfaces

Hasan GERÇEK[1*], İlayda Dilan IŞIK[2], Melike Naz GÜREL[3], Nihan ÖZÜNLÜ PEKYAVAŞ[4], and Atahan ALTINTAŞ[5]

[1]KTO Karatay University, Vocational School Of Health Services, Department Of Physiotherapy, Konya / Türkiye
[2]University of Health Science, Gülhane Faculty of Physiotherapy and Rehabilitation, Ankara / Türkiye
[3-4]Baskent University, Faculty of Health Sciences, Department Of Physiotherapy and Rehabilitation, Ankara / Türkiye
[5]Baskent University, Faculty of Health Sciences, Department of Sport Sciences, Ankara/ Türkiye
*Corresponding author: hasangercek42@gmail.com

Abstract
The aim of the present study was to compare sports injury anxiety levels of athletes doing sports on different surface regardless from sports type. The study was carried out with 150 male athletes between the ages of 15-35 who had at least one sports injury. The participants were divided into three groups depending on the surface including turf (n=50), artificial turf (n=50), and parquet floor (n=50). The "Sport Injury Anxiety Scale" was used in order to determine the sports injury anxiety levels of the participants. The scale was implemented online through Google Forms. The differences between groups were evaluated with the Kruskal-Wallis test. Also differences between paired groups were evaluated with the Mann Whitney U test. It was observed that athletes doing sports on parquet floor had higher levels of sports injury anxiety compared to those doing sports on turf and artificial turf surface ($p < 0.01$). Considering that athletes who do sports on parquet floor have high levels of sports injury anxiety, we think that these athletes should be supported in terms of coping with anxiety.

Keywords
Athlete injury, anxiety, sports surface

INTRODUCTION

Sports causes specific injuries due to its nature. In the literature, all kinds of damage that occur during sports activities are defined as sports injuries (World Health Organization, 2001). This risk of injury in the sports environment is thought to be related to the interactions between the athlete's personal characteristics and external factors (Bittencourt et al., 2016). Factors that are effective on sports injuries include personal factors such as gender, age, physical structure, psychological factors, insufficient rehabilitation and previous injuries, the insufficiency of sports technique, insufficient warming as well as external factors such as the sports type, sports materials, the ground of the sports activity, climate and environmental conditions, sportive activity period and rules of the game (Özdemir, 2004). Recent studies have shown that one of the factors that trigger or prevent sports injuries is psychological factors (Almeida et al., 2014; Johnson & Ivarsson, 2011).

One of the psychological factors that cause sports injuries is anxiety (Podlog et al., 2011). Anxiety is typically defined as "an unpleasant

Received: 25 October 2022 ; **Accepted:** 04 January 2023; **Published:** 28 February 2023
[1]**ORCID:**0000-0001- 7459-4452 , [2] **ORCID:**: 0000-0003-0454-9781, [3]**ORCID:**0000-0001-6296-6730, [4]**ORCID:**0000-0003-0603-5688,
[5]**ORCID:** 0000-0003-1959-9706

How to cite this article: Gerçek, H., Işık, İ.D., Gürel, M.N., Özünlü Pekyavaş, N. and Altıntaş, A. (2023). Comparison of Sports Injury Anxiety in Athletes Doing Sports on Different Surfaces. *Int J Disabil Sports Health Sci*;5(2):1-7. https://doi.org/10.33438/ijdshs.1194307

situation as a reaction to the stress perceived in relation to performing a task under the pressure" (Cheng et al., 2009), and it is a common emotional situation experienced by athletes at all performance levels. Acute and persistent emotional changes such as anxiety, fear and depression are observed in athletes with musculoskeletal injuries (Mercan et al., 2005; Roiger et al., 2015). Anxiety situation may cause the athlete to perceive different situations as stress factors, increase physiological activation and decrease environmental attention (Jarvis, 2005). Injury experiences of athletes may cause athletes to worry about different psychosocial parameters. (Podlog et al., 2011; Wrisberg et al., 2006). Increasing the level of anxiety increases the risk of injury for athletes. (Ivarsson et al., 2013; Johnson & Ivarsson, 2011; Li et al., 2017). Parallel to the literature, Ivarsson and Johnson stated in their study that more injuries were observed in athletes with higher anxiety levels (Ivarsson & Johnson, 2010).

Another risk factor related to sports injuries is the surface where the sports is done. Since the beginning of organized sports competitions, grass has been accepted as a field ground. However, standardization is difficult in studies examining injury rates on natural surfaces, due to climatic factors and weathering of natural surfaces over time. For example, most of the data specific to football compares injury rates on third-generation artificial turf and natural turf (Ekstrand et al., 2006; Hershman et al., 2012).

It is thought that the friction coefficients of the parquets used in indoor sports are lower than artificial parquets. It has been reported that there are more anterior cruciate ligament (ACL) injuries in handball and floorball competitions held on artificial ground than in competitions on parquets floors. (Olsen et al., 2003; Pasanen et al., 2008)

During football competitions, 13.2% of injuries that are 26.5% in high school basketball and 15.8% in college basketball are caused by contact with the surface (Clifton et al., 2018; Kerr et al., 2018). Sports ground is one of the biggest factors in anterior cruciate ligament injuries (Agel, Evans, et al., 2007). In female basketball, 19.2% of all sports injuries are caused by contact with sports surface (Agel, Olson, et al., 2007). The playing ground or area may cause anxiety or affect the individual psychologically. The effect of the match or game environment on anxiety and injury can be emphasized. Athletes may have to play on different grass fields or different hardwood fields, this difference affects the athlete psychologically and may increase the level of injury anxiety. The aim of this study was to compare sports injury anxiety levels of athletes doing sports on different surface regardless from sports type. Surface is one of the risk factors in sports injuries. Determining the relationship between the surface and the sports injury anxiety, regardless of the sports, will enable the effect of the surface to be taken into account in the management of the injury anxiety of the athletes.

MATERIALS AND METHODS

Participants

The study approval was obtained from Drug and Non-Medical Device Research Ethics Committee of University Medical Faculty with the decision number 202/035 and was carried out prospectively with the registration to www.clinicaltrials.gov (NCT).

One hundred and fifty male athletes between 15 and 35 years of age who play different sports on different sports surfaces were included in our study. Only male athletes were included in the study, as there was a difference between genders in the sports injuries anxiety levels (Kaplan & Andre, 2021). All stages of the study were carried out in accordance with the Declaration of Helsinki. The participants were divided into three groups depending on the surface including turf (n=50, 50 football), artificial turf (n=50, 50 football), and parquet floor (n=50, 21 handball, 13 basketball, 16 volleyball). One hundred participants play football, 21 participants play handball, 13 participants play basketball, and 16 participants play volleyball professionally.

Inclusion criteria of our study included having history of at least one sports-associated injury and continuing sports actively. The exclusion criteria of our study were determined as having any neurological problem, any current sports injury under treatment.

Data Collection Tools

The demographic information of the athletes, the type of the sports and the sports surface, the region where they commonly suffered from injuries due to the sports, and sports duration were obtained. The "Sport Injury Anxiety Scale" which has been developed by Rex and Metzler (Rex

Metzler, 2016) and adopted to Turkish by Caz, Kayhan and Bardakçı, of which the validity-reliability studies have been conducted was used to determine sports injury anxiety levels of the athletes (Caz et al., 2019). The Sports Injuries Anxiety Scale is a 5-point Likert-type scale consisting of 19 questions. In the scale, "1" is evaluated as "Definitely disagree", and "5" is evaluated as "definitely agree". There is not any item, which is reversely coded in the scale, and higher scores indicate higher anxiety.

Measurement

Since the measurements could not be carried out face-to-face due to the COVID-19 pandemic, it was applied online via Google Forms allowing the subjects to get results in a shorter time and to fill in the data collection tool at the most convenient time for them. Medical teams of sports clubs were reached to reach athletes with a history of injury. The questions we prepared through Google Forms were sent to the athletes with a history of injury via e-mail or smartphone. Participation in the study was done on a voluntary basis, and the informed consent form was presented to the participants before participating into the study.Participants who approved the informed consent form were required to answer all questions.

Statistical Analysis

SPSS 25 IBM Corp. Released 2017 was used for data review. As a result of the power analysis, it was predicted that a total of 150 individuals should be included in order to achieve a study power of 85%. Kolmogorov-Smirnov test, Shapiro-Wilk test and histogram method were used to test the conformity of the data to normal distribution. Due to the data that did not fit normal distribution, the differences between groups were evaluated with the Kruskal-Wallis test. Also differences between paired groups were evaluated with the Mann Whitney U test. The statistically significant level of $p<0.05$ was accepted.

RESULTS

Demographic Information

Demographic information of the individuals included in our study is presented in Table 1.

Table 1. Demographic Information of the participants

	TURF		ARTIFICIAL TURF		PARQUET		p
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Age (years)	21.58	3.10	22.64	4.17	23.06	2.85	.087
Height (meter)	1.76	0.05	1.79	0.07	1.75	0.24	.455
Weight (kilogram)	69.80	5.87	75.36	10.17	74.54	15.51	.036
BMI (kg/m^2)	22.34	1.51	23.5	2.6	23.17	3.63	.098
Injury History	2.82	2.43	2.02	1.91	3.10	2.44	.052
Sports Duration (Year)	9.62	2.24	11.12	4.17	10.12	3.64	.090

SD, standard deviation; BMI, Body Mass Index, *p<0.05

Injury Anxiety Levels

When the total injury concerns were examined, the highest injury anxiety was found in the parquet floor athletes (Table 2). When the sub-parameters of the scale were examined in terms of sports surfaces, there was no statistically significant difference in the "Anxiety Regarding Loss of Athletics" subscale between those who did sports on grass and artificial grass; However, those who do sports on hardwood floors have more "Anxiety of Losing Athletics" than those who do sports on grass and artificial turf (Table 2).

A statistically significant difference was found between three groups for " Anxiety related to Experiencing Pain ". The highest " Anxiety related to Experiencing Pain " was found highest on the parquet floor and the lowest on the turf surface (Table 2). There was no statistically significant difference between those doing sports on the turf and artificial turf surface in the

"Anxiety related to Reinjury" subscale; however, those who do sports on parquet floor have more "Anxiety related to Reinjury" when compared to those who do sports on turf and those on artificial turf (Table 2). When the groups were compared in pairs, it was found that the "Anxiety Related to Being Perceived as Weak" was higher on turf surface when compared to artificial turf surface, and "Anxiety related to Loss of Social Support" was higher in those who do sports on parquet floor than those who do sports on artificial turf (Table 2).

Table 2 .Comparison of Injury Anxiety Levels Sub-Parameters According to Sports Surface

	TURF	ARTIFICIAL TURF	PARQUET	KRUSKAL WALLIS		MANN WHITNEY U		
	Mean ± SD	Mean ± SD	Mean ± SD	X^2	p	TURF-ARTIFICIAL TURF	TURF-PARQUET	ARTIFICIAL TURF-PARQUET
ARLA	5.48 ± 1.98	5.86 ± 2.61	6.8 ± 2.03	11.80	**.003***	.719	**.001***	**.016***
ARBPW	5.54 ± 1.8	4.74 ± 1.75	5.14 ± 1.60	5.16	.076	**.030***	.228	.200
AREP	6.68 ± 2.59	8.36 ± 3.93	11.44 ± 2.75	41.34	**.000***	.060	**.000***	**.000***
ARHISI	7.26 ± 3.14	6.82 ± 2.3	7.4 ± 2.7	.74	.688	.710	.815	.324
ARLSS	5.3 ± 2.68	4.74 ± 2.44	5.46 ± 1.98	5.76	.056	.093	.303	**.026***
ARR	9.02 ± 4.48	11.02 ± 4.71	12.00 ± 4.04	11.79	**.003***	.078	**.000***	.286
TOTAL	39.28±11.66	41.54±14.26	48.24 ± 9.49	14.38	**.001***	.318	**.000***	**.023***

*p<0,05**,** Mean; SD; Standard Deviation; ARLA, Anxiety Related to Loss of Athleticism; ARBPW, Anxiety Related to Being Perceived as Weak ; AREP, Anxiety related to Experiencing Pain, ARHISI, Anxiety related to Having an Impaired Self-Image; ARLSS "Anxiety Related to Loss of Social Support"; ARR, Anxiety Related to Reinjury

DISCUSSION

This study was conducted to examine the effect of different surfaces on the injury anxiety of athletes. As a result of this study, we found that the highest total injury anxiety levels belongs to the athletes who do sports on parquet floors. "Anxiety related to Loss of Athleticism", "Anxiety related to Experiencing Pain" and "Anxiety related to Reinjury" sub-parameters of the sports injury anxiety scale were also higher in athletes sporting on parquet floor. Studies conducted with elite football players indicated that more than 90% of athletes think that the surface where sports are done affects the ris of injury (Mears et al., 2018; Poulos et al., 2014).

Although it is believed that artificial turf causes more injuries from the first studies comparing the effect of artificial turf and turf on injuries (Canaway et al., 1990; Schmidt-Olsen et al., 1991), different results have appeared in recent studies (Pasanen et al., 2008; Steffen et al., 2007). Players expressed their negative attitude towards the use of artificial turf for training and matches due to the perceived risk of injury (Burillo et al., 2014). Although the results of our study are similar to some studies in the literature, there are studies indicating different results. We think that these differences originate from the socio-cultural and past injury experiences of the athletes.

The perception of injury risk was found to be higher among basketball players who do sports on parquet floor than those who do sports on synthetic surfaces (Akodu et al., 2017). The study of Ekmekci and Micooğulları (Ekmekçi & Okan Miçooğulları, 2018) who detected higher levels of anxiety in handball players when compared to American football players playing on turf or artificial turf versus handball players on parquet or synthetic ground supports the results of our study; however our resulted are different from Kerketta

on comparison of football and volleyball players (Kerketta, 2015). We believe that the difference between the studies is due to the number of samples included in the study and the examination of the sports rather than the surface in the study conducted by Kerketta. In the literature, we have not encountered a study examining the effect of surface on sports injury anxiety levels, regardless of the sports.

The most significant limitation of our study was the lack of differentiation between synthetic parquet surface and natural parquet surface. Another limitation is performing the study on male athletes only. Consequently, the higher injury anxiety level was observed in athletes who do sports on parquet floor than those who do sports on turf and artificial turf surface. Considering that high sports injury anxiety level increases the risk of injury in athletes, this result suggests that individuals who do sports especially on parquet floor need more support for sports injury anxiety situations.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

The study approval was obtained from Drug and Non-Medical Device Research Ethics Committee of University Medical Faculty with the decision number 202/035 and was carried out prospectively with the registration to www.clinicaltrials.gov (NCT).

Author Contributions

Study Design, OA, GEG; Data Collection, GEG, NE; Statistical Analysis, OA, AYÖ; Data Interpretation, OA; Manuscript Preparation, OA, NE; Literature Search, OA, GEG, NE, AYÖ. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Agel, J., Evans, T. A., Dick, R., Putukian, M., & Marshall, S. W. (2007). Descriptive epidemiology of collegiate men's soccer injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2002-2003. Journal of Athletic Training, 42(2), 270–277.

Agel, J., Olson, D. E., Dick, R., Arendt, E. A., Marshall, S. W., & Sikka, R. S. (2007). Descriptive epidemiology of collegiate women's basketball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. Journal of Athletic Training, 42(2), 202–210.

Akodu, A., Akinbo, S., & Ajiboye, A. (2017). Injury patterns and perceived risk factors among basketball players in Nigeria. Journal of the Romanian Sports Medicine Society, 13(2), 2918–2926.

Almeida, P. L., Olmedilla, A., Rubio, V. J., & Palou, P. (2014). Psychology in the realm of sport injury: What it is all about. Revista de Psicologia Del Deporte, 23(2), 395–400.

Bittencourt, N.F.N., Meeuwisse, W.H., Mendonça, L. D., Nettel-Aguirre, A., Ocarino, J. M., & Fonseca, S. T. (2016). Complex systems approach for sports injuries: moving from risk factor identification to injury pattern recognition—narrative review and new concept. British Journal of Sports Medicine, 50(21), 1309–1314. https://doi.org/ 10.1136/ bjsports-2015-095850

Burillo, P., Gallardo, L., Felipe, J. L., & Gallardo, A. M. (2014). Artificial turf surfaces: Perception of safety, sporting feature, satisfaction and preference of football users. European Journal of Sport Science, 14(sup1), S437–S447. https://doi.org/10. 1080/17461391.2012.713005

Canaway, P., Bell, M., Holmes, G., & Baker, S. (1990). Standards for the Playing Quality of Natural Turf for Association Football. In Natural and Artificial Playing Fields: Characteristics and Safety Features (pp. 29-29–19). ASTM International. https://doi. org/ 10.1520/STP25347S

Caz, C., Kayhan, R. F., & Bardakci, S. (2019). Adaptation of the Sport Injury Anxiety Scale to Turkish: Validity and Reliability Study. Turkish Journal of Sports Medicine, 54(1), 52–63.https://doi.org/10.5152/tjsm.2019.116

Cheng, W.-N. K., Hardy, L., & Markland, D. (2009). Toward a three-dimensional conceptualization of performance anxiety: Rationale and initial measurement development. Psychology of Sport and Exercise, 10(2), 271–278. https://doi. org/ 10.1016/j.psychsport.2008.08.001

Clifton, D. R., Hertel, J., Onate, J. A., Currie, D. W., Pierpoint, L. A., Wasserman, E. B., Knowles, S. B., Dompier, T. P., Comstock, R. D., Marshall, S. W., & Kerr, Z. Y. (2018). The First Decade of Web-Based Sports Injury Surveillance: Descriptive Epidemiology of Injuries in US High School Girls' Basketball (2005–2006 Through 2013–2014) and National Collegiate Athletic Association Women's Basketball (2004–2005 Through 2013–2014). Journal of Athletic Training, 53(11), 1037–1048. https://doi.org/10.4085/1062-6050-150-17

Ekmekçi, R., & Okan Miçooğulları, B. (2018). Examination and Comparison of Psychological Characteristics of American Football Players and Handball Players. Universal Journal of Educational Research, 6(11), 2420–2425. https://doi.org/ 10.13189 /ujer.2018.061104

Ekstrand, J., Timpka, T., Hagglund, M., & Karlsson, J. (2006). Risk of injury in elite football played on artificial turf versus natural grass: a prospective two-cohort study Commentary. British Journal of Sports Medicine, 40(12), 975–980. https://doi.org/ 10.1136/bjsm.2006.027623

Hershman, E. B., Anderson, R., Bergfeld, J. A., Bradley, J. P., Coughlin, M. J., Johnson, R. J., Spindler, K. P., Wojtys, E., Powell, J. W., Collins, J. T., Casolaro, M. A., Mayer, T., Pellman, E., Tessendorf, W., & Tucker, A. (2012). An Analysis of Specific Lower Extremity Injury Rates on Grass and FieldTurf Playing Surfaces in National Football League Games. The American Journal of Sports Medicine, 40(10), 2200–2205.https://doi.org/10.1177/0363546512458888

Ivarsson, A., & Johnson, U. (2010). Psychological factors as predictors of injuries among senior soccer players. A prospective study. Journal of Sports Science & Medicine, 9(2), 347–352.

Ivarsson, A., Johnson, U., & Podlog, L. (2013). Psychological Predictors of Injury Occurrence: A Prospective Investigation of Professional Swedish Soccer Players. Journal of Sport Rehabilitation, 22(1), 19–26. https://doi.org/10.1123/jsr.22.1.19

Jarvis, M. (2005). Sport Psychology. In Sport Psychology (Issue 1988). Routledge. https://doi.org/10.4324/9780203976272

Johnson, U., & Ivarsson, A. (2011). Psychological predictors of sport injuries among junior soccer players. Scandinavian Journal of Medicine & Science in Sports, 21(1), 129–136.https://doi.org/10.1111/j.1600-0838.2009.01057.x

Kaplan, E., & Andre, H. (2021). Investigation of the Relationship Between Mental Training and Sports Injury Anxiety. Turkish Journal of Sport and Exercise, 1, 1–8. https ://doi. org/10.15314/tsed.692936

Kerketta, I. (2015). A Comparative Study of Sports Competition Anxiety Between district levels male volleyball and soccer players. International Journal of Physical Education, Sports, and Health2, 1(3), 53–55.

Kerr, Z. Y., Wilkerson, G. B., Caswell, S. V., Currie, D. W., Pierpoint, L. A., Wasserman, E. B., Knowles, S. B., Dompier, T. P., Comstock, R. D., & Marshall, S. W. (2018). The First Decade of Web-Based Sports Injury Surveillance: Descriptive Epidemiology of Injuries in United States High School Football (2005–2006 Through 2013–2014) and National Collegiate Athletic Association Football (2004–2005 Through 2013–2014). Journal of Athletic Training, 53(8), 738–751. https://doi.org/10.4085/1062-6050-144-17

Li, H., Moreland, J. J., Peek-Asa, C., & Yang, J. (2017). Preseason Anxiety and Depressive Symptoms and Prospective Injury Risk in Collegiate Athletes. The American Journal of Sports Medicine, 45(9), 2148–2155. https://doi.org/10.1177/0363546517702847

Mears, A. C., Osei-Owusu, P., Harland, A. R., Owen, A., & Roberts, J. R. (2018). Perceived Links Between Playing Surfaces and Injury: a Worldwide Study of Elite Association Football Players. Sports Medicine - Open, 4(1), 40. https://doi.org/10.1186/s40798-018-0155-y

Mercan, S., Uzun, M., Ertugrul, A., Ozturk, I., Demir, B., & Sulun, T. (2005). Psychopathology and personality features in orthopedic patients with boxer's fractures. General Hospital Psychiatry, 27(1), 13–17. https://doi.org/10.1016/j.genhosppsych.2004.10.001

Olsen, O. E., Myklebust, G., Engebretsen, L., Holme, I., & Bahr, R. (2003). Relationship between floor type and risk of ACL injury in team handball. Scandinavian Journal of Medicine & Science in Sports, 13(5), 299–304.https://doi.org/10.1034/j.1600-0838.2003.00329.x

Özdemir, M. (2004). Principles of prevention and rehabilitation in sports injuries. In Çizgi Kitabevi.

Pasanen, K., Parkkari, J., Rossi, L., & Kannus, P. (2008). Artificial playing surface increases the injury risk in pivoting indoor sports: a prospective one-season follow-up study in Finnish female floorball. British Journal of Sports Medicine, 42(3), 194–197. https://doi.org/10.1136/bjsm.2007.038596

Podlog, L., Dimmock, J., & Miller, J. (2011). A review of return to sport concerns following injury rehabilitation: Practitioner strategies for enhancing recovery outcomes. Physical Therapy in Sport, 12(1), 36–42. https://doi.org/10.1016/j.ptsp.2010.07.005

Poulos, C. C. N., Gallucci, J., Gage, W. H., Baker, J., Buitrago, S., & Macpherson, A. K. (2014). The perceptions of professional soccer players on the risk of injury from competition and training on natural grass and 3rd generation artificial turf. BMC Sports Science, Medicine and Rehabilitation, 6(1), 11. https://doi.org/10.1186/2052-1847-6-11

Rex, C. C., & Metzler, J. N. (2016). Development of the Sport Injury Anxiety Scale. Measurement in Physical Education and Exercise Science, 20(3), 146–158. https://doi.org/10.1080/1091367X.2016.1188818

Roiger, T., Weidauer, L., & Kern, B. (2015). A Longitudinal Pilot Study of Depressive Symptoms in Concussed and Injured/Nonconcussed National Collegiate Athletic Association Division I Student-Athletes. Journal of Athletic Training, 50(3), 256–261. https://doi.org/10.4085/1062-6050-49.3.83

Schmidt-Olsen, S., Jørgensen, U., Kaalund, S., & Sørensen, J. (1991). Injuries among young soccer players. The American Journal of Sports Medicine, 19(3), 273–275. https://doi.org/10.1177/036354659101900311

Steffen, K., Andersen, T. E., & Bahr, R. (2007). Risk of injury on artificial turf and natural grass in young female football players. British Journal of Sports Medicine, 41(Supplement 1), i33–i37. https://doi.org/10.1136/bjsm.2007.036665

World Health Organization. (2001). World Health Organization, Geneva. World Report on Child Injury Prevention.

Wrisberg, C. A., Fisher, L. A., & Cassidy, C. M. (2006). Understanding Sport-Injury Anxiety. Athletic Therapy Today, 11(4), 57–58. https://doi.org/10.1123/att.11.4.57

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

RESEARCH ARTICLE

The Relationship Between Fall Risk, Balance, Posture, Strength, and Functional Parameters In Healthy Adults

Abdulkadir ERTÜRK[1*], Büşra Nur ORHAN[2], Sümeyye Özge MALKOÇ[3], Ebru TEKİN[4] and Fatma ÜNVER[5]

[1,2,3]Pamukkale University Institute of Health Sciences, Denizli / Türkiye
[4]Balıkesir University, Bigadiç Vocational School, Department of Therapy and Rehabilitation, Balıkesir / Türkiye
[5]Pamukkale University, School of Physical Therapy and Rehabilitation, Department of Physiotherapy and Rehabilitation, Denizli / Türkiye
*Corresponding author: ebrutekin123@gmail.com

Abstract
The aim of this study is to examine the relationship between posture, fall risk, balance, strength, and functional parameters in healthy adults with exercise habits. In our study, 45 individuals over 55 years of age who came to Denizli province 1200 Asmalı Evler Healthy Aging Center were included. The quadriceps, hamstring, and hand grip strengths of the participants were measured with a dynamometer. Their balance was assessed with the functional reach test, their posture with the New York Posture Rating Chart, their fear of falling with the fall effectiveness scale (FES-1), their functionality with the 30-second sit-stand test, and their flexibility with the sit and reach test. According to the correlation analysis, moderate and high levels of significant positive correlation between hamstring strength and hand grip strength; A weak to moderate positive correlation was found between quadriceps strength and hand grip strength and functional reach test. A moderately significant negative correlation was found between quadriceps strength (right), functional reaching test and fall activity scale and sit and reach test, between quadriceps strength (left) and functional reaching test, waist/hip ratio, and New York Posture Rating Chart ($p<0.05$). There was no significant relationship between other parameters ($p>0.05$). These results support that hand grip strength is a valid method for estimating lower extremity strength among healthy adults at the group level. However, there is a weak relationship between balance and hand grip strength.

Keywords
Athlete injury, anxiety, sports surface

INTRODUCTION

Balance capability refers to the capability to conserve the center of gravity, fixed body alignment, and posture on the support base (Horak, 1987). Balance control capability can be branched into dynamic and static balance control capability in accord with movement. Dynamic balance control capability controls the balance of the body during movements similar to walking, while static balance control capability controls the balance of the body while standing still (Bressel et al., 2007; Winter et al., 1990). Elements affecting balance capability have been explored numerous times (Bok et al., 2013; Gatev et al., 1999; Han et al., 2014; Lord, 1991; Shumway- Cook, 2001). A specific grade of muscle strength is needed to maintain an upright posture, and the lower extremity muscles near the ankle and knee joint must work agreeably to maintain stance stability

Received: 09 November 2022 ; **Accepted:** 16 January 2023; **Published:** 28 February 2023
[1]**ORCID:**0000-0002-95469-6887 , [2]**ORCID:**: 0000-0003-3821-6985, [3]**ORCID:**0000-0002-2287-1566, [4]**ORCID:**0000-0002-6984-1110, [5]**ORCID:** 0000-0002-3100-0818

How to cite this article: Ertürk, A., Orhan, B.N., Malkoç, S.Ö., Tekin, E. and Ünver, F. (2023). The Relationship Between Fall Risk, Balance, Posture, Strength, and Functional Parameters In Healthy Adults. *Int J Disabil Sports Health Sci*;5(2):8-17. https://doi.org/10.33438/ijdshs.1201745

and prohibit falls (Gatev et al., 1999; Lord, 1991; Shumway-Cook, 2001). Lord et al. reported that decreased sensation and muscle weakness in the legs and increased reaction time are important factors associated with postural instability (Lord, 1991). Eika et al. showed that hand grip strength and lower extremity strength decreased with increasing age in both genders (Eika et al., 2019). Alonso et al. discovered that hand grip strength was significantly related to the strength of the lower extremities in elder adult women, suggesting that hand grip strength could be used as an index of overall strength capability for clinical screening among elder women. Additionally, they associated lower hand grip strength with worse dynamic balance and mobility performance (Alonso et al., 2018). Neri et al. set up that weak hand grip strength was affiliated with a significantly higher threat of falling(Neri et al., 2021). In the study of Muehlbauer et al., they found almost no significant relationship (except for one) between lower extremity muscle strength, power, and balance variables in healthy and physically active elderly people. They stated that there are studies that both support and do not support this result they found, and therefore, they mentioned that more studies are needed to elucidate whether the strength, power, and balance performances of healthy older adults are independent or dependent on each other (Muehlbauer et al., 2012). For these reasons, our study aims to examine the relationship between posture, fall risk, balance, strength, and functional parameters in healthy adults.

MATERIALS AND METHODS

Ethical approval of the study was obtained from Pamukkale University Non-Interventional Clinical Research Ethics Committee at the board meeting dated 08.02.2022 and numbered 03 (Protocol No: 60116787-020-168745). After detailed written and verbal information was given to all participants, written informed consent was obtained from each participant.

Participants

Healthy individuals over 55 years of age, who regularly come to Denizli 1200 Evler Mahallesi Active Aging Center to exercise for at least 3 months, participated in our study. Individuals who scored below 23 points on the mini-mental test, had any neurological problems, had vestibular and cognitive impairments, had a medical condition that would limit exercise participation, and used walking aids were excluded from the study. All participants were given the necessary information and the factors affecting the balance were evaluated.

The evaluated factors are as follows:

Standardized Mini Mental Test (SMMT)

A standardized mini-mental test, which consists of eleven items gathered under five main headings as orientation, recording memory, attention and calculation, recall, and language, and evaluated out of a total score of 30, was administered to all participants. People who scored 23 points or less from the test were excluded from the study (Güngen et al., 2002).

Fall Activity Scale (FES-1)

Participants provided information about the level of anxiety about falls during activities of daily living; It was assessed on the FES-1 scale, which consists of 16 items of four points (1=not at all concerned, 4=very concerned), providing a total score ranging from 16 points (no concern about falling) to 64 points (severe concern about falling) (Ulus et al., 2012).

Quadriceps Muscle Strength Measurement

Quadriceps strength was evaluated while the participants were positioned to sit in a chair with their knees flexed at 90 degrees and arms crossed over the trunk, with their feet not touching the ground. The measurement was performed with the PowerTrack 2 Commander device and according to the device's instructions for use. Two measurements on the right and left extremities were made with an interval of one minute and the averages were taken (Kendall et al.).

Hamstring Muscle Strength Measurement

After the participants were positioned to take the most comfortable prone position on the stretcher, the hamstring strength was evaluated by bringing the knee to 60-70 degrees of flexion. The measurement was performed with the PowerTrack 2 Commander device and according to the device's instructions for use. Two measurements on the right and left extremities were made with an interval of one minute and the averages were taken (Kendall et al.).

Hand Grip Force Measurement

Participants were seated in a chair with back support and fixed arms. Participants were instructed to sit upright and rest their forearms on the arm of the chair with their wrists just at the end of the chair. Two measurements of the right and

left hands were evaluated with a Jamar brand of the results was recorded (Vermeulen et al., 2015).

Waist and Hip Circumference Measurement

Hip and waist circumference measurements of all participants were taken twice and the average of the measurement results were recorded (Hughes et al., 2004).

Waist/hip Ratio

The waist/hip ratio was calculated by dividing the waist circumference by the hip circumference.

30 Second Sit To Stand Test

All participants were asked to get up from the chair in a full and upright position with the arms crossed on the chest in a standard size chair without arms, and the hips should fully contact the chair while sitting, and the number of sitting and standing up in 30 seconds was counted with the start instruction. Measurements were made twice with an interval of 30 seconds and the average was taken (Jones et al., 1999).

Sit and Reach Test

The participants were asked to lie on the bench as much as possible without bending the knees, with the arms extended forward and the hands placed one above the other, in the section where the sit and reach table is located. Measurements were made twice with an interval of 15 seconds and the average was taken (Sweet et al., 2004).

Functional Reach Test

All participants were asked to reach forward as far as they could without raising their heels and losing their balance, by making fists with their desired extremities with a tape measure fixed on the wall, with their hands in 90 degrees flexion and referencing the 3rd metacarpal, and the difference between the starting point was recorded. The measurements were measured twice with a 15-second interval and averaged (Duncan et al., 1990).

Posture Analysis

Posture Analysis was calculated and recorded by an experienced physiotherapist in a special room with New York Posture Analysis (McRoberts et al., 2013).

Statistical Analysis

The G*Power 3.1.9.7 program was used to determine the sample size of the study. Our study was calculated as at least 45 people to achieve dynamometer at one minute intervals. The average 80% power with r:0.395 α=0.05 type I error β=0.10 type II error (Kim & Kim, 2018).

Data were analyzed with SPSS 25.0 (IBM SPSS 25 Software, IBM Corp, Armonk, NY, USA) package program. Continuous variables were expressed as mean ± standard deviation and categorical variables as numbers and percentages. The conformity of the data to the normal distribution was examined with the Shapiro-Wilk test. After examining the normal distributions of the data, the relationships between continuous variables were made using Spearman or Pearson correlation analysis.

RESULTS

47 individuals, 21 males and 26 females, who regularly do sports in the healthy aging center with an average age of 68.62±0.90 years and an average weight of 89.58±1.95 kg, participated in our study. Participants reported that they exercise 1.18±0.08 hours a day, 4.33±0.33 days a week. Only 11% of the participants reported a history of falls in the past 12 months. The descriptive values of our evaluation results are given below (Table 1).

Hamstring strength (right) versus hand grip strength (right) (r=0.593, p=0.001), hamstring strength (right) versus hand grip strength (left) (r=0.657, p=0.001), hamstring strength (left) hand grip strength (right) (r=0.584, p=0.001), hamstring strength (left) and hand grip strength (left) (r=0.647, p=0.001) significant positive moderate and high correlation; Quadriceps strength (right) versus hand grip strength (right) (r=0.332, p=0.026), quadriceps strength (right) versus hand grip strength (left) (r=0.541, p=0.001), quadriceps strength (left) hand grip strength (right) (r=0.416, p=0.004), quadriceps strength (left) and hand grip strength (left) (r=0.544, p=0.001), hand grip strength (left) and functional reach (r= 0.339, p=0.023, a significant positive, weak and moderate correlation was found. Quadriceps strength (right) sit and reach test (r=-0.339, p=0.023), quadriceps strength (left) sit and reach test (r=-0.331, p=0.026), functional reach test and sit and reach test (r= -0.364, p=0.014), fall activity scale and sit and reach test (r=-0.364, p=0.014), waist/hip ratio and newyork posture analysis were found to be significantly negative and weakly correlated (Table 2).

Table 1. Evaluation results of participants

	Mean±standard deviation	Median (Min-Max)
Hamstring Strength (Right)	89.58±5.01	86.35 (40.70-157)
Hamstring Strength (Left)	88.99±5.01	84.15 (40.70-167)
Quadriceps Strength (Right)	154.10±5.78	155.50 (80.30-245)
Quadriceps Strength (Left)	124.97±5.33	122 (48.40-225)
Hand Grip Force (Right)	25.92±0.91	24.88 (13.05-57.25)
Hand Grip Force (Left)	25.11±0.88	24.70 (13.75-57.50)
Sit and Reach Test (cm)	24.50±0.87	24.88 (10-34.50)
Fall Activity Scale (score)	23.45±1.22	22 (16-54)
Mini Mental Test (points)	25.11±0.58	26 (12-30)
New York Posture Analysis (points)	40.84±1.62	39 (17-59)
Thirty Second Sit to Stand Test (pcs)	11.75±0.03	12 (7.50-17)
Functional Reach Test (cm)	29.08±1.01	28.50 (16-51.50)
Waist/hip Ratio	0.90±0.01	0.90 (0.74-1.07)

Between hamstring strength and thirty-second sit and stand test, functional reach test, sit and reach test, fall activity scale, new york posture analysis; between quadriceps strength and thirty-second sit and stand test, functional reach test, fall efficiency scale, New York posture analysis; between hand grip strength (right) and thirty-second sit and stand test, functional reach test, sit and reach test, fall activity scale, and New York posture analysis; between hand grip strength (left) and the thirty-second sit and stand test, sit and lie down test, fall activity scale, new york posture analysis; between the thirty-second sit and stand test and the functional reach test, sit and lie down test, fall efficiency scale, and New York posture analysis; between sit and lie test and new york posture analysis; There was no significant relationship between the fall activity scale and the New York posture analysis ($p>0.05$) (Table 2).

DISCUSSION

The main finding of this study is that hand grip strength is positively related to lower extremity muscle strength in healthy adults and there is a weak positive correlation between the functional reach test, which is an indicator of dynamic balance and functionality, and hand grip strength. These findings are important because hand grip strength can be used clinically as a measure of muscle strength ability in healthy individuals. It has also been shown that hand grip strength can provide information about the dynamic balance and functionality of individuals.

Studies showing the relationship between hand grip strength and quadriceps and hamstring are available in the literature (Kilgour et al., 2013; Norman et al., 2010; Stel et al., 2003). In parallel with our study, there is a study in the literature showing that hand grip strength is positively and moderately related to hamstring and quadriceps muscle strength (Alonso et al., 2018). Pijnappels et al. on the other hand, they found a significant relationship between hand grip strength and knee extension strength (Pijnappels et al., 2008). In some studies in the literature, a weak relationship was found between hand grip strength and quadriceps-hamstring strength (Fragala et al., 2016; Yeung et al., 2018). In our study, there is a moderately positive relationship between hand grip strength and quadriceps and hamstring muscle strength, in line with these studies.

In the literature; Alonso et al. while they found a significant correlation between hand grip strength and lower extremity strength, they reported that with a decrease in hand grip strength, your dynamic balance and mobility performance decreased, and the relationship between hand grip strength and fall risk and balance (Alonso et al., 2018).

Table 2. The Relationship between participants' fall risk, balance, posture, strength and functional parameters

	r	p
Hamstring Strength (right)-Hand Grip Strength (right)	0.593	**0.001***
Hamstring Strength (right)-Hand Grip Strength (left)	0.657	**0.001***
Hamstring Strength (left)-Hand Grip Strength (right)	0.584	**0.001***
Hamstring Strength (left)-Hand Grip Strength (left)	0.647	**0.001***
Quadriceps Strength (right)-Hand Grip Strength (right)	0.332	**0.026***
Quadriceps Strength (right)-Hand Grip Strength (left)	0.541	**0.001***
Quadriceps Strength (left)-Hand Grip Strength (right)	0.416	**0.004***
Quadriceps Strength (left)-Hand Grip Strength (left)	0.544	**0.001***
Hand Grip Strength (right)-Functional Reach Test	0.217	0.152
Hand Grip Strength (left)-Functional Reach Test	0.339	**0.023***
Hamstring Strength (right)-Functional Reach Test	0.181	0.235
Hamstring Strength (left)-Functional Reach Test	0.219	0.148
Quadriceps Strength (right)-Functional Reach Test	0.217	0.153
Quadriceps Strength (left)-Functional Reach Test	0.258	0.087
Hand Grip Strength (right)-Fall Activity Scale	-0.076	0.616
Hand Grip Strength (left)-Fall Activity Scale	0.036	0.810
Hamstring Strength (right)-Fall Activity Scale	-0.230	0.125
Hamstring Strength (left)-Fall Activity Scale	-0.262	0.079
Quadriceps Strength (right)-Fall Activity Scale	-0.039	0.796
Quadriceps Strength (left)-Fall Activity Scale	0.012	0.937
Waist/hip Ratio - New York Posture Analysis	-0.321	**0.034****
Functional Reach Test – Sit and Reach Test	-0.364	**0.014***
Hamstring Strength (right)-Sit and Reach Test	-0.241	0.111
Hamstring Strength (left)-Sit and Reach Test	-0.203	0.182
Quadriceps Strength (right)-Sit and Reach Test	-0.339	**0.023****
Quadriceps Strength (left)- Sit and Reach Test	-0.331	**0.026****
Sit and Reach Test - Fall Activity Scale	-0.364	**0.014***
Hand Grip Strength (right)-Sit and Reach Test	-0.147	0.330
Hand Grip Strength (left)-Sit and Reach Test	-0.273	0.066
Hamstring Strength (right)-Thirty Second Sit and Stand Test	0.139	0.362
Hamstring Strength (left)-Thirty Second Sit and Stand Test	0.204	0.178
Quadriceps Strength (right)-Thirty Second Sit and Stand Test	0.257	0.088
Quadriceps Strength (left)-Thirty Second Sit and Stand Test	0.177	0.244
Hand Grip Strength (right)-Thirty Second Sit and Stand Test	0.031	0.840
Hand Grip Strength (left)-Thirty Second Sit and Stand Test	0.017	0.910
Hamstring Strength (right)-New York Posture Analysis	-0.139	0.374
Hamstring Strength (left)-New York Posture Analysis	-0.135	0.388
Quadriceps Strength (right)-New York Posture Analysis	-0.192	0.217
Quadriceps Strength (left)-New York Posture Analysis	0.055	0.725
Hand Grip Strength (right)-New York Posture Analysis	-0.029	0.852
Hand Grip Strength (left)-New York Posture Analysis	-0.098	0.525
Thirty Second Sit and Stand Test - Functional Reach Test	0.102	0.506
Thirty Second Sit and Stand Test - Sit and Reach Test	0.083	0.581
Thirty Second Sit and Stand Test - Fall Activity Scale	0.117	0.437
Thirty Second Sit and Stand Test - New York Posture Analysis	-0.048	0.758
Functional Reach Test - Fall Activity Scale	0.148	0.326
Functional Reach Test - New York Posture Analysis	-0.002	0.991
Sit and Reach Test - New York Posture Analysis	0.228	0.136
Fall Activity Scale- New York Posture Analysis	-0.010	0.948

In another study, there was a meaningful relationship between dynamic balance and hand grip strength (Wiśniowska-Szurlej et al., 2019), while in the study of Fujita et al., weaker hand grip strength and higher dynamic balance disorder were reported (Fujita et al., 2019). In our study, a weak positive correlation was found between the left hand grip strength and the functional reach test, which is one of the tests of dynamic balance. There are many factors affecting dynamic balance, we think that hand grip strength can be used as a parameter in evaluating dynamic balance, but more studies are needed in the literature on this subject.

Laughton et al. reported that the decrease in lower extremity muscle strength negatively affects postural sway and Kligytė et al. found a significant relationship between the decrease in lower extremity muscle strength and the ability to control balance (Kligyte et al. 2003; Laughton et al. 2003). Shumway-Cook et al. reported that lower extremity muscle strength should be at a certain threshold value in order to maintain balance and that coordination between the muscles in the lower extremity maintains static balance and prohibit falls (Shumway-Cook & Woollacott, 1995). In our study, however, no correlation or significance was found between quadriceps and hamstring muscle strength and functional reach test, which is one of the indicators of dynamic balance. Similar to our study in the literature, Muehlbauer et al.'s study evaluated the relationship between muscle strength and balance in healthy elderly individuals with different methods as reactive balance and proactive balance and reported that there was no relationship between lower extremity muscle strength and dynamic balance (Muehlbauer et al., 2012). In a study conducted on adult women in 2011, it was concluded that knee flexor muscle groups did not show any significance with the functional reach, while knee extensor muscle groups were weakly correlated with functional reach test (Yıldırım et al., 2011). Conflicting results in the literature on this subject show that more studies are needed.

When we look at the studies in the literature examining the relationship between fear of falling and muscle strength, Yardimci et al. They found that there was a negative correlation between hand grip strength and fear of falling, and they found that upper extremity muscle strength affected the fear of falling (Yardimci et al., 2021). In the literature, there are negative correlations between lower extremity muscle strength and fear of falling (Binda et al., 2003; Delbaere et al., 2004; Trombetti et al., 2016). However, in our study, no significant relationship was found between strength and the FES-1 fall efficiency scale. We think that this is because our sample group is active individuals.

In our study, we found that the waist/hip ratio was positively correlated with the New York posture analysis. There is no study in the literature that directly examines this relationship and gives results. Therefore, this result could not be discussed. Although more studies are needed, we think that the waist/hip ratio shows that it can be a practical method to evaluate the posture analysis status.

In our study, we found a weak negative correlation between the sit and reach test and the functional reach test, which measures dynamic balance and functional reaching ability. In the literature review, only Overmoyer et al. we found a study in which they examined the relationship between flexibility and dynamic balance in healthy active young adults (age = 21.9 ± 2.6 years), where they reported a significant relationship between flexibility and balance (Overmoyer & Reiser, 2015). Our study shows parallelism with this study in the literature, but more literature studies are needed to discuss this issue.

In our study, we could not find a meaningful connection between hamstring muscle strength and the sit-and-reach test, but we found a weak negative connection between quadriceps muscle strength and the sit-and-reach test. In a study conducted in 2018 evaluating lower extremity and functional parameters in the elderly, a significant relationship was found between lower extremity muscles and trunk flexibility, but unlike our study, in this study, muscle strength was not measured specifically for muscles, but measurements were made according to range of motion (Torpi, 2018). In the study of Akınoğlu et al., in which they examined the relationship between trunk muscle strength and sit and reach test on athletes, a significant relationship was found between trunk muscle strength and sit and reach test (Akınoğlu et al., 2020). However, both the sample group and the muscles evaluated in this study differ from our study.

Another finding of this study is that there is a weak negative correlation between sit and reach test and fall efficiency scale. In the literature, we

did not find any research that directly examines the sit-and-reach test and the fall effectiveness scale. However, there are studies in the literature that indicate that flexibility exercises are effective in increasing dynamic balance (Barrett & Smerdely, 2002; Costa et al., 2009; Overmoyer & Reiser, 2015). Thus, the relationship between flexibility and balance, albeit indirectly, is in parallel with the relationship we found between the sit and reach test and the fall effectiveness scale.

Wisniowska-Szurlej et al. found that lower limb flexibility in women was a connection with hand grip strength, while there was a relationship between upper limb flexibility and hand grip strength in men (Wiśniowska-Szurlej et al., 2019). Silva et al. In their study, they found that there was no significant relationship between hand grip strength and flexibility (de Almeida Silva et al., 2013). In our study, no relationship was found between hand grip strength and flexibility. We think that many factors affecting flexibility cause this difference.

In this study, no correlation was observed between the 30-second sit-to-stand test, which is frequently used in the literature to measure lower extremity muscle strength, and dynamic balance, and quadriceps, hamstring strength. In the literature, according to Torpi et al. In a study they conducted in 2018, they reported a moderate positive correlation between lower extremity muscle strength and the 30-second sit-stand test. (Torpi, 2018).Cebolla et al., in their study in 2015, reported that an increase in lower extremity muscle strength increased the 30-second sit-to-stand test performance (Cebolla et al., 2015). In our study, there was no significant difference between hand grip strength and 30-second sit-to-stand test. In 2021, Yee et al. investigated the role of the 30-second sit-to-stand test in the diagnosis of sarcopenia in elderly people and found a weak positive correlation between the hand grip strength and the 30-second sit-to-stand test (Yee et al., 2021). We think that due to the fact that our sample group exercised regularly and was healthy, they did not have difficulty in the 30-second sit and stand test, and therefore no correlation was observed.

In this study, there was no significant relationship between quadriceps, hamstring and hand grip strengths and New York Posture Rating Chart. There was no correlation between the thirty-second sit-to-stand test, which is one of the other parameters, and the functional reach test, sit-and-reach test, fall efficiency scale and New York Posture Rating Chart. There was no correlation between the functional reach test and sit-and-reach test, fall efficiency scale and New York Posture Rating Chart. There was no significant relationship between the sit-and-reach test and the New York Posture Rating Chart, and between the fall efficiency scale and the New York Posture Rating Chart, which are among the other parameters examined. We have not come across a study in the literature that directly examines and investigates the relationship between these parameters. Therefore, these parameters could not be discussed. More work is needed.

Conclusion

As a result, the fact that hand grip strength is moderately related to lower extremity muscle strength shows that it can give information about lower extremity muscle strength, while the relationship between hand grip strength and functional reach shows that hand grip strength can give an idea about dynamic balance and functional reach of individuals. On the other hand, we think that waist/hip ratio may be a parameter that can give an idea about posture analysis and that more studies are needed on these issues.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

Ethical approval of the study was obtained from Pamukkale University Non-Interventional Clinical Research Ethics Committee at the board meeting dated 08.02.2022 and numbered 03 (Protocol No: 60116787-020-168745).

Author Contributions

Study Design, ET, AE, BNO; Data Collection, BNO, SÖM; Statistical Analysis, OA, AYÖ; Data Interpretation, ET, FÜ; Manuscript Preparation, BNO, ET, SÖM; Literature Search, AE, BNO, SÖM, ET, FÜ. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Akinoğlu, B., Kocahan, T., Ünüvar, E., Eroğlu, İ., & Hasanoğlu, A. (2020). Investigation of the Relationship Between Trunk Muscle Strength and Sit-Reach Flexibility in Athletes. *Turkiye Klinikleri Journal of Sports Sciences, 12*(1).

Alonso, A. C., Ribeiro, S. M., Luna, N. M. S., Peterson, M. D., Bocalini, D. S., Serra, M. M., Brech, G. C., Greve, J. M. D. A., & Garcez-Leme, L. E. (2018). Association between handgrip strength, balance, and knee flexion/extension strength in older adults. *PLoS One, 13*(6), e0198185.

Barrett, C., & Smerdely, P. (2002). A comparison of community-based resistance exercise and flexibility exercise for seniors. *Australian Journal of Physiotherapy, 48*(3), 215-219.

Binda, S. M., Culham, E. G., & Brouwer, B. (2003). Balance, muscle strength, and fear of falling in older adults. *Experimental aging research, 29*(2), 205-219.

Bok, S.-K., Lee, T. H., & Lee, S. S. (2013). The effects of changes of ankle strength and range of motion according to aging on balance. *Annals of rehabilitation medicine, 37*(1), 10-16.

Bressel, E., Yonker, J. C., Kras, J., & Heath, E. M. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of athletic training, 42*(1), 42.

Cebolla, E. C., Rodacki, A. L., & Bento, P. C. (2015). Balance, gait, functionality and strength: comparison between elderly fallers and non-fallers. *Brazilian journal of physical therapy, 19*, 146-151.

Costa, P. B., Graves, B. S., Whitehurst, M., & Jacobs, P. L. (2009). The acute effects of different durations of static stretching on dynamic balance performance. *The Journal of Strength & Conditioning Research, 23*(1), 141-147.

de Almeida Silva, N., de Menezes, T. N., de Melo, R. L. P., & Pedraza, D. F. (2013). Handgrip strength and flexibility and their association with anthropometric variables in the elderly. *Revista da Associação Médica Brasileira (English Edition), 59*(2), 128-135.

Delbaere, K., Crombez, G., Vanderstraeten, G., Willems, T., & Cambier, D. (2004). Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort study. *Age and ageing, 33*(4), 368-373.

Duncan, P. W., Weiner, D. K., Chandler, J., & Studenski, S. (1990). Functional reach: a new clinical measure of balance. *Journal of gerontology, 45*(6), M192-M197.

Eika, F., Blomkvist, A. W., Rahbek, M. T., Eikhof, K. D., Hansen, M. D., Søndergaard, M., Ryg, J., Andersen, S., & Jorgensen, M. (2019). Reference data on hand grip and lower limb strength using the Nintendo Wii balance board: a cross-sectional study of 354 subjects from 20 to 99 years of age. *BMC Musculoskeletal Disorders, 20*(1), 1-10.

Fragala, M. S., Alley, D. E., Shardell, M. D., Harris, T. B., McLean, R. R., Kiel, D. P., Cawthon, P. M., Dam, T. T. L., Ferrucci, L., & Guralnik, J. M. (2016). Comparison of handgrip and leg extension strength in predicting slow gait speed in older adults. *Journal of the American Geriatrics Society, 64*(1), 144-150.

Fujita, K., Kaburagi, H., Nimura, A., Miyamoto, T., Wakabayashi, Y., Seki, Y., Aoyama, H., Shimura, H., Kato, R., & Okawa, A. (2019). Lower grip strength and dynamic body balance in women with distal radial fractures. *Osteoporosis International, 30*(5), 949-956.

Gatev, P., Thomas, S., Kepple, T., & Hallett, M. (1999). Feedforward ankle strategy of balance during quiet stance in adults. *The Journal of physiology, 514*(3), 915-928.

Güngen, C., Ertan, T., Eker, E., Yaşar, R., & Engin, F. (2002). The validity and reliability of the standardized mini mental test in the diagnosis of mild dementia in the Turkish population. *Turkish Journal of Psychiatry, 13*(4), 273-281.

Han, M.-J., Yuk, G.-C., Gak, H., Suh, S.-R., & Kim, S.-G. (2014). Acute effects of 5 min of plantar flexor static stretching on balance and gait in the elderly. *Journal of physical therapy science, 26*(1), 131-133.

Horak, F. B. (1987). Clinical measurement of postural control in adults. *Physical therapy, 67*(12), 1881-1885.

Hughes, V. A., Roubenoff, R., Wood, M., Frontera, W. R., Evans, W. J., & Fiatarone Singh, M. A. (2004). Anthropometric

assessment of 10-y changes in body composition in the elderly. *The American journal of clinical nutrition, 80*(2), 475-482.

Jones, C. J., Rikli, R. E., & Beam, W. C. (1999). A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Research quarterly for exercise and sport, 70*(2), 113-119.

Kilgour, R., Vigano, A., Trutschnigg, B., Lucar, E., Borod, M., & Morais, J. (2013). Handgrip strength predicts survival and is associated with markers of clinical and functional outcomes in advanced cancer patients. *Supportive care in cancer, 21*(12), 3261-3270.

Kim, S.-G., & Kim, W.-S. (2018). Effect of ankle range of motion (ROM) and lower-extremity muscle strength on static balance control ability in young adults: a regression analysis. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research, 24*, 3168.

Kligyte, I., Lundy-Ekman, L., & Medeiros, J. M. (2003). Relationship between lower extremity muscle strength and dynamic balance in people post-stroke. *Medicina (Kaunas), 39*(2), 122-128.

Laughton, C. A., Slavin, M., Katdare, K., Nolan, L., Bean, J. F., Kerrigan, D. C., Phillips, E., Lipsitz, L. A., & Collins, J. J. (2003). Aging, muscle activity, and balance control: physiologic changes associated with balance impairment. *Gait & posture, 18*(2), 101-108.

Lord, S. (1991). Clark RD, and Webster IW. *Postural stability and associated physiological factors in a population of aged persons. J Gerontol, 46*, M69-M76.

McRoberts, L. B., Cloud, R. M., & Black, C. M. (2013). Evaluation of the New York Posture Rating Chart for assessing changes in postural alignment in a garment study. *Clothing and Textiles Research Journal, 31*(2), 81-96.

Muehlbauer, T., Besemer, C., Wehrle, A., Gollhofer, A., & Granacher, U. (2012). Relationship between strength, power and balance performance in seniors. *Gerontology, 58*(6), 504-512.

Neri, S. G., Lima, R. M., Ribeiro, H. S., & Vainshelboim, B. (2021). Poor handgrip strength determined clinically is associated with falls in older women. *Journal of frailty, sarcopenia and falls, 6*(2), 43.

Norman, K., Stobäus, N., Smoliner, C., Zocher, D., Scheufele, R., Valentini, L., Lochs, H., & Pirlich, M. (2010). Determinants of hand grip strength, knee extension strength and functional status in cancer patients. *Clinical Nutrition, 29*(5), 586-591.

Overmoyer, G. V., & Reiser, R. F. (2015). Relationships between lower-extremity flexibility, asymmetries, and the Y balance test. *The Journal of Strength & Conditioning Research, 29*(5), 1240-1247.

Pijnappels, M., van der Burg, P. J., Reeves, N. D., & van Dieën, J. H. (2008). Identification of elderly fallers by muscle strength measures. *European journal of applied physiology, 102*(5), 585-592.

Shumway-Cook, A. (2001). Normal postural control. *Motor control: Theory and practical applications*.

Shumway-Cook, A., & Woollacott, M. H. (1995). Theory and practical applications. *Motor Control*.

Stel, V. S., Pluijm, S. M., Deeg, D. J., Smit, J. H., Bouter, L. M., & Lips, P. (2003). A classification tree for predicting recurrent falling in community-dwelling older persons. *Journal of the American Geriatrics Society, 51*(10), 1356-1364.

Sweet, T. W., Foster, C., McGuigan, M. R., & Brice, G. (2004). Quantitation of resistance training using the session rating of perceived exertion method. *The journal of strength & conditioning research, 18*(4), 796-802.

Torpi, H. K. (2018). The effect of lower extremity muscle strenght on balance, functional capacity, kinesiophobia and quality of life in elderly.

Trombetti, A., Reid, K., Hars, M., Herrmann, F., Pasha, E., Phillips, E., & Fielding, R. (2016). Age-associated declines in muscle mass, strength, power, and physical performance: impact on fear of falling and quality of life. *Osteoporosis international, 27*(2), 463-471.

Ulus, Y., Durmus, D., Akyol, Y., Terzi, Y., Bilgici, A., & Kuru, O. (2012). Reliability and validity of the Turkish version of the Falls Efficacy Scale International (FES-I) in community-dwelling older persons. *Archives of gerontology and geriatrics, 54*(3), 429-433.

Vermeulen, J., Neyens, J. C., Spreeuwenberg, M. D., van Rossum, E., Hewson, D. J., & de Witte, L. P. (2015). Measuring grip strength in older adults: comparing the grip-ball with the Jamar dynamometer. *Journal of geriatric physical therapy*, *38*(3), 148-153.

Winter, D. A., Patla, A. E., & Frank, J. S. (1990). Assessment of balance control in humans. *Med prog technol*, *16*(1-2), 31-51.

Wiśniowska-Szurlej, A., Ćwirlej-Sozańska, A., Wołoszyn, N., Sozański, B., & Wilmowska-Pietruszyńska, A. (2019). Association between handgrip strength, mobility, leg strength, flexibility, and postural balance in older adults under long-term care facilities. *BioMed Research International*, *2019*.

Yardimci, B., Akdeniz, M., & Demir, T. (2021). The correlation between fear of falling and upper extremity muscle strength. *Saudi Medical Journal*, *42*(4), 411.

Yee, X. S., Ng, Y. S., Allen, J. C., Latib, A., Tay, E. L., Abu Bakar, H. M., Ho, C. Y. J., Koh, W. C. C., Kwek, H. H. T., & Tay, L. (2021). Performance on sit-to-stand tests in relation to measures of functional fitness and sarcopenia diagnosis in community-dwelling older adults. *European Review of Aging and Physical Activity*, *18*(1), 1-11.

Yeung, S. S., Reijnierse, E. M., Trappenburg, M. C., Hogrel, J.-Y., McPhee, J. S., Piasecki, M., Sipila, S., Salpakoski, A., Butler-Browne, G., & Pääsuke, M. (2018). Handgrip strength cannot be assumed a proxy for overall muscle strength. *Journal of the American Medical Directors Association*, *19*(8), 703-709.

Yıldırım, N. Ü., Özengil, N., Özdemir, Ö. Ç., & Gökdoğan, F. (2011). The relationship between functionality, performance and reaction time and quality of life in elderly individuals. *Turkish Journal of Geriatrics*.

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

RESEARCH ARTICLE

Knowledge of workplace postural requirements among private dental practitioners

Lohan MORADİA[1], Aayushi BAGGA[2], Anusuya CHOWDHRY[3], Anusha GALLA[4], Kalyana CHAKRAVARTHY PENTAPATİ[5*] and Abhinav TADİKONDA NİTİN[6]

[1]Department of Epidemiology and Biostatistics, Texas A & M University Health Science Center, College Station, TX / USA
[2]Melbourne School of Population and Global Health, The University of Melbourne / Australia
[3,5]Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka / India
[4]College of public health, Temple University, Pennsylvania / USA
[6]Department of Public Health Dentistry, Sri Sai College of Dental Surgery, Vikarabad, Telangana / India
*Corresponding author: drkalyan81@gmail.com

Abstract
Objective: We aimed to evaluate the basic postural requirements for dental professionals during routine patient care and to assess significant differences in the knowledge of postural requirements with demographic characteristics and clinical experience. Materials and methods: A cross-sectional online survey was conducted among Indian private dental practitioners with a clinical experience (CE > 1-year). They were invited to participate via WhatsApp through based practice networks. We collected data related to age, sex, educational qualification, and CE. The postural requirements questionnaire was adapted from Garbin et al which has 8 items. The total knowledge score of the postural requirements questionnaire was obtained and categorized as "inadequate (1-2), regular (3-4), satisfactory (5-7), and excellent (8)". A Chi-square test and Binary logistic regression was done to compare the knowledge of postural requirements with demographic variables and CE. Results: A total of 383 dental practitioners participated in this online survey, out of which 59.5% were females and mean age was 30.73. More than 1/3rd of the practitioners had an excellent level of knowledge regarding the postural requirements. The majority of the practitioners had satisfactory levels of knowledge. Only 6.8% had inadequate/regular knowledge. Bivariate analysis showed that significantly higher numbers of female dental practitioners (37.3%) showed excellent scores than males (27.1%) (P=0.038). Binary logistic regression showed that females were 1.6 times more likely to have excellent total knowledge scores (OR: 1.6). Conclusion: Our survey showed that more than 1/3rd of private dental practitioners had excellent knowledge of postural requirements.

Keywords
Postural requirements, ergonomics, dentists

INTRODUCTION

Dentistry requires static prolonged working posture, limited access, and poor illumination inside the oral cavity. Long static positions can lead to stretching and compression of the supporting structures. Due to this, there will be persistent contraction of muscles which leads restricted blood flow causing muscular fatigue and increased chances of muscle injury. Repetitive movements can lead to fatigue and give less time to muscle recovery which might lead to muscle

Received: 09 December..2022 ; **Accepted:** 01 February 2023; **Published:** 28 February 2023
[1]**ORCID:**0000-0002-0358-748X , [2]**ORCID:**: 0000-0002-9233-7553, [3]**ORCID:**0000-0001-5541-1403, [4]**ORCID:**0000-0002-0836-1316,
[5]**ORCID:** 0000-0002-5462-5677, [5]**ORCID:** 0000-0002-6473-8093

How to cite this article: Moradia, L., Bagga, A., Chowdhry, A., Galla, A., Chakravarthy Pentapati, K. and Tadikonda Nitin, A. (2023). Knowledge of workplace postural requirements among private dental practitioners. *Int J Disabil Sports Health Sci*;6(1):18-23 https://doi.org/10.33438/ijdshs.1216644

injury. Persistent forciful movements can lead to muscle fatigue and lead to injury Due to this, dental practitioners are prone to various workplace musculoskeletal disorders (MSDs). Coupled with poor posture, there can be increased incidence of MSD. Literature on MSD among dental practitioners have shown a high prevalence (Chenna et al., 2022; Chikte et al., 2011; Hayes et al., 2009; Leggat et al., 2007; Puriene et al., 2007; ZakerJafari & YektaKooshali, 2018), often due to poor postural practices linked to lack of knowledge, negligence, and poor practices. Previous research showed a positive relationship between poor posture and the prevalence of MSD (Yousef & Al-Zain, 2009). This can lead to poor quality of life, decreased productivity, and poor performance in clinical practice.

"The International Ergonomics Association defines ergonomics as the scientific regulations concerned with the relations between humans, main beliefs, and methods to design a workplace to optimize human comfort and largely system performance"(Diaz-Caballero et al., 2010). The knowledge of ergonomics helps in understanding and applying the principles of safe, healthy, and comfortable work culture along with prevention of MSD, increasing productivity and improving the quality of life. Application of principles of ergonomics during patient care in the dental setting is prudent and helps in the prevention of MSD and stress.

Substantial literature exists on the prevalence and risk factors of MSD and postural habits (Chenna et al., 2022; Yousef & Al-Zain, 2009). Substantial literature exists on the knowledge, attitude, practices and behavior towards ergonomics from developing countries on dentists and dental students (Galla et al., 2022; Jadhav et al., 2018; Kalghatgi et al., 2014; Karibasappa & Rajeshwari, 2014; Ketkar & Malaiappan, 2020; M. Kumar et al., 2021; P. M. Kumar et al., 2020; Nayakar et al., 2020; Vyas et al., 2014). However, literature is scant on the knowledge of optimum postural requirements among dental practitioners in developing countries. Ergonomics is often neglected in the dentistry curriculum, with limited emphasis on operator positions (DCI, 2007). Thorough knowledge of the same is required among dental health care professionals. It is a prerequisite to have an appropriate posture during clinical dental practice. Identification of knowledge gaps is required for the development of training strategies. Hence, we aimed to evaluate the basic postural requirements for dental professionals during routine patient care. We also aimed to assess significant differences in the knowledge of postural requirements concerning demographic variables and clinical experience (CE).

MATERIALS AND METHODS

A cross-sectional online survey among private dental practitioners was conducted. Indian private dental practitioners with more than 1-year of clinical experience were invited to participate. Dentists who were not into private dental practice were excluded from the study. The online survey link was sent through WhatsApp through based practice networks. Sample size was calculated based on the response distribution of 50% which yielded a sample of 377 with a precision of 5% and confidence interval of 95%.

We prepared a questionnaire in English that had information on age, sex, educational qualification, and CE. The postural requirements questionnaire was adapted from Garbin et al (Garbin et al., 2011). It has 8 items with responses as "yes (1)" or "no (0)" (Table 1). The items from the questionnaire were from ergonomic guidelines for proper posture, treatments, instrument manipulation and adequacy of dental offices in patient treatment laid down by International Standards Organization.

Analysis was done using SPSS version 20. A p-value of <0.05 was considered statistically significant. The total knowledge score of the postural requirements questionnaire was obtained by adding the responses to all the questions. Subsequently, the score is categorized as "inadequate (1-2), regular (3-4), satisfactory (5-7), and excellent (8)" (Garbin et al., 2011). Age and years of CE were dichotomized using a median split. Total knowledge score was dichotomized as excellent or optimum (8) and sub-optimum (less than 8). Chi-square test was used to compare the total knowledge score with demographic variables and CE. Binary logistic regression was done to evaluate the relationship between total knowledge score and significant predictors.

Permission to conduct the study was obtained from "Kasturba hospital and Kasturba Medical College institutional ethics committee

(IEC: 263/2021)", and informed consent was sought from all the dental practitioners.

RESULTS

A total of 383 dental practitioners participated in this online survey, out of which 59.5% were females. The mean age was 30.73 (SD: 6.65; Range: 24 -67; Median: 29). The mean CE was 6.18 (SD: 6.33; Range: 1-38; Median: 3 years). Most of the dental practitioners had post-graduate qualifications (60.3%).

More than 90% of dental practitioners have responded "yes" to Q2, Q4, and Q7. Almost 40% of dental practitioners have answered "no" to Q8. Similarly, more than 1/4th of the practitioners responded as "no" for Q3. More than 1/5th of the practitioners have responded "no" for Q1 (Table 1). More than 1/3rd of the practitioners had an excellent level of knowledge regarding the postural requirements. The majority of the practitioners had satisfactory levels of knowledge. Only 6.8% had inadequate/regular knowledge.

Table 1. Distribution of responses to postural requirements questionnaire among the dental practitioners

	Question	No / N (%)	Yes / N (%)
Q1.	"The angle between the lower and upper leg, with the legs slightly spread, must be ~ 110 or slightly more."	84(21.9%)	299(78.1%)
Q2.	"The dentist should sit symmetrically upright and as far back as possible in the seat, tilting the upper body forward to a maximum of 10—20º, avoiding rotation and lateral slopes."	28(7.3%)	355(92.7%)
Q3.	"The head of the surgeon-dentist can be tilted forward to up to 25º."	102(26.6%)	281(73.4%)
Q4.	"The pedal drive must be positioned close to one of the feet, so that it does not have to be directed laterally during its operation."	28(7.3%)	355(92.7%)
Q5.	"The upper limbs are next to the upper body in front of the trunk, with the forearm raised from ~ 10º to a maximum of 25º."	49(12.8%)	334(87.2%)
Q6.	"The working field (patient's mouth) must remain aligned with the front of the upper body, such that the distance between the working area in the mouth and the eyes (or glasses) of ~ 35-40 cm."	42(11.0%)	341(89.0%)
Q7.	"The hand tools should be positioned within the visual field of the dentist at a distance of 20—25 cm".	37(9.7%)	346(90.3%)
Q8.	"A dental operating light must be able to be positioned around the head of the dentist, before and sideward so that the light beam is parallel to the viewing direction."	151(39.4%)	232(60.6%)

Bivariate analysis showed that significantly higher numbers of female dental practitioners (37.3%) showed excellent scores than males (27.1%) (P=0.038). No significant differences were seen in the distribution of knowledge scores concerning age, educational qualification, and years of CE (Table 2).

Table 2. Bivariate analysis of demographic factors with total knowledge scores of postural requirements questionnaire among the dental practitioners

		Total knowledge score		P-value
		Sub-optimal N (%)	Excellent or optimum N (%)	
Age in years	≤29	132(65.7%)	69(34.3%)	0.61
	≥30	124(68.1%)	58(31.9%)	
Sex	Male	113(72.9%)	42(27.1%)	0.038
	Female	143(62.7%)	85(37.3%)	
Clinical experience in years	≤3	131(68.2%)	61(31.8%)	0.143
	≥3	125(65.4%)	66(34.6%)	
Educational qualification	Graduation	95(62.5%)	57(37.5%)	0.563
	Masters	161(69.7%)	70(30.3%)	

Binary logistic regression showed that females were 1.6 times more likely to have excellent total knowledge scores (OR: 1.6). There was no change in the odds ratio after adjusting for covariates (age, educational qualification and clinical experience). However, there was no significant association between sex and knowledge scores (Table 3). Post-hoc power analysis yielded a power of 99% for distribution of knowledge scores between males and females.

Table 3. Binary logistic regression between sex and total knowledge scores of postural requirements questionnaire among the dental practitioners

Predictor	P-value	OR	95% CI
Sex	0.038	1.6	1.03-2.5
Sex (Adjusted for age, educational qualification, and clinical experience)	0.062	1.6	0.98-2.6

DISCUSSION

Maintaining correct posture is a pre-requisite for any profession and dentistry is no exception. Correct posture during clinical dental practice would prevent work related MSD, increase efficiency, and decrease stress and there by improve the quality of life. There are many challenges to maintain correct posture viz., optimum knowledge and practices regarding ergonomics, type, and duration the procedure, intermittent stretching between patients, number of patients treated, patient inflow, armamentarium, appropriate training in the curriculum etc. Optimum knowledge and best practices regarding ergonomics is very essential to maintain the posture during dental practice. Hence, we conducted an online survey among private dental practitioners to evaluate the postural requirements for clinical practice which has clinical relevance in terms of prevention of MSD.

Our survey showed that more than 1/3rd of private dental practitioners had excellent or optimum scores with respect to the knowledge of postural requirements. Substantial dental practitioners lacked knowledge on positioning of the operating light (Q8: 39%) which is a prerequisite for dental practice followed by head tilting position (Q3: 27%) and the angle between the lower and upper legs (Q1:22%). Similar trend of lack of knowledge was seen for Q1 and Q8 among dental students(Garbin et al., 2011). However, the overall knowledge to various postural requirements was much higher than previous study among dental students(Garbin et al., 2011). This difference could be due to the inclusion of experienced dental practitioners in our study.

There were no significant differences in the distribution of knowledge scores with respect to age, educational qualification, and CE. Previous research showed higher knowledge among specialists than general dental practitioners (Kalghatgi et al., 2014; Karibasappa & Rajeshwari, 2014). However, female dental practitioners had better knowledge than males, which was similar to previous studies(Alyahya et al., 2018; Vyas et al., 2014). El-Sallamy et al. showed no significant difference between male and female dental students(El-sallamy et al., 2018). Based on the findings of our research, there is a deficiency in the knowledge levels of postural requirements which exist irrespective of age, educational qualification, and CE of the dental practitioners which can be attributed due to the lack of inclusion of the same in the curriculum during training years.

Our study had limitations. It only evaluated the knowledge component of the postural requirements. It may not be necessary that optimum knowledge translates to good ergonomic postures during clinical dental practice. A previous study on dental students showed that knowledge was not entirely reflected. This could be due to the limited understanding of ergonomics, which creates a knowledge gap between theory and practice. Owing to the nature of the study (online survey), we could not evaluate the practice component of the same during chairside treatment. Knowledge of these ergonomic principles can be acquired at any stage, but the early installation of these principles during the training years can help maintain good posture and prevent the development of MSD among dental practitioners. Another limitation was that this study considered only those principles relevant to clinical dental practice with the dentist seated in the chair.

There are many additional tasks (like operator positions during radiography or film/sensor placement, use of a computer, and chair-side assistance) that require the adoption of ergonomic principles in the dental setting. Inclusion of these components needs exhaustive preparation and requires a lengthy questionnaire which may deter participation. Also, these additional components may or may not be practiced by all the dental practitioners. Future studies should focus on all the additional areas that require ergonomic posture in the dental setting. There is an urgent need for motivation and promoting of ergonomic principles for dental practitioners. Also, the application of ergonomic principles should not only be limited to the clinical dental practice but has to be extended to all routine daily activities to have a holistic approach to the prevention of the development of MSD.

Our survey showed that more than 1/3rd of private dental practitioners had excellent knowledge of postural requirements. There is an urgent need for motivation and promoting of ergonomic principles for dental practitioners.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics committee approval:

"Kasturba hospital and Kasturba Medical College institutional ethics committee (IEC: 263/2021)" approved the study protocol.

Author Contributions

Study Design: LM, , KCP, ATN; Data Collection: LM, AB, AC, AG, KCP, ATN; Statistical Analysis: KCP; Data Interpretation: KCP, ATN; Manuscript Preparation: LM, AB, AC, KCP; Final review and editing: KCP and ATN; Literature Search, KCP, ATN. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Alyahya, F., Algarzaie, K., Alsubeh, Y., & Khounganian, R. (2018). Awareness of ergonomics & work-related musculoskeletal disorders amongdental professionals and students in Riyadh, Saudi Arabia. *J Phys Ther Sci*, 30(6), 770. https://doi.org /10.1589/JPTS.30.770

Chenna, D., Pentapati, K. C., Kumar, M., Madi, M., & Siddiq, H. (2022). Prevalence of musculoskeletal disorders among dental healthcare providers: A systematic review and meta-analysis. *F1000Research* 2022 11:1062, 11, 1062. https://doi.org/10.12688 /f1000research.124904.1

Chikte, U. M., Khondowe, O., Louw, Q., & Musekiwa, A. (2011). A meta analysis of the prevalence of spinal pain among dentists. In *SADJ : journal of the South African Dental Association* (Vol. 66, Issue 5, pp. 214–218).

DCI. (2007). Dental Councıl of Indıa BDS course regulatıons 2007 *Dental Councıl of Indıa*.

Diaz-Caballero, A., Gomez-Palencia, I., & Diaz-Cardenas, S. (2010). Ergonomic factors that cause the presence of pain muscle in students of dentistry. *Med Oral Patol Oral Cir Bucal* 15(6), e906–e911. https://doi.org/10.4317 /medoral.15.e906

El-sallamy, R. M., Atlam, S. A., Kabbash, I., El-fatah, S. A., & El-flaky, A. (2018). Knowledge, attitude, and practice towards ergonomics among undergraduates of Faculty of Dentistry, Tanta University, Egypt. *Environ Sci Pollut Res Int*, 25(31), 30793–30801. https://doi.org/10.1007/ s1135 6-017-8615-3

Galla, A., Chowdhry, A., Bagga, A., Moradia, L., Tadikonda, A., Pentapati, K., & Mysore, N.-K. (2022). Dental practitioners' knowledge, attitudes, and practices of ergonomics - a cross-sectional web-based survey. *Acta Bio-Medica : Atenei Parmensis,* 93(S2), e2022048. https://doi.org/10.23750/abm.v9 3iS2.12908

Garbin, A. J. ., Garbin, C. A. S., Diniz, D. G., & Yarid, S. D. (2011). Dental students' knowledge of ergonomic postural requirements and their application during clinical care. *Eur J Dent Educ*, 15(1), 31–35. https://doi.org/10.1111/J.1600-0579.2010.0 0629.X

Hayes, M. J., Cockrell, D., & Smith, D. R. (2009). A systematic review of musculoskeletal disorders among dental professionals. Int J Dent Hyg, 7(3): 159-165. https://doi.org/ 10.1111/j.1601-5037.2009.00395.x

Jadhav, H. C., Vishwakarma, P. Y., Dodamani, A. S., Kshirsagar, M. M., Dodamani, G. A., & Naik, R. G. (2018). Awareness Among Dentists Regarding Ergonomics in Dental

Practice: A Cross-sectional Survey. *J Oral Health Community Dent*, 12(3), 85–89. https://doi.org/10.5005/jp-journals-10062-0032

Kalghatgi, S., Prasad, K. V. V., Chhabra, K. G., Deolia, S., & Chhabra, C. (2014). Insights into ergonomics among dental professionals of a dental institute and private practitioners in Hubli-Dharwad twin cities, India. *Saf Health Work* 5(4), 181–185. https://doi.org/10.1016/j.shaw.2014.09.001

Karibasappa, G., & Rajeshwari, K. (2014). Dentists' Knowledge, Attitude and Behavior towards the Dental Ergonomics. *IOSR J Dent and Medical Sci*, 13(5), 86–89. https://doi.org/10.9790/0853-13528689

Ketkar, G. N., & Malaiappan, S. (2020). Knowledge Attitude and Practice of Ergonomics and Musculoskeletal Disorders as an Occupational Hazard among Periodontists in India – A Questionnaire Based Survey. *J Pharmaceutical Res Int*, 32(20), 162–183. https://doi.org/10.9734/jpri/2020/v32i2030739

Kumar, M., Mishra, G., Vaibhav, R., Priyadarshini, S., Simran, & Turagam, N. (2021). Assessment of knowledge about ergonomics and determining musculoskeletal disorders in dentists: An original research. *J Pharm Bioallied Sci* 13(5), S391–S394. https://doi.org/10.4103/jpbs.JPBS_591_20

Kumar, P. M., Sahitya, S., Penmetsa, G., Supraja, S., Kengadaran, S., & Chaitanya, A. (2020). Assessment of knowledge, attitude, and practice related to ergonomics among the students of three different dental schools in India: An original research. *J Edu Health Promotion*, 9(1), 266. https://doi.org/10.4103/jehp.jehp_208_20

Leggat, P. A., Kedjarune, U., & Smith, D. R. (2007). Occupational health problems in modern dentistry: A review. In Industrial Health (Vol. 45, Issue 5, pp. 611–621). *Ind Health*.https://doi.org/10.2486/indhealth.45.611

Nayakar, R., Joshi, D., & Patil, A. K. (2020). Knowledge, Awareness, and Practices about Ergonomics among Dental Postgraduate Students -A Cross Sectional Study. *Int J Scientific Study*, 8(7), 35–40.

Puriene, A., Janulyte, V., Musteikyte, M., & Bendinskaite, R. (2007). General health of dentists. Literature review. *Stomatologija*, 9(1), 10–20.

Vyas, K., Parihaar, L., Rajoria, K., Arora, J., Pandit, A., & Singh, J. (2014). Knowledge, Attitude and Behavior towards "ERGONOMICS" among Oral Health Professionals in Jodhpur city, Rajasthan, India. *Int J Prev Clin Den Res*, 1(3), 5–9.

Yousef, M., & Al-Zain, A. (2009). Posture Evaluation of Dental Students. *J King Abdulaziz Uni Med Sci*, 16(2), 51–68. https://doi.org/10.4197/med.16-2.5

ZakerJafari, H. R., & YektaKooshali, M. H. (2018). Work-Related Musculoskeletal Disorders in Iranian Dentists: A Systematic Review and Meta-analysis. *Saf Health Work*, 9(1), 1–9. https://doi.org/10.1016/j.shaw.2017.06.006

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

RESEARCH ARTICLE

Comparison of the Effects of Self-Myofascial Release and Combined Core Stabilization Exercises in Physiotherapy and Rehabilitation Students with Non-Specific Low Back Pain

Ufuk DOĞANCALI[1], Elif Tuğçe ÇİL[2*] and Feryal SUBAŞI[3]

[1,2,3]Yeditepe University, Department of Physical Therapy and Rehabilitation, Istanbul, Turkey
*Corresponding author: elif.cil@yeditepe.edu.tr

Abstract
Objectives: To compare the efficacy of two treatment protocols, core stability exercises combined with the self-myofascial release and only the self-myofascial release on physiotherapy and rehabilitation students sufferin from non-specific low back pain in terms of functional capability and pain. Study Design: Randomized Clinical Trial**.** Methods: 28 (18 females, 10 males) physiotherapy students whose activity VAS was equal or more than 6 (mean age, 26.78 ± 3.66 years) were randomly allocated to 1 of 2 groups. Group 1 received SMFR combined with core exercises while Group 2 received only SMFR. The duration of the study was 5 weeks and each protocol was performed 2 times per week. Evaluations were undertaken in the 1st, 3rd and 5th weeks. Functional capacity was evaluated with Oswestry Scale (ODI), while the pain was measured with the Visual Analogue Scale (VAS). Results: VAS, total ODI and its sub-groups decreased statistically significantly in both groups ($p<0.05$). Statistically significant decreases between groups have been found regarding VAS, total ODI and sub-ODI scores (pain intensity, lifting, walking, sitting, and standing) ($p<0.05$). Conclusions: The self-myofascial release has a clinical effect in reducing pain, and improving function. We may conclude that self-myofascial release combined with core stability exercises seems to be more effective on pain and functional capacity.

Keywords
Self Myofascial Release, Core exercises, Low Back Pain, Functional Status

INTRODUCTION

Low back pain (LBP) is one of the most frequent musculoskeletal problems all around the world. LBP has a variety of categories, but the most common form is non-specific low back pain (NSLBP) (O'Sullivan, 2005). Since NSLBP might affect nearly all ages, this could create several socioeconomic problems in countries (Golob AL and Wipf JE, 2014). According to recent studies, it has been demonstrated that 35 to 50 % of people have NSLBP persisting for more than twelve months (Janwantanakul et al., 2008; Ayanniyi et al.,2010). Recent studies showed that the annual prevalence of NSLBP is found to be 15% to 45% and its point prevalence is approximately %30 (Juul-Kristensen et al., 2004; Sitthipornvorakul et al., 2015). This painful disorder could be caused by mainly traumatic injuries, postural problems, and lumbar-region-based strains. (Allegri et al., 2016) Regarding the risk factors for NSLBP, there are two categories, which are individual and psychosocial. Individual factors are age, gender, fitness level, biomechanical changes, and fascial problems, whereas environmental factors are

Received: 28 December.2022 ; **Accepted:** 08 February 2023; **Published:** 28 February 2023
[1]**ORCID:** 0000-0002-6192-0850 , [2]**ORCID:** 0000-0001-8231-115X , [3]**ORCID:** 0000-0003-0723-0186

How to cite this article: Doğancalı, U., Çil, T.E., Subaşı, F. (2023). Comparison of the Effects of Self-Myofascial Release and Combined Core Stabilization Exercises in Physiotherapy and Rehabilitation Students with Non-Specific Low Back Pain. *Int J Disabil Sports Health Sci*;6(1):24-37 https://doi.org/10.33438/ijdshs.1224969

psychological health, economic status, and posture (Hoy et al., 2014).

Among risk factors, poor posture and lack of exercise could be the most predisposing components for NSLBP (Lizier et al., 2012). The posture in a sitting position may lead to increased mechanical stress on the spine and may have an increased static load on the ligaments of the lumbar spine (Akkarakittichoke et al., 2017; Anggiat et al., 2018). Therefore, viscoelastic deformations on fascia (myofascial adhesions) could occur, thus leading to spasms of paraspinal muscles that could trigger metabolic reactions (Plaut, 2022). This accelerates disc degeneration and possibly disc herniation (Beach et al., 2005). Also, during the sustained sitting posture, the amount of lumbar lordosis could decrease and the posterior pelvic tilt may increase, thus possibly leading to the occurrence of pain (Kett et al., 2021). In addition, it has been suggested in studies that individuals, who do not perform exercise sufficiently could be more prone to develop muscle strain, spasms, intervertebral disc injuries, and eventually LBP because the deeply-localized stabilizer muscles could weaken and cannot maintain an optimal stabilization of trunk (Teichtahl et al., 2015; Citko A et al., 2018). A study showed that NSLBP could highly affect certain occupations that necessitate the sitting posture for long periods, such as office workers and university students (Bontrup et al., 2019, Anggiat et al., 2020). Another study also suggested that university students could be more prone to develop such problems because they tend to spend time sitting at the computer and their daily routine lacks regular exercise (Morais et al., 2018). Therefore, like other populations, they develop some postural changes and become more susceptible to pain, myofascial injuries, and loss of functional capacity (FC) (Manchikanti et al., 2014). In the management of LBP, there are several evidence-based effective healing options, namely pharmacological treatments, and physiotherapeutic approaches such as electrotherapy, kinesiotaping, exercises, and manual therapy (Almeida M et al., 2018).

Myofascial release (MFR) is one of the applications of manual therapy and is performed by a physiotherapist or patient himself with a foam roller (Self Myofascial Release) (Barnes, 1997). John F. Barnes stated that MFR is based on the release of all tensions and painful points, and the main goal is to relieve the pain by eliminating the fascia problems associated with mobility (Barnes, 1997). Also, Myers has defined several myofascial meridians (a group of muscles) (Myers TW, 2013). Those meridians are quite fundamental because when one of the muscles found in those chains is injured, it could directly affect other muscle groups located on the corresponding meridian, leading to LBP via tensegretive properties of the fascia (Myers TW, 2013). Therefore, MFR is applied to those meridians to eliminate fascial problems effectively. Moreover, recently conducted studies have suggested that MFR could be quite effective in the management of NSLBP (Cheatham et al., 2015; Wu, Z et al., 2021).

Among exercise procedures, Core stabilization is one of the most recommended techniques to manage the symptoms of NSLBP (Wang et al., 2012). Core stabilization is made up of passive, active, and neural systems. Those muscles are divided into global and core muscles (Panjabi and M. M., 1992). Global muscles provide general stabilization, while core muscles provide segmental stabilization (Gibbons et al., 2001). Global muscles are erector spinae, and abdominal muscles, while core muscles are multifidus, deep rotators, and intertranversarii muscles. With those exercises, they can be strengthened (Gibbons et al., 2001). The basic framework of the core is formed by four elements, namely the pelvic floor muscles, transversus abdominis, paraspinal muscles, and diaphragm (Akuthota V et al., 2008). A study suggested that patients with NSLBP could have delayed activation of Transversus abdominis during movements, hence leading to an insufficient stabilization of the trunk (Hodges et al., 1996). Hides has stated that individuals with LBP are more likely to have poor contraction of multifidus muscles (Hides et al., 2011). It has been suggested that when there is a diminished activation of core muscles, there is an increased burden on the surrounding structures and less control during gait or other movements, resulting in possibly LBP (Hodges et al., 1996; Hides et al., 2011). According to the study by Granacher, this method could allow the back muscles to gain the appropriate strength (Granacher et al., 2014). A systematic review has proposed that core exercises could be effective in decreasing pain compared to normal home exercises, thus increasing FC (Frizziero et al., 2015). According to recent

studies, core exercises could have beneficial effects on patients with NSLBP regarding pain and FC, increasing the activation of the aforementioned muscle groups (Ajimsha et al., 2014; Ozsoy et al., 2019). MFR protocol has been recommended with the combination of other manual therapy methods, occupational therapy, and core exercises (Ozsoy et al., 2019). Nevertheless, MFR combined with core exercise protocols has become quite prominent recently and studies had different protocols for comparison of the effectiveness of those interventions, such as „Core exercise versus MFR“ or „MFR combined core exercises versus core exercises alone“ (Meltzer et al., 2017). According to the recent systematic review, both MFR and MFR combined with other interventions seem to be effective in the management of NSLBP, yet there is no consensus between studies regarding MFR protocols, myofascial meridians, and study duration (Akhtar et al., 2017; Majeed A et al., 2019). To our best knowledge, there is no study conducted for the comparison of the effectiveness of SMFR combined with core exercises and SMFR alone on patients with NSLBP regarding pain intensity and FC.

The purpose of this study was to compare the effectiveness of two treatment protocols, which are core stability exercises combined with SMFR and only SMFR. Thus, we aim to compare the effects of both protocols on FC and pain.

MATERIALS AND METHODS

Study design and blinding

This study was randomized and controlled and performed with 32 physiotherapy and rehabilitation students aged 18-30, suffering from NSLBP.University's Ethics Committee approved the study protocol with reference number 202109095. All participants gave their written informed consent, and our study was carried out following the Helsinki Declaration. Due to the pandemic, this study took place online. The randomization was based on the paper selection. Since this was an online study, we selected one paper for each participant. Participants numbered 1 to 16 were selected for the self-myofascial release group combined with core exercises (G1), while participants numbered 17 to 32 were assigned to the self-myofascial release group (G2) only. In group G1, we introduced to our participants both core exercises followed by self-myofascial release exercises; while in G2, patients received only self-myofascial release exercises. At pre-intervention, mid-intervention (3rd week), and post-intervention (at the end of the 5th week) all participants were assessed. Because of our study protocol, we could not perform blinding in this study. The same physiotherapist was in charge of each session.

Participants

Out of 40 volunteers suffering from NSLBP at the beginning, 8 participants were excluded for several reasons. Out of 8 students, 4 participants did not meet the inclusion criteria because they had rheumatismal diseases and scoliosis. The resting 3 students refused to participate in our study for personal reasons. The remaining thirty-two were randomly divided into two groups. (SMFR combined with core exercises group (G1), n=16; and the SMFR group (G2), n=16). However, two participants in the SMFR combined with the core exercises group and two participants in the SMFR group dropped out of the study owing to the pandemic Covid-19.

Thirty-two physical therapy and rehabilitation students from Yeditepe University between the ages of 18 and 35 participated (Average age-Gender; 26, 78 ± 3, 66; F/M: 18/10) in our study. Inclusion criteria were (1) being between in ages of 18-35, (2) being a physiotherapy and rehabilitation student at Yeditepe University, (3) having non-specific low back pain prolonging more than 6 months, (4) having an activity VAS score of more than 6 for pain, and (5) having neither orthopaedic nor neurological problems. Exclusion criteria were (1) the presence of the musculoskeletal condition in 2 months, (2) neurological or vestibular diseases, (3) osteopenia or Osteoporosis, radiculopathy, (4) spondylolysis, (5) scoliosis, (6) rheumatismal or myopathic diseases, (7) taking medications that may affect the balance or the locomotor system, (8) having a history of surgery carried out in the spinal cord and low back area, (9) ongoing inflammation in the body, (10) surgery in 6 months, and (11) pregnancy.

Interventions

The first group received both core stabilization exercises and self-myofascial release techniques, while the second group received only self-myofascial release techniques. During warm-up and cool-down, the participants in G1

performed light jogging, high knee, and modified jumping jack.

Core Stabilization Exercise

The core is made up of many different muscle groups, which are paraspinal muscles, diaphragm, pelvic floor muscles, and abdominal muscles. They are capable of maintaining stability in our body, allowing our distal limbs to move comfortably and freely. When they become weak, we become more prone to developing pain in our spine. It is very important to engage our core muscles efficiently to reduce the risk of injury and optimize stability (Cook et al., 2006; Hibbs et al., 2008). Core stability exercises were introduced to our first group in the study. The main purpose was to strengthen these muscles. In this way, we can eliminate the pain and reduce the risk of recurrence of low back pain. The exercises can be classified into three difficulties, easy, medium, and difficult. If a participant performs the current exercise easily and we increased the difficulty, by moving on to the next movement.

In the first week, participants from G1 performed abdominal draw-in exercises (10x2), supine twist (6x2), plank (10 seconds-1min x 2), side plank (10 seconds-1min x 2), cat stretches (5 times), press-ups (6x2), quadruped opposite arm-leg (8 times for each side) and bridge (10 x2). Gradually, in the second week, we added several other exercises, which are dead bug (8x2), prone cobra (10x1), and semi-curl-up (10x2). Also, the duration of plank and side planks has been step by step increased up to 1 minute. Between the 3rd and 5th weeks, lunge (8 x2), seated Russian twist (8 x2) and supine single leg butt lift (10 x 5-7 seconds for each side) exercises were introduced to our participants.

Self-Myofascial Release (SMFR)

In this study, each participant got a foam roller and a small tennis ball to perform self-myofascial release at home. The foam roller is a popular piece of equipment for self-myofascial release. This tool can apply a sufficient amount of pressure on soft tissues. These tense areas can relax, decreasing pain. We used a standard foam roller (6 ×36 inches) (Beardsley and Škarabot, 2015).

The muscles applied and their durations in the following;

• The self-myofascial release of quadratus lumborum (30-sec x 3 times) with 1 min rest interval

• The self-myofascial release of the thoracolumbar fascia and paravertebral muscles (40 seconds x 3 times) with 1 min rest interval (T12 -L1)

• The self-myofascial release of the psoas muscle (30 seconds x 3 times) with 1 min rest interval

• The self-myofascial release of piriformis muscle +gluteals (30 seconds x 3 times) with 1 min rest interval

Assessments

Before all interventions, all participants filled socio-demographic questionnaire so that we could determine the suitable population for our study. In the study, we measured pain intensity with the Visual Analogue Scale (VAS) and functional capacity with Oswestry Disability Index (ODI). Evaluations have been performed at pre-intervention, mid-intervention (3rd week), and post-intervention (5th week).

Demographic data form

The socio-demographic questionnaire was used to collect personal information about each participant. In the first part, age, gender, occupation, income level, marital status, and education level were recorded. In the second part, the questions are mainly related to health. In particular, these include smoking and alcohol habits, use of medication, activity level, and chronic diseases.

Visual analogue scale (VAS)

The Visual Analogue Scale is an instrument used to determine the degree of pain. We can evaluate the intensity of symptoms. On this scale, there are numbers from 0 to 10. 0 means no pain, while 10 stands for unbearable pain. 5 represents moderate pain. Numbers from 5 to 10 represent severe pain. Numbers from 0 to 5 represent mild pain. In our study, VAS has been measured two times in the first week to show sudden effects. VAS is also divided into 2 parts, activity VAS and resting VAS (Aun C et al., 1986).

Oswestry Disability Index (OID)

The OID is one of the most popular tools for determining the level of function in patients with low back pain. This questionnaire consists of ten different parts, namely pain intensity, self-care, carrying heavy objects, walking, sitting, standing, sleeping, social life, travelling, and degree of change in pain. Each question contains six different answers representing an increasing worsening of symptoms from 1 to 6. In other words, 1 represents no disability, while 6 represents maximum disability. When the patient

has answered all the questions, the total score is added. Then the total score is divided by the worst maximum score and multiplied by one hundred. 0-20% represents minimal disability. 20-40% stands for mild disability. 40-60% stands for severe disability. 60-80% stands for very severe disability and finally, 80-100% means the patient may be disabled and bedridden. In our study, in addition to the total ODI score, we have shown the change in each sub-ODI score. Also, we demonstrated the distribution of total ODI in groups according to the severity level of disability at different weeks (Fairbank et al., 1980).

RESULTS

The participant's characteristics are shown in Table 1. No relevant differences were found at the baseline (p>0.05, Table 1).

Table 1. Socio-demographic Features of University Students

	G1 (n= 14) Mean ± SD	G2 (n= 14) Mean ± SD	F	P value
Age (year)	25.92 ± 3.26	27.64 ± 4.06	1.510	.741
Weight (kg)	71.78 ± 16.59	64.00 ± 11.63	2.066	.260
Height (cm)	170.50 ± 7.61	170.64 ± 7.24	0.003	.960
BMI (kg/m$^{2)}$	24.62 ± 4.97	21.88 ± 2.82	3.217	.085

*: Mann-Whitney U Test, G1: Core stabilization exercises combined with SMFR, G2: self-myofascial release group, BMI. Body Mass Index, kg: kilogram, cm: centimeter, kg/m^2: kilogram/meter^2

All sudden (T_{0-1}) activity and rest VAS pre-post measurements (pre-study and the end of 1st week) in both groups were not statistically significant (p>0.05, Table 2), except the increase in the rest VAS of G1 (p=.046, Table 2). Statistically significant decreases in all activity and rest VAS between pre-post (T0-3), pre-mid (T_{0-2}) and mid-post (T_{2-3}) measurements were observed in both groups (p<0.05, Table 2), except the rest VAS between pre-mid (T_{0-2}) measurements in G2.

Table 2. Intragroup comparison of activity-rest VAS of groups

		G1 (n= 14) Mean ± SD	z	p value	G2 (n= 14) Mean ± SD	z	P value
A-VAS	**T0**	6.42 ± 0.64	-0.577	.564	6.14 ± 0.36	-1.000	.317
	T1	6.50 ± 0.75			6.21 ± 0.42		
	T0	6.42 ± 0.64			6.14 ± 0.36		
	T2	4.42 ± 0.93	-3.373	**<0.001**	5.50 ± 0.94	-2.264	**.024**
	T2	4.42 ± 0.93			5.50 ± 0.94		
	T3	2.92 ± 0.99	-3.126	**.002**	5.14 ± 1.09	-2.236	**.025**
	T0	6.42 ± 0.64			6.14 ± 0.36		
	T3	2.92 ± 0.99	-3.384	**<0.001**	5.14 ± 1.09	-2.274	**.008**
R-VAS	**T0**	4.42 ± 2.20	-2.000	**.046**	3.85 ± 1.87	0.000	
	T1	4.71 ± 2.43			3.85 ± 1.87		1
	T0	4.42 ± 2.20			3.85 ± 1.87		
	T2	3.07 ± 1.94	-3.126	**.002**	3.57 ± 1.60	-1.027	.305
	T2	3.07 ± 1.94			3.57 ± 1.60		
	T3	1.85 ± 1.65	-3.064	**.002**	3.00 ± 1.75	-2.828	**.005**
	T0	4.42 ± 2.20			3.85 ± 1.87		
	T3	1.85 ± 1.65	-3.316	**<0.001**	3.00 ± 1.75	-2.144	**.032**

*: Wilcoxon Test; Data expressed as mean ± standard deviation. T0: pre-intervention measurement, T1: measurement in 1st week, T2: mid-measurement at 3rd week, T3: post-intervention measurement, A-VAS: Activity visual analogue scale, R-VAS: Resting Visual Analogue Scale, G1: Core stabilization exercises combined with SMFR, G2: self-myofascial release group

Table 3. Intragroup comparison of total and each oswestry disability index subscores of groups at different intervals

		G1 (n= 14) Mean ± SD	Z P value	G2 (n= 14) Mean ± SD	Z P value
Pain Intensity	**T0**	2.42 ± 0.75	-3.207	1.85 ± 0.86	-0.447
	T2	1.57 ± 0.85	**.001**	1.78 ± 0.97	.655
	T2	1.57 ± 0.85	-3.071	1.78 ± 0.97	-2.449
	T3	0.57 ± 0.75	**.002**	1.35 ± 0.92	**.014**
	T0	2.42 ± 0.75	-3.442	1.85 ± 0.86	-2.646
	T3	0.57 ± 0.75	**<0.001**	1.35 ± 0.92	**.008**
Self-Care	**T0**	1.21 ± 0.97	-2.121	1.07 ± 0.91	-1.414
	T2	0.78 ± 0.69	**.034**	0.92 ± 0.82	.157
	T2	0.78 ± 0.69	-2.449	0.92 ± 0.82	-2.828
	T3	0.35 ± 0.49	**.014**	0.35 ± 0.63	**.005**
	T0	1.21 ± 0.97	-2.762	1.07 ± 0.91	-2.887
	T3	0.35 ± 0.49	**.006**	0.35 ± 0.63	**.004**
Lifting	**T0**	1.85 ± 0.94	-2646	1.64 ± 1.15	-1.732
	T2	1.35 ± 0.74	**.008**	1.42 ± 1.15	.083
	T2	1.35 ± 0.74	-2.333	1.42 ± 1.15	-1.633
	T3	0.85 ± 0.77	**.020**	1.14 ± 0.94	.102
	T0	1.85 ± 0.94	-3.071	1.64 ± 1.15	-2.333
	T3	0.85 ± 0.77	**.002**	1.14 ± 0.94	**.020**
Walking	**T0**	1.71 ± 0.72	-2.588	0.92 ± 0.82	-0.577
	T2	0.85 ± 0.77	**.010**	0.85 ± 0.86	.564
	T2	0.85 ± 0.77	-2.000	0.85 ± 0.86	-1.000
	T3	0.57 ± 0.75	**.046**	0.71 ± 0.82	.317
	T0	1.71 ± 0.72	-2.859	0.92 ± 0.82	-1.342
	T3	0.57 ± 0.75	**.004**	0.71 ± 0.82	.180
Sitting	**T0**	1.64 ± 0.74	-2.333	1.42 ± 0.75	-1.732
	T2	1.14 ± 0.36	**.020**	1.21 ± 0.69	.083
	T2	1.14 ± 0.36	-2.646	1.21 ± 0.69	-1.414
	T3	0.64 ± 0.63	**.008**	1.07 ± 0.82	.157
	T0	1.64 ± 0.74	-3.125	1.42 ± 0.75	-2.236
	T3	0.64 ± 0.63	**.002**	1.07 ± 0.82	**.025**
Standing	**T0**	2.14 ± 0.77	-2.530	1.50 ± 0.85	-1.414
	T2	1.50 ± 0.65	**.011**	1.35 ± 0.84	.157
	T2	1.50 ± 0.65	-2.646	1.35 ± 0.84	-2.000
	T3	1.00 ± 0.55	**.008**	1.07 ± 0.82	**.046**
	T0	2.14 ± 0.77	-3.066	1.50 ± 0.85	-2.449
	T3	1.00 ± 0.55	**.002**	1.07 ± 0.82	**.014**

Table 3. Continue

	T0	0.78 ± 0.89	-2.499	1.00 ± 0.87	-2.236
	T2	0.35 ± 0.74	**.014**	0.64 ± 0.92	**.025**
Sleeping	**T2**	0.35 ± 0.74	-1.342	0.64 ± 0.92	-1.414
	T3	0.14 ± 0.36	.180	0.50 ± 0.85	.157
	T0	0.78 ± 0.89	-2.530	1.00 ± 0.87	-2.333
	T3	0.14 ± 0.36	**.011**	0.50 ± 0.85	**.020**
	T0	1.28 ± 0.61	-1.857	0.85 ± 0.66	0
	T2	0.85 ± 0.66	.063	0.85 ± 0.77	1
Social Life	**T2**	0.85 ± 0.66	-1,732	0.85 ± 0.77	-1.414
	T3	0.64 ± 0.74	.083	0.71 ± 0.72	.157
	T0	1.28 ± 0.61	-2.251	0.85 ± 0.66	-1.414
	T3	0.64 ± 0.74	**.024**	0.71 ± 0.72	.157
	T0	1.71 ± 0.61	-2.714	1.28 ± 0.72	-2.236
	T2	1.07 ± 0.26	**.007**	0.92 ± 0.73	**.025**
	T2	1.07 ± 0.26	-2.000	0.92 ± 0.73	-2.000
Travelling	**T3**	0.78 ± 0.57	**.046**	0.64 ± 0.63	**.046**
	T0	1.71 ± 0.61	-2.919	1.28 ± 0.72	-3.000
	T3	0.78 ± 0.57	**.004**	0.64 ± 0.63	**.003**
	T0	2.21 ± 1.12	-2,588	1.71 ± 0.91	-2.449
	T2	1.35 ± 0.92	**.010**	1.28 ± 0.91	**.014**
Degree of change in pain	**T2**	1.35 ± 0.92	-2.530	1.28 ± 0.91	-2.449
	T3	0.78 ± 0.57	**.011**	0.85 ± 0.86	**.014**
	T0	2.21 ± 1.12	-3.133	1.71 ± 0.91	-2.972
	T3	0.78 ± 0.57	**.002**	0.85 ± 0.86	**.003**
	T0	16.64 ± 3.62	-3.304	13.28 ± 6.21	-2.728
	T2	10.57 ± 2.65	**<0.001**	11.14 ± 5.70	**.006**
Total Oswestry scores	**T2**	10.57 ± 2.65	-3.309	11.14 ± 5.70	-2.862
	T3	6.28 ± 3.04	**<0.001**	8.42 ± 5.37	**.004**
	T0	16.64 ± 3.62	-3.309	13.28 ± 6.21	-3.301
	T3	6.28 ± 3.04	**<0.001**	8.42 ± 5.37	**<0.001**

*: Wilcoxon Test, T0: pre-intervention measurement, T2: mid-measurement at 3rd week, T3: post-intervention measurement, G1: Core stabilization exercises combined with SMFR, G2: self-myofascial release group,

In terms of intragroup results for measurements between pre-mid study, all sub-ODI scores in G1 decreased statistically significantly, except social life, while only sleeping, travelling, degree of change in pain and total ODI decreased statistically significantly in G2 ($p<0.05$, Table 3). Regarding the mid-post measurements, all subgroups diminished statistically significantly in the SMFR combined with core exercises group, except sleeping and social life, whereas all scores decreased in the SMFR group, but improvements in pain intensity, self-care, standing and total ODI were statistically significant ($p<0.05$, Table 3). As for the pre-post measurements, all sub-groups of ODI have diminished statistically significantly in G1 ($p<0.05$, Table 3). However, all subgroups except walking and social life decreased statistically significantly in G2 ($p<0.05$, Table 3).

Regarding the intergroup differences, a statistically significant increase in sudden rest VAS was observed ($p=.034$, Table 4). Similarly, statistically significant decreases in all activity and rest VAS regarding pre-post, and pre-mid measurements between groups were observed ($p<0.05$, Table 4), except the score obtained between mid-post measurements.

Regarding the intergroup results of ODI for pre-mid measurements, only the decreases in pain intensity, lifting, walking, standing, and total ODI were found statistically significant ($p<0.05$, Table 5). As for the mid-post measurements, we have obtained statistically significant improvements in pain intensity, sitting and total ODI ($p<0.05$, Table 5). In terms of the pre-post measurements, statistically significant improvements in pain intensity, walking, sitting, standing and total ODI were observed ($p<0.05$, Table 5).

Table 4 Intergroup comparison of activity-rest VAS of groups

		G1 (n= 14) Mean ± SD	G2 (n= 14) Mean ± SD	z	P value
Δ A-VAS	T_{0-1}	0.14 ± 0.36	0.07 ± 0.26	-0.600	.549
	T_{0-2}	-2.00 ± 0.67	-0.64 ± 0.92	-3.462	**<0.001**
	T_{2-3}	-1.50 ± 1.01	-0.35 ± 0.49	-3.248	**.001**
	T_{0-3}	-3.07 ± 1.85	-1.00 ± 1.03	-3.636	**<0.001**
Δ R-VAS	T_{0-1}	0.28 ± 0.46	0.00 ± 0.00	-2.121	**.034**
	T_{0-2}	-1.35 ± 0.84	-0.28 ± 0.99	-2.726	**.006**
	T_{2-3}	-1.21 ± 1.12	-0.57 ± 0.51	-1.716	.086
	T_{0-3}	-2.57 ± 1.22	-0.85 ± 1.23	-3.202	**.001**

*: Mann-Whitney U Test, Δ: Difference, T0-1: the difference between pre-intervention and measurement in the 1st week,T0-2: the difference between pre-mid measurements (weeks 1-3), T2-3: the difference between mid-post measurements (weeks 3-5), T0-3: the difference between pre-post measurement (weeks 1-5), A-VAS: Activity visual analogue scale, R-VAS: Resting Visual Analogue Scale, G1: Core stabilization exercises combined with SMFR, G2: self-myofascial release group

Table 5. Intergroup comparison of each oswestry disability index subscores of group at different week intervals

		G1 (n= 14) Mean ± SD	G2 (n= 14) Mean ± SD	Z	P value
Δ Pain intensity	T_{0-2}	-0.85 ± 0.53	-0.07 ± 0.61	-3.066	**.004**
	T_{2-3}	-1.00 ± 0.67	-0.42 ± 0.51	-2.241	**.044**
	T_{0-3}	-1.85 ± 0.53	-0.50 ± 0.51	-4.251	**<0.001**
Δ Self-care	T_{0-2}	-0.42 ± 0.64	-0.14 ± 0.36	-1.340	.180
	T_{2-3}	-0.42 ± 0.51	-0.57 ± 0.51	-0.742	.458
	T_{0-3}	-0.78 ± 0.80	-0.71 ± 0.61	-0.126	.900
Δ Lifting	T_{0-2}	-0.50 ± 0.51	-0.22 ± 0.47	-2.111	**.035**
	T_{2-3}	-0.50 ± 0.65	-0.28 ± 0.61	-1.093	.275
	T_{0-3}	-1.00 ± 0.67	-0.50 ± 0.65	-1.933	.053
Δ Walking	T_{0-2}	-0.85 ± 0.94	-0.71 ± 0.47	-2.528	**.011**
	T_{2-3}	-0.28 ± 0.46	-0.00 ± 0.55	-1.394	.163
	T_{0-3}	-1.14 ± 0.94	-0.21 ± 0.57	-2.668	**.008**
Δ Sitting	T_{0-2}	-0.50 ± 0.65	-0.21 ± 0.42	-1.268	.205
	T_{2-3}	-0.50 ± 0.51	-0.14 ± 0.36	-1.987	**.047**
	T_{0-3}	-1.00 ± 0.78	-0.35 ± 0.49	-2.419	**.016**
Δ Standing	T_{0-2}	-0.64 ± 0.84	-0.14 ± 0.36	-2.028	**.043**
	T_{2-3}	-0.50 ± 0.51	-0.28 ± 0.46	-1.140	.254
	T_{0-3}	-1.14 ± 1.02	-0.42 ± 0.51	-2.239	**.025**
Δ Sleeping	T_{0-2}	-0.42 ± 0.51	-0.35 ± 0.49	-0.380	.704
	T_{2-3}	-0.21 ± 0.57	-0.14 ± 0.36	-0.076	.940
	T_{0-3}	-0.64 ± 0.84	-0.42 ± 0.51	-0.524	.600
Δ Social life	T_{0-2}	-0.42 ± 0.75	0.00 ± 0.39	-1.730	.084
	T_{2-3}	-0.21 ± 0.42	-0.14 ± 0.36	-0.485	.628
	T_{0-3}	-0.64 ± 0.84	-0.14 ± 0.36	-1.795	.073
Δ Travelling	T_{0-2}	-0.64 ± 0.63	-0.35 ± 0.49	-1.232	.218
	T_{2-3}	-0.28 ± 0.46	-0.28 ± 0.46	0.000	1
	T_{0-3}	-0.92 ± 0.73	-0.64 ± 0.49	-1.067	.286
Δ Degree of pain change	T_{0-2}	-0.85 ± 0.94	-0.42 ± 0.51	-1.171	.242
	T_{2-3}	-0.57 ± 0.64	-0.50 ± 0.51	-0.183	.855
	T_{0-3}	-1.42 ± 1.08	-0.85 ± 0.66	-1.461	.144
Δ Total Oswestry Score	T_{0-2}	-6.07 ± 3.38	-2.14 ± 2.31	-1.182	**<0.001**
	T_{2-3}	-4.28 ± 1.97	-2.71 ± 2.23	-0.190	**.030**
	T_{0-3}	-10.21± 4.40	-4.85 ± 3.20	-1.199	**.001**

*: Mann-Whitney U Test, T0: pre-intervention measurement, T2: mid-measurement at 3rd week, T3: post-intervention measurement, G1: Core stabilization exercises combined with SMFR, G2: self-myofascial release group,

In addition, we analyzed the correlation of the distribution of total ODI in groups according to the severity level of disability at different weeks (3rd, and 5th). However, we did not find any statistically significant correlations between the SMFR protocols and distribution of total ODI scores according to severity levels ($p>0.05$, Figure 1). The Distributions of total ODI scores in groups according to the severity level of disability changed as a percentage over 5 weeks. At post-intervention, G1 has a higher percentage (92, 9%) of minimal disability compared to G2 (7, 1%) Even though the percentage of participants with more severe ODI had higher in G1 at pre-intervention, the percentage of participants with a minimal disability was higher in G1 at post-intervention compared to G2 (Figure 1).

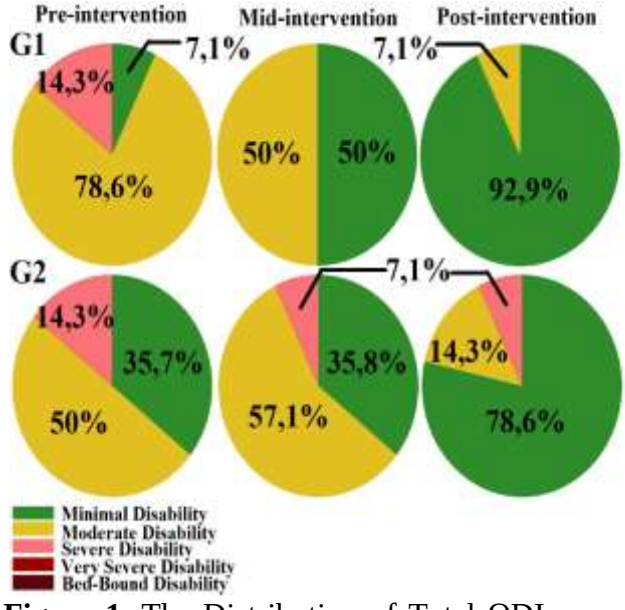

Figure 1. The Distribution of Total ODI score in groups according to the severity level of disability at different weeks

DISCUSSION

The outcome of this study is that core exercise combined with SMFR may have beter short and long-term improvements, in pain intensity and functional status in physiotherapy students with NSLBP than the alone SMFR protocol ($p<0.05$, Table 4 and 5).

Consistent with our hypothesis, we demonstrated that the core combined with SMFR was more effective to relieve pain and boost the functional status compared to the protocol without core exercises. Nevertheless, the core exercises with SMFR could have adverse effects on pain in the first week.

Özsoy et al compared MFR combined with core exercises and only core exercises for six weeks on 45 elderly with NSLBP for 6 weeks, 3 times. According to the results, the first group had significant improvements in core stability endurance ($p=0.031$) and spinal mobility ($p=0.022$) during the post-intervention. However, there were no significant improvements between groups for pain and functional status ($p>0.05$). Intragroup quality of life, lower back flexibility, pain intensity, and functional status results were significant in the post-intervention ($p<0.001$). They suggested that MFR combined with core exercises could be more beneficial for the elderly with NSLBP on pain and functional status (Ozsoy et al., 2019). In contrast to Özsoy, we mainly focused on university students with NSLBP. Also, the total duration was shorter, the frequency was lower and each session had the same duration as that of Özsoy. Despite our shorter sessions, we reached significant differences even at the end of 3rd week in each group and between groups in favour of core exercise combined with SMFR, regarding pain and functional status. Therefore, it may be concluded that the combined MFR protocols could be more effective regarding pain and functional status.

A randomized controlled study conducted by Ajimsha et al compared MFR and sham MFR on 80 nurses over 8 weeks, 3 times with chronic LBP, regarding pain and functional status. Group one received MFR, while Group two received sham MFR. Both received specific back exercises. The results showed that the MFR group had significant intra-and intergroup improvements in the eighth, and twelfth weeks for pain and functional status ($p< 0.005$) (Ajimsha et al., 2014). They suggested that MFR could have better effects on pain and functional status. In contrast, our total number of sessions was fewer. Our duration of exercise was higher, while our duration of MFR was shorter. Also, we measured functional status with ODI and each sub-score of ODI was evaluated separately and showed the distributions of severity levels, which is one of the unique properties of our study. Similarly, we could find significant results between the two groups in favour of core exercise combined with SMFR. Therefore, the representation of change in each sub-ODI score and distribution of severity levels weekly could

enhance our understanding of the evaluation of the functional status.

In another study, the effectiveness of MFR and sham MFR were investigated over twelve weeks on 45 participants with LBP. In contrast to Özsoy and Ajimsha, their protocols did not include core exercises. The first group received MFR and the second group received sham MFR twice a week for 2 weeks. MFR was applied on SBL, DFL, and LL. The measurements were made in pre-intervention, in the 2nd and the 12th weeks. The pain intensity was evaluated with the Short-Form McGill Pain Questionnaire (SFMPQ) and VAS, functional status was evaluated with Rolando Morris Questionnaire (RMQ). In the 2nd and 12th weeks, VAS and SFMPQ intragroup differences were significant in both groups ($p<0.01$). In the 12th week, they found significant improvements between groups regarding only SFMPQ ($p=0.04$). Also, in the 12th week, they found significant differences between groups regarding RMQ ($p=0.03$). (Arguisuelas et al., 2017). In 2019, Arguisuelas et al conducted the same protocol on fewer individuals with the flexion-relaxation phenomenon (FRP). They found similar results. Flexion-relaxation was significant between groups in the post-intervention, in favour of the MFR group ($p<0.05$). Those studies of Arguisuelas showed that MFR could have beneficial effects on the Flexion-relaxation phenomenon, functional status, and pain in patients with LBP (Arguisuelas et al., 2019). In contrast, we emphasized 4 myofascial lines and we used SMFR. Similarly, we could find significant improvements even in the 3rd week in and between groups regarding pain and functional status. We might deduce that the utilization of 4 myofascial chains could be more beneficial for patients with LBP.

Seong Yu et al investigated the effectiveness of core exercises and MFR on 40 elderly women regarding pain, flexibility, and balance. Each protocol was performed for 8 weeks (3 times). The first group performed core exercise program. The second group received an MFR of DFL. Participants were evaluated at the pre-and post-intervention. They evaluated pain intensity, balance, and flexibility. According to the results, they found significant intragroup improvements at the post-intervention, regarding pain and flexibility in the MFR group ($p<0.05$). Significant intragroup improvements were found regarding pain and balance in the ADIE group ($p<0.05$). No significant differences were found between groups in the eighth week ($p>0.05$). They concluded that MFR could have positive impacts on pain and flexibility in elderly women, whereas core exercises could benefit more pain and balance (Yu, S. et al., 2016). In contrast, we showed both the short and long-term effects of different SMFR protocols on pain and functional status. Our study had a shorter duration and fewer sessions. Nevertheless, we found significant decreases in pain and improvements in the functional status between groups in the 3rd and 5th weeks in favour of core exercise combined with SMFR. This could be related to the difference in the study protocols. However, we measured neither the lumbar flexibility nor the balance. We could suggest that those parameters should be examined in future studies to assess the functional status efficiently.

In a recent study, the effectiveness of SMFR and Core (Lumbar Stabilization) Exercises (LSE) were evaluated over 6 weeks (3 times/week) on thirty patients with NSLBP. Group one received SMFR of SBL using a lacrosse ball and group two received core exercises. Measurements were done in the pre-and post-intervention using VAS, ODI, trigger point palpation, and ROM. VAS was divided into VAS activity and VAS at rest. According to the results, intragroup VAS activity, VAS at rest, ODI, and ROM in each group improved significantly in the post-intervention ($p<0.05$). They found significant improvements between groups in the post-intervention, in favour of the SMFR group regarding ROM right rotation, ROM left lateral flexion, and trigger point location ($p<0.05$). They concluded that both protocols seem to be effective regarding pain, functional status, and ROM. However, SMFR could be more beneficial for trigger points and Lumbar ROMs (Ling, L. Z. et al., 2022). Similarly, we measured VAS in 2 sections. In contrast, we also showed the acute effects of two protocols on both VAS scores. Regarding sessions, we had fewer sessions compared to this study. Fewer sessions notwithstanding, we demonstrated significant improvements between groups regarding pain and functional status. This could be related to the fact that we compared core exercise combined with SMFR and SMFR. Compared to this study, we demonstrated the distribution of the total ODI according to the severity levels in different weeks (mid-, and post-intervention). Even though we

could not find any significant correlation between ODI-intensity levels and the type of protocol in total ODI scores, it might be concluded that the demonstration of those distributions could provide a better chance of monitoring the change in the functional status.

To the best of our knowledge, there are no studies that compared the effectiveness of core exercises combined with SMFR and only SMFR regarding pain and functional capacity. Additionally, the functional status has always been examined using the total ODI or RMQ score without their sub-scores or distribution of ODI scores according to severity levels. Taking into consideration our results, we reported that the representation of each sub-ODI score and the distributions of total ODI scores according to severity levels in two groups might provide a better understanding of following the patient with LBP. In addition, previous studies focused on generally one or two myofascial meridians. No studies were conducted to include the combination of four myofascial meridians (SBL, BFL, DFL, and LL). As a result, it could be deduced that the utilization of those aforementioned four myofascial meridians together could be more effective in the management of LBP.

Our study has some limitations. We examined the five-week results regarding pain and functional capacity, but the follow-up effects remain unknown. The sample size could have been higher. Also, we could not include the measurements for Lumbar ROMs, lumbar flexibility, and depression, due to the pandemic situations. Furthermore, the absence of a blind assessor was another point that caused the bias.

In conclusion, core exercises combined with Self-Myofascial Release and only Self-Myofascial Release have been found effective in decreasing pain and improving the functional capacity in the 3rd and 5th weeks of students with NSLBP. Furthermore, core exercises combined with Self-Myofascial Release can be more effective for reducing pain and improving function.

Declaration of Conflicting Interests

All authors declare no conflicts of interest.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

Ethical Aspect of the Study

The Ethics Committee of Yeditepe University accepted the study protocol on October 19, 2021, under the number 202109095. We acquired written informed consent from all participants and our study was performed by adhering to the Helsinki Declaration.

Author Contributions

Study Design: ETÇ; Data Collection: UD, ETÇ, FS; Statistical Analysis: ETÇ; Data Interpretation: ETÇ, FS; Manuscript Preparation: ETÇ, UD, FS; Final review and editing: ETÇ and FS; Literature Search, ETÇ, UD, FS. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Ajimsha, M. S., Daniel, B., & Chithra, S. (2014). Effectiveness of myofascial release in the management of chronic low back pain in nursing professionals. *Journal of bodywork and movement therapies*, 18(2), 273-281.

Akhtar, M. W., Karimi, H., & Gilani, S. A. (2017). Effectiveness of core stabilization exercises and routine exercise therapy in management of pain in chronic non-specific low back pain: A randomized controlled clinical trial. *Pakistan journal of medical sciences*, 33(4), 1002.

Akkarakittichoke, N., & Janwantanakul, P. (2017). Seat Pressure Distribution Characteristics During 1 Hour Sitting in Office Workers With and Without Chronic Low Back Pain. *Safety and health at work*, 8(2), 212–219.

Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2008). Core stability exercise principles. *Current sports medicine reports*, 7(1), 39-44.

Allegri, M., Montella, S., Salici, F., Valente, A., Marchesini, M., Compagnone, C., & Fanelli, G. (2016). Mechanisms of low back pain: a guide for diagnosis and therapy. *F1000Research*, 28;5.

Almeida, M., Saragiotto, B., Richards, B., & Maher, C.G. (2018). Primary care management of non-specific low back pain: key messages from recent clinical guidelines. *Medical Journal of Australia*, 208(6), 272-275.

Anggiat, L., Hon, W. H. C., & Baait, S. N. (2018). The incidence of low back pain among

university students. Jurnal Pro-Life, 5(3), 677-687.

Anggiat, L., Hon, W. H. C., Sokran, S. N. B. B. M., & Mohammad, N. M. B. (2020). The changes of functional disability in non-specific low back pain among university population after proprioceptive neuromuscular facilitation and McKenzie method. *International Journal of Medical and Exercise Science*, 6(1), 656-667.

Arguisuelas, M. D., Lisón, J. F., Sánchez-Zuriaga, D., Martínez-Hurtado, I., & Doménech-Fernández, J. (2017). Effects of myofascial release in nonspecific chronic low back pain: a randomized clinical trial. *SPINE* 42(9):p 627-634.

Arguisuelas, M. D., Lison, J. F., Domenech-Fernandez, J., Martinez-Hurtado, I., Coloma, P. S., & Sanchez-Zuriaga, D. (2019). Effects of myofascial release in erector spinae myoelectric activity and lumbar spine kinematics in non-specific chronic low back pain: randomized controlled trial. *Clinical Biomechanics*, 63, 27-33.

Aun, C., Lam, Y. M., & Collett, B. (1986). Evaluation of the use of visual analogue scale in Chinese patients. *Pain*, 25(2), 215-221.

Ayanniyi, O., Ukpai, B. O., & Adeniyi, A. F. (2010). Differences in prevalence of self-reported musculoskeletal symptoms among computer and non-computer users in a Nigerian population: a cross-sectional study.*BMC musculoskeletal disorders*,*11*, 177.

Barnes, M. F. (1997). The basic science of myofascial release: morphologic change in connective tissue. *Journal of bodywork and movement therapies*, 1(4), 231-238.

Beach, T. A., Parkinson, R. J., Stothart, J. P., & Callaghan, J. P. (2005). Effects of prolonged sitting on the passive flexion stiffness of the in vivo lumbar spine. The spine journal: official journal of the *North American Spine Society*, 5(2), 145–154.

Beardsley, C., & Škarabot, J. (2015). Effects of self-myofascial release: a systematic review. *Journal of bodywork and movement therapies*, 19(4), 747-758.

Bontrup, C., Taylor, W. R., Fliesser, M., Visscher, R., Green, T., Wippert, P. M., & Zemp, R. (2019). Low back pain and its relationship with sitting behaviour among sedentary office workers. *Applied ergonomics*, 81, 102894.

Cheatham, S. W., Kolber, M. J., Cain, M., & Lee, M. (2015). The effects of self-myofascial release using a foam roll or roller massager on joint range of motion, muscle recovery, and performance: a systematic review. *International journal of sports physical therapy*, 10(6), 827.

Citko, A., Górski, S., Marcinowicz, L., & Górska, A. (2018). Sedentary Lifestyle and Nonspecific Low Back Pain in Medical Personnel in North-East Poland. *BioMed research international*, 2018, 1965807.

Cook, G., Burton, L., & Hoogenboom, B. (2006). Pre-participation screening: The use of fundamental movements as an assessment of function–Part 2. *North American journal of sports physical therapy: NAJSPT*, 1(3), 132.

Fairbank, J. C., Couper, J., Davies, J. B., & O'Brien, J. P. (1980). The Oswestry low back pain disability questionnaire. *Physiotherapy*, 66(8),271-273.

Frizziero, A., Pellizzon, G., Vittadini, F., Bigliardi, D., & Costantino, C. (2021). Efficacy of Core Stability in Non-Specific Chronic Low Back Pain. *Journal of functional morphology and kinesiology*, 6(2), 37.

Gibbons, S. G., & Comerford, M. J. (2001). Strength versus stability Part II. Limitations and Benefits, Orthopaedic Division Review.

Golob, A. L., & Wipf, J. E. (2014). Low back pain. *The Medical clinics of North America*, *98*(3), 405–428.

Granacher, U., Schellbach, J., Klein, K., Prieske, O., Baeyens, J. P., & Muehlbauer, T. (2014). Effects of core strength training using stable versus unstable surfaces on physical fitness in adolescents: a randomized controlled trial. *BMC sports science, medicine and rehabilitation*, 6(1), 1-11.

Hibbs, A. E., Thompson, K. G., French, D., Wrigley, A., & Spears, I. (2008). Optimizing performance by improving core stability and core strength. *Sports medicine*, 38(12), 995-1008.

Hides, J., Stanton, W., Mendis, M. D., & Sexton, M. (2011). The relationship of transversus abdominis and lumbar multifidus clinical muscle tests in patients with chronic low back pain. *Manual therapy*, 16(6), 573-577.

Hodges, P. W., & Richardson, C. A. (1996). Inefficient muscular stabilization of the lumbar spine associated with low back pain: a motor control evaluation of transversus abdominis. *Spine*, 21(22), 2640-2650.

Hoy, D., March, L., Brooks, P., Blyth, F., Woolf, A., Bain, C., Williams, G., Smith, E., Vos, T., Barendregt, J., Murray, C., Burstein, R., & Buchbinder, R. (2014). The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Annals of the rheumatic diseases*, 73(6), 968–974.

Janwantanakul, P., Pensri, P., Jiamjarasrangsri, V., & Sinsongsook, T. (2008). Prevalence of self-reported musculoskeletal symptoms among office workers. *Occupational medicine (Oxford, England)*, 58(6), 436–438.

Juul-Kristensen, B., Søgaard, K., Strøyer, J., & Jensen, C. (2004). Computer users' risk factors for developing shoulder, elbow and back symptoms. *Scandinavian journal of work, environment & health*, 30(5), 390–398.

Kett, A. R., Sichting, F., & Milani, T. L. (2021). The Effect of Sitting Posture and Postural Activity on Low Back Muscle Stiffness. *Biomechanics*, 1(2), 214–224.

Lauridsen, H. H., Hartvigsen, J., Manniche, C., Korsholm, L., & Grunnet-Nilsson, N. (2006). Responsiveness and minimal clinically important difference for pain and disability instruments in low back pain patients. *BMC musculoskeletal disorders*, 7(1), 1-16.

Ling, L. Z., Singh, K., Govind, S., & Wah, Y. C. (2022). Effect of Lumbar Stabilization Exercise and Myofascial Release Therapy in Non-specific Low Back Pain: A Randomized Controlled Trial. *Journal of Positive School Psychology*, 6(3), 4035-4046.

Lizier, D. T., Perez, M. V., & Sakata, R. K. (2012). Exercícios para tratamento de lombalgia inespecífica. *Revista Brasileira de Anestesiologia*, 62, 842-846.

Manchikanti, L., Singh, V., Falco, F. J., Benyamin, R. M., & Hirsch, J. A. (2014). Epidemiology of low back pain in adults. Neuromodulation: *Technology at the Neural Interface*, 17, 3-10.

Majeed A, S., TS, A., Sugunan, A., & MS, A. (2019). The effectiveness of a simplified core stabilization program (TRICCS—Trivandrum Community - based Core Stabilisation) for community - based intervention in chronic non-specific low back pain. *Journal of orthopaedic surgery and research*, 14(1), 1-8.

Meltzer, K. R., Cao, T. V., Schad, J. F., King, H., Stoll, S. T., & Standley, P. R. (2010). In vitro modeling of repetitive motion injury and myofascial release. *Journal of bodywork and movement therapies*, 14(2), 162-171.

Morais, M. L., Silva, V. K. O., & Silva, J. M. N. D. (2018). Prevalence of low back pain and associated factors among physiotherapy students. *BrJP*, 1, 241-247.

Myers, T. W. (2013). Anatomy trains e-book: myofascial meridians for manual and movement therapists. *Elsevier Health Sciences.*

O'Sullivan, P. (2005). Diagnosis and classification of chronic low back pain disorders: maladaptive movement and motor control impairments as underlying mechanism. *Manual therapy*, 10(4), 242-255.

Ozsoy, G., Ilcin, N., Ozsoy, I., Gurpinar, B., Buyukturan, O., Buyukturan, B. & Sas, S. (2019). The effects of myofascial release technique combined with core stabilization exercise in elderly with non-specific low back pain: a randomized controlled, single-blind study. *Clinical Interventions in Aging*, 14, 1729.

Panjabi, M. M. (1992). The stabilizing system of the spine. Part II. Neutral zone and instability hypothesis. *Journal of spinal disorders*, 5, 390-390.

Plaut, S. (2022). Scoping review and interpretation of myofascial pain/fibromyalgia syndrome: An attempt to assemble a medical puzzle. *PloS one*, 17(2), e0263087.

Sitthipornvorakul, E., Janwantanakul, P., & Lohsoonthorn, V. (2015). The effect of daily walking steps on preventing neck and low back pain in sedentary workers: a 1-year prospective cohort study. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society, 24(3), 417–424.

Teichtahl, A. J., Urquhart, D. M., Wang, Y., Wluka, A. E., O'Sullivan, R., Jones, G., & Cicuttini, F. M. (2015). Physical inactivity is

associated with narrower lumbar intervertebral discs, high fat content of paraspinal muscles and low back pain and disability. *Arthritis research & therapy*, 17(1), 114.

Wang, X. Q., Zheng, J. J., Yu, Z. W., Bi, X., Lou, S. J., Liu, J. & Chen, P. J. (2012). A meta-analysis of core stability exercise versus general exercise for chronic low back pain. *PloS one*, 7(12), e52082.

Wu, Z., Wang, Y., Ye, X., Chen, Z., Zhou, R., Ye, Z. & Xu, X. (2021). Myofascial release for chronic low back pain: A systematic review and meta-analysis. *Frontiers in medicine*, 8, 697986.

Yu, S. H., Sim, Y. H., Kim, M. H., Bang, J. H., Son, K. H., Kim, J. W., & Kim, H. J. (2016). The effect of abdominal drawing-in exercise and myofascial release on pain, flexibility, and balance of elderly females. *Journal of Physical Therapy Science*, 28(10), 2812-2815.

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

RESEARCH ARTICLE

Students' challenges and barriers in the completion of an undergraduate thesis in the case of a premier local college in the Philippines

Joseph Lobo [1*]

[1*]Physical Education Department, Institute of Education, Arts, and Sciences, City College of Angeles, Angeles City / Philippines
*Corresponding author: josephlobo@cca.edu.ph

Abstract
Writing a thesis has always been considered one of the most challenging aspects of being an undergraduate student. However, no research on the difficulties of undergraduate students in the setting of Local Colleges and Universities (LCUs) in the Philippines has been identified. The purpose of this sequential explanatory research was to evaluate the challenges and obstacles experienced by undergraduate students while finishing their theses. Students pursuing a Bachelor of Physical Education at City College of Angeles in the Philippines who have completed writing and defending their theses comprise the study's participants. After gathering data from 116 students via an online survey (N_{male} = 59, N_{female} = 57) for the quantitative phase, it was determined that infrastructure, communication, and time management presented a moderate amount of difficulty for students. Additionally, after the thematic analysis, three major themes and six sub-themes emerged: (1) Internet connectivity challenges and communication (connectivity issues and inadequate scientific resources, as well as communication with thesis groupmates), (2) Data gathering impediments (participant recruitment and rejection), and (3) Time Management issues (drawbacks of working students and thesis writing contrasted with other academic course works). Based on the findings, this report offers recommendations for tackling these obstacles and issues. Finally, the study's limitations and proposals for further research are presented.

Keywords
Challenges and barriers, Physical Education, Research excellence, Thesis Writing, Undergraduate Thesis

INTRODUCTION

A thesis is a written output of a systematic study that follows a period of supervised research in the college (Ermiati et al., 2021). The final output should be demonstrated by its originality, critical and independent thinking, proper construction, format, and documentation (Azmat & Ahmad, 2022). It promotes scientific thinking, formulation of research questions and objectives, managing and evaluating data, and reporting the overall study (Matin & Khan, 2017). The process of writing a thesis is described as complex because students are projected to combine their knowledge and capabilities in understanding, examining, describing, and explaining problems vis-à-vis the scientific topic in which they are currently engaged. Thesis writing has been well-known to be the most rigorous phase of pursuing an undergraduate degree which is supported by various educational scholars (Alsied & Ibrahim, 2018; Merç, 2016; Subia et al., 2022). Published scholarly works concerning these issues are prevalent in various degree programs, particularly for post-graduate degrees such as Masters and Doctorate programs (Mohammadi & Zolqadr,

Received: 06 january.2023 ; **Accepted:** 05 February 2023; **Published:** 28 February 2023
[1]**ORCID:** 0000-0002-2553-467X

How to cite this article: Lobo, J. (2023). Students' challenges and barriers in the completion of an undergraduate thesis in the case of a premier local college in the Philippines. *Int J Disabil Sports Health Sci*;6(1):38-52. https://doi.org/10.33438/ijdshs.1230630

2022; Shahsavar & Kourepaz, 2020; Sükan & Mohammadzadeh, 2022). Unfortunately, after assessing papers that were previously conducted concerning this issue, no studies were found focusing on the challenges and barriers of undergraduate students in writing a thesis, especially those students taking a teacher education degree in Physical Education. Additionally, there is a scarcity of conducted investigations in the Local Colleges and Universities (LUCs) sector in the Philippine context. Hence, a call for an investigation to fill the gap in this particular area should be performed. In the case of City College of Angeles, thesis writing courses of the Bachelor of Physical Education program are offered for two consecutive semesters (BPEd 117A and BPEd117B) during their 3rd-year, both the first and second semesters. Thesis Writing 1 or BPEd117A aims for students to apply the theoretical and practical aspects of research planning and methodology and enable them to apply various research strategies focusing on Physical Education, Health, and Music. At the same time, Thesis Writing 2 or BPEd117B is the pre-requisite of BPEd117A, which aims to apply various data gathering and analysis techniques and to write their discussion and conclusion based on obtained data and defend it to research panelists. Proposing and defending a thesis is a partial requirement of the degree.

Therefore, students are mandated to take and undergo these courses. Based on observations, students struggle to complete their undergraduate thesis for some crucial reasons. Indeed, research excellence is a one of the three components Higher Education Institutions are striving for. However, these challenges and barriers remain undiscovered and undocumented. In line with these, this study aimed to explore the various challenges and barriers of students in completing their thesis. Finally, this research has the implication to provide practical interventions for students struggling in carrying out their thesis writing.

MATERIALS AND METHODS

Research Design

The inquiry is a *survey descriptive* study. In this method, data are collected in two (2) separate but consecutive stages over a given time frame (Draucker et al., 2020). The quantitative data was collected and evaluated first, and then the qualitative data were obtained and analyzed (Toyon, 2021). This allowed the researcher to investigate additional difficulties encountered by undergraduates during the thesis writing process.

Participants

The participants for the study are 4th-year undergraduate students who successfully defended and passed their thesis writing [PE117A (Thesis Writing 1) and PE117B (Thesis Writing 2)] and 3rd year students who are currently enrolled on these course at City College of Angeles, located in the City of Angeles, Philippines. Moreover, the participants for the study were selected via *Purposive Sampling*. This non-probability sampling technique is used because of the participants' qualities that are needed and fitted for this investigation (Lobo, 2022). One hundred sixteen (116) students voluntarily participated in the investigation, and all responses were accepted for analysis. As can be seen in Table 1, most of the respondents are males (N=59), constituting 50.9% of the overall sample population, compared to females (N=57), with 49.1%.

Table 1. Demographic characteristics

Variable	Item	N(%)
Gender		
	Male	59(50.9%)
	Female	57(49.1%)

Instruments and Data Gathering

Quantitative Phase

For the first phase, the data were collected via an *online survey* using Google Forms. Conducting an online survey has a great potential to gather an amount of data efficiently, cost-effective, and within a relatively short time frame (Li et al., 2021). The questionnaire that was utilized is based on the study of Mohammad El-Freihat (2021), which is a 21-item that measures undergraduates' challenges and barriers in the completion of a thesis based on three domains: *Infrastructure* (e.g., "There is a paucity of equipment needed for completing the undergraduate thesis"), *Communication* (e.g., "It is difficult to have the necessary channels to communicate with the academic supervisor"), and *Time Management* (e.g., "It is difficult to find free time to collect resources").

Qualitative Phase

To explore other challenges and barriers that undergraduate students faced during the completion of their thesis which cannot be measured by the survey questionnaire that was used in the first phase, an *open-ended question* was used (Swain & King, 2022).

Data Analysis

Quantitative Phase

A test of normality, reliability test, and bivariate correlation for inter-scale relationships was performed. As can be seen in Table 2, the skewness and kurtosis obtained the threshold value [-2, 2] across all subscales. Therefore, the data are generally distributed across the three subscales. Additionally, the table explicates the reliability test results, which indicated that all subscales are highly reliable, with Cronbach's Alpha value ranging between .87 to .89. Lastly, the bivariate correlations are also displayed in the table which displayed a significant relationship across all variables ($p < .01$).

Table 2. Descriptive statistics, normality estimates, internal consistency coefficients, and bivariate correlations

	Gender	*M* ± *SD*	*Skewness*	*Kurtosis*	1	2	3
Infrastructure	Male	2.82 ± .80	-.421	.783	(.89)		
	Female	2.77 ± .98	.161	-.056			
Communication	Male	2.70 ± .79	-.402	.840	.675**	(.87)	
	Female	2.33 ± .81	.243	-1.48			
Time Management	Male	3.14 ± .88	.042	.420	.585**	.637**	(.87)
	Female	2.80 ± .82	-.054	-.710			

* Statistically significant at $p < .05$. ; ** Statistically significant at $p < .01$.

Moreover, to describe the participants' responses, descriptive statistics such as *Mean* (M) and *Standard Deviation* (SD) were used via IBM SPSS version 27. For the facilitation of the interpretation of obtained data, a point-scale interpretation was adapted from Lobo et al. (2022) to describe per item response which is shown in Table 3.

Table 3. Descriptive interpretations

Range of weighted mean	Description	Interpretation
4.20 – 5.00	Strongly agree	Very high
3.40 – 4.19	Agree	High
2.60 – 3.39	Neither agree nor disagree	Moderate
1.80 – 2.59	Disagree	Low
1.00 – 1.79	Strongly disagree	Very low

Qualitative Phase

The gathered data were analyzed by performing Thematic analysis. *Thematic analysis* is the procedure of classifying outlines or themes within the qualitative data (Nowell et al., 2017).

Ethical considerations

Respondents were needed to provide consent by accepting the accompanying statement in the Google Forms. In addition, respondents were informed about the study's objectives, its tools, and the variables being measured. In addition, several minor dangers associated with completing the online survey were mentioned. Respondents may withdraw or request a debriefing at any time.

RESULTS

Quantitative Phase's Results

Tables 4, 5, and 6 illustrate the participants' responses concerning their challenges in completing their undergraduate thesis based on the three domains: Infrastructure, Communication, and Time Management, while Table 7 illustrates the overall level of the three domains by rank. Regarding infrastructure, most of the participants neither agree nor disagree with the majority of the

statements, which can be posited that there is a moderate level of challenges that are being faced by students (2.80 ± .891). Additionally, concerning communication, most of the respondents neither agreed nor disagreed across all statements, which indicated that students faced a moderate level of challenge when communicating with their respective research supervisors (2.52 ± .819). Lastly, concerning time management, most of the students neither agreed nor disagreed with all the accounts except for the statement *"I always have a busy schedule"* (3.57 ± 1.113), which they all agreed on. Based on the finding, students' overall challenge in time management is moderate (2.98 ± .862). In conclusion, the level of challenge faced by students in completing their undergraduate thesis according to the three domains is moderate, and the ranking is as follows: Time Management (2.98 ± .862), Infrastructure (2.80 ± .891), and Communication (2.52 ± .819).

Table 4. Infrastructure

Statements	M ± SD	Interpretation
The library lacks adequate scientific resources	2.80 ± 1.073	NAND
The library doesn't contain enough computers to access the database	2.68 ± 1.139	NAND
The college does not provide access to international resources	2.46 ± 1.122	D
The college does not have scientific labs for experimentation	2.97 ± 1.183	NAND
There is a paucity of equipment needed for completing the undergraduate thesis	2.96 ± .990	NAND
The college lacks adequate scientific facilities needed	2.91 ± 1.213	NAND

Note: SA- Strongly agree, A- Agree, NAND- Neither agree nor disagree, D- Disagree, SD- Strongly disagree.

Table 5. Communication

Statements	M ± SD	Interpretation
There is no flexibility to contact the supervisor	2.35 ± 1.129	D
Using social media tools to contact supervisors is not an option in the supervisory relationship	2.61 ± 1.200	NAND
Academic supervisors prefer traditional communication channels	2.76 ± 1.108	NAND
There are no fixed hours to communicate with the academic supervisor	2.65 ± 1.210	NAND
It is difficult to have the necessary channels to communicate with the academic supervisor	2.66 ± 1.142	NAND
The academic supervisor does not respond to my calls when I need an advice	2.31 ± 1.008	D
The supervisor does not contact me if there is any debate	2.45 ± 1.098	D
It is hard to contact the academic supervisor when most needed	2.36 ± 1.114	D

Note: SA- Strongly agree, A- Agree, NAND- Neither agree nor disagree, D- Disagree, SD- Strongly disagree.

Table 6. Time management

Statements	M ± SD	Interpretation
I always have a busy schedule	3.57 ± 1.113	A
There is a contradiction between my schedule and one of my academic supervisors	2.84 ± 1.142	NAND
It is difficult to arrange my timetable with my academic supervisor	2.70 ± 1.057	NAND
The supervisor always has a heavy workload, so I cannot contact him	2.78 ± 1.127	NAND
It is difficult to find free time to collect resources	3.08 ± 1.166	NAND
Social activities keep me always busy that hinder my academic work	2.93 ± 1.140	NAND
I feel that I am always delaying my academic tasks	2.95 ± 1.291	NAND

Note: SA- Strongly agree, A- Agree, NAND- Neither agree nor disagree, D- Disagree, SD- Strongly disagree.

Table 7. Ranking of domains

Construct	M ± SD	Interpretation
Time Management	2.98 ± .862	Moderate
Infrastructure	2.80 ± .891	Moderate
Communication	2.52 ± .819	Moderate

Qualitative Phase's Results

Emerging themes

Following an analysis of the statements made by the participants, there were found to be three (3) main themes and six (6) sub-themes that emerged throughout the process. These major themes and sub-themes are as follows: (1) Internet connectivity challenges and communication (connectivity issues, insufficiency of scientific resources, and communication with thesis groupmates); (2) Data gathering impediments (recruitment of the participants and rejection from the participants), and (3) Time Management issues (drawbacks of working students and thesis writing contrasted with other academic course works). Following is a discussion of each main subject as well as any relevant subthemes.

Theme 1: Internet connectivity challenges and communication

Sub-theme 1.1: Connectivity issues and inadequacy of scientific resources

Based on the statements of the participants, most of them are experiencing poor internet connection which thwarts them from productively performing their tasks of finding reliable sources and references on the web which can be of great help for their respective theses. Examples of responses are as follows:

BPEd10: *"The significant challenge that I have experienced during the completion of my undergraduate thesis is lack of sources."*

BPEd69: *"Barriers include lack of internet connectivity to search for related studies."*

BPEd75: *"In my view, the most challenging part we experienced is the lack of internet, time and difficulty finding related literature connected to our study. We also have difficulty finding the review of related literature because some RRLs are not connected to our study, which is why it is also time-consuming."*

BPEd78: *"Internet Connection is the main problem I experienced in doing our thesis because sometimes the connection and data are not cooperating when making and finding resources I need."*

Sub-theme 1.2: Communication with thesis groupmates

Another significant finding is the difficulty of virtual communication with their fellow thesis groupmates. Due to internet connectivity problems, conducting meetings and consultations with their classmates has been one of the main challenges for them. Examples of responses are:

BPEd10: *"The significant challenges that I experience during the completion of my undergraduate thesis are a need for sources and sometimes a lack of communication with my groups."*

BPEd14: *"The internet connection and communication to my fellow groupmates."*

BPEd33: *"During our thesis completion, my groupmates and I always had difficulty setting a date/time for us to meet virtually due to various reasons such as internet issues."*

BPEd34: "*The meeting setup. Because there are times that it is tough to explain through Google Meet or other social media platforms, and sometimes they misunderstand what I am saying. Therefore, the communication is not just good."*

Theme 2: Data gathering impediments

Sub-theme 2.1: Recruitment of the Participants

Based on the findings, most participants have argued that one of the main challenges hindering them from finishing their undergraduate thesis is the difficulty of recruiting respondents/participants for the study. One of the significant problems that emerged which delays undergraduate students to move forward into the data analysis phase. Since the thesis writing of the participants commenced during the onslaught of COVID-19, most of the statements of the participants can be accounted for it. Cases of responses are:

BPEd31: *"The significant barrier for me is the availability of our participants; since they are students and most of them are graduating and working students, we need help in scheduling our time of interviews with them since most of the time they are busy."*

BPEd51: *"The challenge I experienced during our thesis was the study participants. Since it is still pandemic, the sources are limited, so we need to double our time to meet our goal."*

BPEd79: "*The most significant barrier that hindered us in completing our undergraduate thesis is that we collected and facilitated our data gathering face to face. It took us much time to complete our target participants. We went from schools to barangays, which delayed us from completing our thesis."*

Sub-theme 2.2: Rejection from the participants

Moreover, some of the undergraduate students have also raised concerns about rejection from the participants to partake in data gathering and not answering questionnaires/interviews seriously. Some the of responses from the participants are mentioned below:

BPEd05: *"Some participants rejected the researchers to conduct an interview."*

BPEd21: *"The challenge we encountered while completing our thesis was the lack of respondents, and some respondents needed to answer our questionnaire more seriously."*

BPEd24: *"During the thesis completion, it is hard for me and my group to gather data because the survey can only be done online wherein there are target respondents who are not willing to answer the questionnaire."*

BPEd58: *"Collecting the respondents' responses because some of them just ignore our messages."*

BPEd79: *"Respondents are not taking the questionnaire seriously. Principals do not want to allow us to gather data even though we have complete authorization letters from the Division Office. Prospect participants who do not want to cooperate."*

Theme 3: Time Management issues

Sub-theme 3.1: Drawbacks of working students

Time management has also been one of the prevalent issues that emerged during the analysis of responses. Based on the breakdown, students who have experienced a lot of time management problems are those who are working. Students experienced difficulty in balancing their time in work and academics, most especially on their thesis writing. Moreover, the school is a local college and it can be expected that most of the students are from the marginalized sector. It is not a surprise that most of the students in the program are also doing side jobs to provide for their personal and family needs. Some of the examples of the responses:

BPEd29: *"Time management when deciding to meet and do our assigned work. Since some of our research members are working."*

BPEd49: *"For me, we are not same free time schedule as my groupmates because we are all working students."*

BPEd55: *"One of the challenges and my experience when doing research is when the tasks come together, and sometimes the problem is the members because they are working and not helping us to complete the task."*

BPEd68: *"I am a working student dad. Myschedule was my problem not just on our research but also on other subjects."*

Sub-theme 3.2: Thesis writing contrasted with other academic course works

Aside from the thesis writing needed to be accomplished, there are also other academic courses that requires submission of various outputs which challenged students to work with their time management skills and balancing their academic priorities. Bombarded with various academic tasks from other courses while conducting thesis writing has been a great challenge which was displayed based from the statements of the participants. Examples of responses:

BPEd12: *"There are still some errands to consider, not just the thesis. We are taking other subjects, so other activities are present."*

BPEd60: *"Yes. Specifically, the thesis isnot the only thing we students focus on. There are different things we need to focus on, such as working and doing different activities of subjects; that is why we have difficulty completing the research."*

BPEd94: *"For me, it is because of time management. There is a time when all the activities should be finished as early as possible because it affects the completion of the thesis."*

BPEd105: *"Being bombarded with so many activities and passion you need to attend for it is your motivation to pursue your dreams. I know time management is a must, but sometimes, it is too much. Everything is rushed, and that is what I am feeling right now. Everything should be finished as soon as possible. As a college student, I understand having many activities. However, I am just being honest with my answer and feelings. It is better to speak what is real than being blind."*

DISCUSSION

Quantitative

Using the information gathered in the quantitative phase, it was determined that undergraduates had only encountered mild difficulties in areas like infrastructure, communication, and time management. In this light, it can be assumed that the students' experiences with the aforementioned three domains have been neutral. The finding of the study have supported by the report of Mohammad El-Freihat (2021) which uncovered that students from Jordanian universities have also experienced a mild difficulty as measured by the three domains.

Even if the average level of yield across all the statements under the *infrastructure* domain was only moderate, it is still crucial for the college, and especially the library, to offer a wide variety of resources (i.e., research papers, books, periodicals) that students can use for their undergraduate theses. In addition, there are many resources that a typical student cannot access online (e.g., research papers and journals that require a paid subscription, e-books, etc.), which presents a significant barrier to them finishing their papers on time. The library is a gateway to knowledge and new insights (Soulen & Tedrow, 2022), and students will be able to learn how to conduct proper research if the school library gives access to additional electronic references and materials, hence, contributing to improved students' performance. Libraries are essential to fostering a culture of creativity and innovation because of the opportunities they provide for education, the spread of knowledge, and the development of fresh ideas and points of view. It also contributes to the reliability of the historical record of human learning. Having a library that is both successful and of excellent quality can be a crucial element in attracting and maintaining great researchers. Students have disputed the common perception that they cannot access international materials in the college library. This suggests that the library is making an effort to supply students with high-quality materials and references that can be used in the creation of robust theses. Moreover, additional facilities that students can use for conducting experiments (e.g., laboratories) are highly suggested to be taken into consideration by the management of the college. Students' experiences of focal phenomena in laboratories may be shaped by the experimental technologies employed, in a human-mediating tools-world fashion, by highlighting or hiding specific features of reality (Bernhard, 2018). Some areas of physical education are extremely experimental, therefore having a well-equipped laboratory has educational benefits beyond the simple fact that students have a positive experience conducting their experiments, which may result in novel finding on their field being studied during thesis writing. Students benefit from this since it enhances their learning through exposure to real-world scenarios. The goal of a lab is not to win a competition by providing the "correct answer," but rather to teach students how to acquire knowledge, through observation and the interpretation of results (Gericke et al., 2022; Pareek, 2019; Watts et al., 2022). The availability of computers and other essential tools (e.g., internet connection) for student researchers should also be enhanced. Given the fact that most of the students in the college belongs to the marginalized sector; learning and study can both be conducted on computers via the internet. Students can save and organize their research materials on computers, as well as access helpful information online for their thesis. The availability and accessibility of education have been vastly improved by the advent of computers, which have provided access to an endless number of educational resources. It has been prevalent from other published scholarly works that the influence of computer has a positive association on students' motivation and academic achievement (Harris et al., 2016; Nouri et al., 2022; Simões et al., 2022).

Students report no issues with connecting with their research supervisor, which is an interesting finding based on the *communication* domain. This suggests that students have a positive time writing their theses, especially when they have questions that need answering and can quickly contact their research supervisor for help. However, there have been numerous studies that were reported having difficulties in dealing with research supervisors. Several studies have already demonstrated that thesis candidates receive insufficient supervision from their advisors (Boufeldja & Bouhania, 2020; Qasem & Zayid, 2019; Silinda & Brubacher, 2016). As an example, the study of Lestari (2020) revealed that, as a result of teachers' heavy workloads, students often struggle to get in touch with their research supervisors. In this regard, research supervisors should also provide more hands-on support to students in completing their undergraduate theses. Emmerson (2019) has stated that "communication as empowerment" is a vital role of research supervisors to encourage positive outcomes by motivating student researchers to complete their degrees with minimal problems and maximum satisfaction.

Lastly, it was found that most of the students are having difficulty in managing their times under the *time management* domain. Previous studies accentuated the time management skills has a significant and direct relationship on academic performance (Adams & Blair, 2019; Ahmad et al., 2019). Nonetheless, most students are having difficulty in managing their time because of the excessive amount of course loads they are currently confronting in addition to the writing of their theses. Previously conducted studies have also emphasized that there is a significant relationship between the number of course loads and academic performance of the students (Attewell & Monaghan, 2016; Huntington-Klein & Gill, 2021). Surprisingly, time management is a skill that can be taught, and several studies have underlined this fact to undergraduates. Because of this, students need to learn how to effectively manage their time as soon as they set foot on campus. Researchers have found that students who learn to manage their time well early in their school careers have more success later on (Alyami et al., 2021; Wilson et al., 2021).

Qualitative

As have mentioned in the findings, there are three (3) themes and 6 sub-themes emerged during the process which are (1) Internet connectivity challenges and communication (connectivity issues and inadequacy of scientific resources, and communication with thesis groupmates), (2) Data gathering impediments (recruitment of the participants and rejection from the participants), and (3) Time Management issues (drawbacks of working students and thesis writing contrasted with other academic course works).

Internet connectivity challenges and communication

Participants' statements suggest that a lack of a reliable internet connection is a barrier to finding relevant studies for undergraduate theses (AlMarwani, 2020; Medaille et al., 2021; Nurkamto et al., 2022), and to having productive discussions with group members, which is corroborated by earlier research (Natividad-Franco, 2021; Nurkamto et al., 2022). Considering that the majority of the participants come from socially excluded demographics, this is a common theme among their statements. Additionally, as have mentioned earlier, poor internet connection really hinders students in conducting research, most especially during the pandemic. Previous research has already emphasized that students' ability to succeed academically, including in the area of thesis writing, is hindered by slow or nonexistent internet connection. The study of Apuke and Iyendo (2018) have reported that North-Eastern Nigerian students overwhelmingly agreed that having ready access to the internet meant they could do their research ahead of time, allowing them to scour the web for relevant articles and materials from a variety of free, online sources. Also, the usage of the internet in educational settings has made it much simpler to access a wide variety of resources and to collaborate on research. Moreover, poor internet connection thwarts students to productively collaborate with their groupmates. Slow internet connection is highly evident most especially in the Philippines. In comparison to other emerging countries in Asia today, the Philippines' Internet infrastructure is severely lacking, especially in terms of Internet connectivity (Salac & Kim, 2016). The majority of the participants' concerns can be explained by the fact that they have to spend more time than necessary looking for

relevant scholarly articles for their research due to connection issues.

Data gathering impediments

Considering the previous section, it is indeed safe to say that data analysis is one of the trickiest parts of writing an undergraduate thesis. Recruiting will be challenging to carry out because data collection from target respondents/participants is entirely discretionary. The findings of this study have been corroborated by other published research papers (Azmat & Ahmad, 2022; Djatmika et al., 2022; Subia et al., 2022), since there have also other factors that should be highly considered when gathering data from people under studies. For example, Rimando et al. (2015) found that doctoral students face a number of difficulties when collecting data, including the fact that some respondents or participants may be reluctant to disclose private information. Another instance, some potential participants may be wary because of a lack of trust in the researchers, particularly those who are working in the community-based research, who they have yet to get to know and appreciate (Holden et al., 2015). Not only that, but poor timing is also cited as a reason why potential participants decline study invitations (Arfken & Balon, 2011; Mfutso-Bengo et al., 2008). If respondents or participants are unable to take part in the investigation, it is likely because the timing conflicts with other obligations they must attend. It is clear from the information shown above that student researchers may be in a precarious situation when it comes to enlisting participants and responses for their investigations. Intriguingly, a plethora of studies have highlighted different and efficient methods of recruiting respondents/participants for the study. To begin, the research instructor has to have a comprehensive discussion on the main fundamental processes involved in conducting a research project, most notably the process of participant recruiting. This is done so that prospective volunteers can be successfully invited without infringing any ethical procedures, such as seeking for ethical approval from the office in-charge of conducting investigations (Davis et al., 2022; Gelling, 2016). By securing ethical approval, student researchers show that their study adheres to the minimum requirements for conduct as set forth by the scientific community (Fleming & Zegwaard, 2018). It is the responsibility of the researchers to disclose to the participants who have access to their information and exactly what is being performed with it. Additionally, in inviting prospect respondents/participants, information about the researcher and the study's purpose should be included in the invitation (Rajabzadeh et al., 2021). The participant should know who are the researchers and why we they are being contacted in order to properly reply to such an invitation. In addition, student researchers should put out all of the relevant information, such as granting consent by the individuals in the process of conducting the study and additional benefits and hazards that participants may face during the course of the investigation (Barrow et al., 2022; Eyal, 2020; Gordon, 2020). Respect for individual autonomy can best be shown through obtaining informed permission, making it a crucial ethical need in research (Musmade et al., 2013; Xu et al., 2020). Lastly, it is crucial to assure the respondents/participants that their information will be kept private and utilized exclusively for the goals of the study itself (Badampudi et al., 2022; Surmiak, 2018). In order to help students, become comfortable with the methodical process of data collection and to get the most out of potential participants, the research instructor might teach them the aforementioned suggestions as stated earlier.

Time Management issues

Participants reported significant challenges in juggling employment and school, particularly when writing their undergraduate theses. Eastgate et al. (2022) and Tumin et al. (2020) are just two of many examples of scholarly studies that demonstrate how difficult it may be for college students to juggle their academic and professional responsibilities (Mutya et al., 2022; Tsurugano et al., 2021). It has already been established that the majority of the college population is comprised of members of socially vulnerable groups who often have to hold down part-time jobs to make ends meet. Additionally, juggling all academic courses (e.g., thesis writing and other courses; Lestari (2020) has been a prevalent issue among college students, with prior research (Appleby et al., 2022; Kennett et al., 2019; Ulriksen & Nejrup, 2021) showing that many students sacrificed significant personal events in order to meet the demands of their coursework. On a positive note, as have mentioned earlier, as soon as they step foot on

campus, students need to start learning how to manage their time efficiently.

CONCLUSION

The present study examined the challenges and barriers students have faced during the completion of their undergraduate thesis in a sample of 4th-year Bachelor of Physical Education Students at City College of Angeles via a sequential explanatory approach. Based on the findings, participants have only experienced moderate challenges concerning Infrastructure, Communication, and Time Management. For a more in-depth explanation, the structured questionnaire has only focused on the use of the library and related facilities for experimentation, communication with the research supervisor, and time management (mostly concerning with research supervisor and thesis writing). However, based on students' statements, other challenges emerged that the structured questionnaire used for the study was unable to measure. Other challenges identified during the process are Internet connectivity and communication, Data gathering impediments, and Time Management issues.

The following results may provide new insights into practical interventions that can be employed for students who are completing their undergraduate theses—firstly, concerning infrastructure, such as improving the library by providing enormous reliable sources from trusted repositories that students may use in their respective areas of study. This will ensure that students' manuscripts are based on reliable sources, not predatory ones. Concerning communication with the research supervisors, as mentioned earlier, instructors should provide a more hands-on approach to collaborating with students to guide them throughout their thesis writing journey. Research supervisors are responsible for students' outcomes, specifically their manuscripts, which should be of high quality. Fostering positive communication with the students will result in higher motivation and satisfaction. Regarding time management, the college may introduce various time management systems to students as soon as they enter the premises. This will ensure that in students' early years in college, they will able to practice managing their time in able for them to satisfy the needs and pressures of various academic course works, most especially the rigorous process of thesis writing.

Aside from these practical interventions mentioned earlier, this study highly proposed other strategic interferences addressing the challenges that emerged in the study's qualitative phase. Addressing the first theme, internet connectivity challenges and communication, the college may provide various pieces of training in evaluating resources from the internet. The training should be focused on teaching students how to judge resources based on their reliability and credibility. Also, the college may strategically plan to provide free access to students using computers in the library. This is helpful for students who need more facilities and equipment to finish their outputs. As mentioned earlier, students enrolled in college belong to a marginalized sector. Hence, it is only imperative for the college to provide free access to struggling students in their thesis writing. Moreover, inculcating the 'value' of teamwork in students is highly suggested. The college may provide interventions by providing team exercises to students to help foster solidarity. Furthermore, regarding data-gathering impediments, it is highly suggested that students be guided accordingly by providing an in-depth explanation of various data-gathering plans and strategies they can effectively use since this specific phase is one of the most rigorous parts of thesis writing, as mentioned by various scholars. Finally, concerning time management issues for working students and those struggling to balance other academic courses with thesis writing, specifically for working students, the college may reconceptualize 'work,' and its vital role in students' learning and engagement. In line with this, transforming employment into an experience that can develop students' intellectual growth is highly emphasized. Lastly, like the previous suggestion, introducing a time management system in the early years may produce positive outcomes for students facing difficulties balancing all their academic courses.

Furthermore, this present study has certain drawbacks that must be considered highly. First, this study is limited to a sample of Bachelor of Physical Education students at City College of Angeles. Thus, the findings of this investigation cannot generalize the entire students of other Higher Education Institutions from various sectors, such as from the State Universities and Colleges (SUCs) or even Private Higher Education

Institutions (PHEIs). Ergo, this study highly suggests conducting a similar study by collecting data from the HEIs of various sectors to determine if the findings support or refute the claims of this investigation. It is suggested to adopt the questionnaire that was used on this or any instrument that will encompass other challenges which will help researchers to provide a more feasible solution. Finally, adopting a multi-informant approach is highly recommended by amassing research supervisors' reports, as these significant individuals may provide profound information specifically about the various challenges and barriers their students are facing in thesis writing which may be used for a more cohesive practical intervention beneficial for the students.

ACKNOWLEDMENT

The author would like to thank all the Bachelor of Physical Education Students for participating in the study. Also, the author would like to reach out his sincerest gratitude to the City College of Angeles' Vice President for Research, Extension, and Quality Assurance, Dr. Jean Paolo G. Lacap; OVPREQA Research Coordinator, Mrs. Nickole Z. Pineda; Vice President for Academic Affairs, Dr. Carolina A. Sarmiento; and the Dean of the Institute of Education, Arts, and Sciences, Mrs. Levita P. De Guzman.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics committee approval:

Respondents participating in the study gave their consent by accepting the accompanying statement in Google Forms. In addition, the participants were informed about the aims, tools and measured variables of the study.

Author Contributions

Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Final review and editing, performed by the author.

REFERENCES

Adams, R. V., & Blair, E. (2019). Impact of Time Management Behaviors on Undergraduate Engineering Students' Performance. *SAGE Open*, *9*(1), 215824401882450. https://doi.org/10.1177/2158244018824506

Ahmad, S., Batool, A., & Hussain Ch, A. (2019). Path Relationship of Time Management and Academic Achievement of Students in Distance Learning Institutions. *Pakistan Journal of Distance and Online Learning*, *5*(2), 191–208.

AlMarwani, M. (2020). Academic Writing: Challenges and Potential Solutions. *Arab World English Journal*, *6*(6), 114–121. https://doi.org/10.24093/awej/call6.8

Alsied, S. M., & Ibrahim, N. W. (2018). Exploring Challenges Encountered by EFL Libyan Learners in Research Teaching and Writing. *IAFOR Journal of Language Learning*, *3*(2), 143–158. https://doi.org/10.22492/ijll.3.2.06

Alyami, A., Abdulwahed, A., Azhar, A., Binsaddik, A., & Bafaraj, S. M. (2021). Impact of Time-Management on the Student's Academic Performance: A Cross-Sectional Study. *Creative Education*, *12*(03), 471–485. https://doi.org/10.4236/ce.2021.123033

Appleby, J. A., King, N., Saunders, K. E., Bast, A., Rivera, D., Byun, J., Cunningham, S., Khera, C., & Duffy, A. C. (2022). Impact of the COVID-19 pandemic on the experience and mental health of university students studying in Canada and the UK: a cross-sectional study. *BMJ Open*, *12*(1), e050187. https://doi.org/10.1136/bmjopen-2021-050187

Apuke, O. D., & Iyendo, T. O. (2018). University students' usage of the internet resources for research and learning: forms of access and perceptions of utility. *Heliyon*, *4*(12), e01052.https://doi.org/10.1016/j.heliyon.2018.e01052

Arfken, C. L., & Balon, R. (2011). Declining Participation in Research Studies. *Psychotherapy and Psychosomatics*, *80*(6), 325–328. https://doi.org/10.1159/000324795

Attewell, P., & Monaghan, D. (2016). How Many Credits Should an Undergraduate Take? *Research in Higher Education*, *57*(6), 682–713.https://doi.org/10.1007/s11162-015940 1z

Azmat, M., & Ahmad, A. (2022). Students Experience in Completing Thesis at Undergraduate Level. *Journal of Materials and Environmental Science*, *13*(3), 291–300.

https://www.jmaterenvironsci.com/Document/vol13/vol13_N3/JMES-2022-13024 Azmat.pdf

Badampudi, D., Fotrousi, F., Cartaxo, B., & Usman, M. (2022). Reporting Consent, Anonymity and Confidentiality Procedures Adopted in Empirical Studies Using Human Participants. *E-Informatica Software Engineering Journal*, *16*(1), 220109. https://doi.org/10.37190/e-Inf220109

Barrow, J. M., Brannan, G. D., & Khandhar, P. B. (2022). Research Ethics. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459281/

Bernhard, J. (2018). What matters for students' learning in the laboratory? Do not neglect the role of experimental equipment! *Instructional Science*, *46*(6), 819–846. https://doi.org/10.1007/s11251-018-9469-x

Boufeldja, B., & Bouhania, B. (2020). A Qualitative Inquiry into the Difficulties Experienced by Algerian EFL Master Students in Thesis Writing: 'Language is not the Only Problem.' *Arab World English Journal*, *11*(2), 243–257. https://doi.org/10.24093/awej/vol11no2.17

Davis, K., Tan, L., Miller, J., & Israel, M. (2022). Seeking Approval: International Higher Education Students' Experiences of Applying for Human Research Ethics Clearance in Australia. *Journal of Academic Ethics*, *20*(3), 421–436. https://doi.org/10.1007/s10805-021-09425-1

Djatmika, D., Prihandoko, L. A., & Nurkamto, J. (2022). Lecturer Supervisors' Perspectives on Challenges in Online Thesis Supervision. *Proceedings of the 67th Teflın International Virtual Conference & the 9th ICOELT 2021 (Teflın Icoelt 2021)*, *624*, 270–276. https://doi.org/10.2991/assehr.k.220201.048

Draucker, C. B., Rawl, S. M., Vode, E., & Carter-Harris, L. (2020). Integration Through Connecting in Explanatory Sequential Mixed Method Studies. *Western Journal of Nursing Research*, *42*(12), 1137–1147. https://doi.org/10.1177/0193945920914647

Eastgate, L., Hood, M., Creed, P. A., & Bialocerkowski, A. (2022). Managing work and study with an eye on the future. *International Journal of Educational Research Open*, *3*(February), 100142. https://doi.org/10.1016/j.ijedro.2022.100142

Emmerson, M. (2019). Communicating "Success" with Research Students: Institutional Responsibilities in Encouraging a Culture of Research Higher Degree Completions. In *Traversing the Doctorate* (pp. 57–73). Springer International Publishing. https://doi.org/10.1007/978-3-030-23731-8_4

Ermiati, E., Widiasih, R., Suryati, Y., & Murtianingsih, M. (2021). Student Experience in Completing Thesis and its Implications for International Students in Indonesia. *Open Access Macedonian Journal of Medical Sciences*, *9*(T6), 45–51. https://doi.org/10.3889/oamjms.2021.7367

Eyal, N. (2020). Is There an Ethical Upper Limit on Risks to Study Participants? *Public Health Ethics*, *13*(2), 143–156. https://doi.org/10.1093/phe/phaa028

Fedyuk, O., & Zentai, V. (2018). The Interview in Migration Studies: A Step towards a Dialogue and Knowledge Co-production? In *IMISCOE Research Series* (pp. 171–188). https://doi.org/10.1007/978-3-319-76861 8_10

Fleming, J., & Zegwaard, K. E. (2018). Methodologies, methods and ethical considerations for conducting research in work-integrated learning. *International Journal of Work-Integrated Learning*, *19*(3), 205–213.

Gelling, L. (2016). Applying for ethical approval for research: the main issues. *Nursing Standard*, *30*(20), 40–44. https://doi.org/10.7748/ns.30.20.40.s46

Gericke, N., Högström, P., & Wallin, J. (2022). A systematic review of research on laboratory work in secondary school. *Studies in Science Education*, *00*(00), 1–41. https://doi.org/10.1080/03057267.2022.2090125

Gordon, B. G. (2020). Vulnerability in Research: Basic Ethical Concepts and General Approach to Review. *Ochsner Journal*, *20*(1),34–38.https://doi.org/10.31486/toj.19 . 0079

Harris, J. L., Al-Bataineh, M. T., & Al-Bataineh, A. (2016). One to One Technology and its Effect on Student Academic Achievement and Motivation. *Contemporary Educational Technology*, *7*(4), 368–381. https://doi.org/10.30935/cedtech/6182

Holden, R. J., McDougald Scott, A. M., Hoonakker, P. L. T., Hundt, A. S., &

Carayon, P. (2015). Data collection challenges in community settings: insights from two field studies of patients with chronic disease. *Quality of Life Research : An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation*, *24*(5), 1043–1055. https://doi.org/10.1007/s11136-014-0780-y

Huntington-Klein, N., & Gill, A. (2021). Semester Course Load and Student Performance. *Research in Higher Education*, *62*(5), 623–650. https://doi.org/10.1007/s11162-020-09614-8

Kennett, D. J., Reed, M. J., & VandenBerg, T. R. (2019). The Importance of Perceived University Life Balance, Hours per Week Engaged in Academic Activities, and Academic Resourcefulness. *Teaching & Learning Inquiry: The ISSOTL Journal*, *7*(1), 136–153. https://doi.org/10.20343/teachlearninqu.7.1.9

Lestari, D. M. (2020). An Analysis of the Students' Difficulties in Writing Undergraduate Thesis at English Education Study Program of Muhammadiyah University of Bengkulu. *Premise: Journal of English Education*, *9*(1), 17. https://doi.org/10.24127/pj.v9i1.2588

Li, B., Shamsuddin, A., & Braga, L. H. (2021). A guide to evaluating survey research methodology in pediatric urology. *Journal of Pediatric Urology*, *17*(2), 263–268. https://doi.org/10.1016/j.jpurol.2021.01.009

Lobo, J., Bautista, C., Dimalanta, G., & Manuel, S. (2022). Coaching commitment and physical development of student-athletes from various public schools in Angeles City, Pampanga, Philippines. *International Journal of Health Sciences*, *6*(S6), 5735–5758. https://doi.org/10.53730/ijhs.v6nS6.10874

Matin, M. A., & Khan, M. A. (2017). Common problems faced by postgraduate students during their thesis works in Bangladesh. *Bangladesh Journal of Medical Education*, *8*(1), 22–27. https://doi.org/10.3329/ bjme.v8i1.32245

McMullin, C. (2021). Transcription and Qualitative Methods: Implications for Third Sector Research. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*. https://doi.org/10.1007/s11266-021-00400-3

Medaille, A., Beisler, M., Tokarz, R., & Bucy, R. (2021). Honors Students and Thesis Research: A Study of Information Literacy Practices and Self-Efficacy at the End of Students' Undergraduate Careers. *College & Research Libraries*, *82*(1), 92. https://doi.org/10.5860/crl.82.1.92

Merç, A. (2016). Research anxiety among Turkish graduate ELT students. *Current Issues in Education*, *19*(1), 1–15. https://cie.asu.edu/ojs/index.php/cieatasu/article/view/1539

Mfutso-Bengo, J., Masiye, F., Molyneux, M., Ndebele, P., & Chilungo, A. (2008). Why do people refuse to take part in biomedical research studies? Evidence from a resource-poor area. *Malawi Medical Journal*, *20*(2), 57–63.https://doi.org/10.4314/mmj.v20i2.10958

Mohammad El-Freihat, S. (2021). Challenges facing students in writing theses at the Jordanian universities. *Cypriot Journal of Educational Sciences*, *16*(6), 3266–3277. https://doi.org/10.18844/cjes.v16i6.6321

Mohammadi, M., & Zolqadr, S. (2022). Survey on the Obstacles of Thesis Writing for the Postgraduate Students, Case Study: Postgraduate students of Zanjan University. *Management of Information Resources and Services*, *9*(1), 53–70. https://doi.org/https://doi.org/10.30473/mrs.2022.65457.1536

Musmade, P., Nijhawan, L., Udupa, N., Bairy, K., Bhat, K., Janodia, M., & Muddukrishna, B. (2013). Informed consent: Issues and challenges. *Journal of Advanced Pharmaceutical Technology & Research*, *4*(3), 134. https://doi.org/10.4103/2231-4040.116779

Mutya, R. C., Geverola, I. J. R., Cano Jr., A. C., & Friolo, R. V. (2022). Coping with uncertainties: Unveiling the lived experiences of working students in the new normal. *Ho Chi Minh City Open University Journal of Science - Social Science*, *12*(1), 112–129.https://doi.org/10.46223/ HCMCOUJS.soci.en.12.1.2264.2022

Natividad-Franco, V. (2021). Difficulties and Challenges of Library and Information Science Students in Thesis Writing during the Pandemic. *SSRN Electronic Journal*, *3*, 353–365.https://doi.org/10.2139/ssrn.3919528

Nouri, A., Zandi, T., & Etemadizade, H. (2022). A

canonical correlation analysis of the influence of access to and use of ICT on secondary school students' academic performance. *Research in Learning Technology*, *30*(1063519), 1–13. https:// doi.org/10.25304/rlt.v30.2679

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis. *International Journal of Qualitative Methods*, *16*(1), 160940691773384. https://doi.org/10.1177/1609406917733847

Nurkamto, J., Djatmika, D., & Prihandoko, L. A. (2022). Students' Problems of Academic Writing Competencies, Challenges in Online Thesis Supervision, and the Solutions: Thesis Supervisors' Perspectives. *TEFLIN Journal - A Publication on the Teaching and Learning of English*, *33*(1), 123. https://doi. org/ 10.15639/teflinjournal.v33i1/123-147

Pareek, R. B. (2019). An assessment of Availability and Utilization of Laboratory facilities for Teaching Science at Secondary Level. *Science Education International*, *30*(1), 75–81. https://doi. org/10.33828/ sei.v30.i1.9

Qasem, F. A. A., & Zayid, E. I. M. (2019). The challenges and problems faced by students in the early stage of writing research projects in L2. *European Journal of Special Education Research*, *4*(1), 32–46. https://doi.org/10. 5281/zenodo.2557036

Rajabzadeh, R., Janani, L., & Motevalian, S. A. (2021). Effects of different invitation strategies on participation in a cohort study of Iranian public sector employees: a cluster randomized trial. *BMC Medical Research Methodology*, *21*(1), 206. https://doi.org/10. 1186/s12874-021-01405-8

Rimando, M., Brace, A., Namageyo-Funa, A., Parr, T., Sealy, D.-A., Davis, T., Martinez, L., & Christiana, R. (2015). Data Collection Challenges and Recommendations for Early Career Researchers. *The Qualitative Report*, *20*(12), 2025–2036. https://doi.org/10. 46 743/2160-3715/2015.2428

Salac, R. A., & Kim, Y. S. (2016). A Study on The Internet Connectivity in The Philippines. *Asia Pacific Journal of Business Review*, *1*(1), 67–88. https://doi.org/10. 20522 /APJBR.2016.1.1.67

Shahsavar, Z., & Kourepaz, H. (2020). Postgraduate students' difficulties in writing their theses literature review. *Cogent Education*,*7*(1).https://doi.org/10.1080/2331186X.2020.1784620

Silinda, F. T., & Brubacher, M. R. (2016). Distance Learning Postgraduate Student Stress while Writing a Dissertation or Thesis Résumé. *International Journal of E-Learning & Distance Education*, *32*(1), 1–21.

Simões, S., Oliveira, T., & Nunes, C. (2022). Influence of computers in students' academic achievement. *Heliyon*, *8*(3), e09004. https://doi.org/10.1016/j.heliyon.2022.e09004

Soulen, R. R., & Tedrow, L. (2022). Students' frequency of access to school library materials in transformative times. *Journal of Librarianship and Information Science*, *54*(4), 622–639. https://doi.org/10.1177/09610006211037721

Stuckey, H. (2015). The second step in data analysis: Coding qualitative research data. *Journal of Social Health and Diabetes*, *03*(01), 007–010. https://doi.org/10.4103/2321-0656.140875

Subia, G. S., Gaston, C. O., Gaspar, J. F. A., Padilla, D. A. S., & Valenzuela, M. D. A. (2022). Thesis Writing amidst the COVID-19 Pandemic: The Case of Hospitality and Tourism Management Students of Wesleyan University Philippines. *Open Journal of Social Sciences*, *10*(02), 191–198. https://doi.org/10.4236/jss.2022.102013

Sükan, S., & Mohammadzadeh, B. (2022). Challenges of Writing Theses and Dissertations in an EFL Context: Genre and Move Analysis of Abstracts Written by Turkish M.A. and Ph.D. Students. *Frontiers in Psychology*, *13*(June). https://doi.org /10.3389/fpsyg.2022.925420

Surmiak, A. (2018). Confidentiality in qualitative research involving vulnerable participants: Researchers' perspectives. *Forum Qualitative Sozialforschung*, *19*(3). https://doi.org/10.17169/fqs-19.3.3099

Swain, J., & King, B. (2022). Using Informal Conversations in Qualitative Research. *International Journal of Qualitative Methods*, *21*, 160940692210850. https://doi.org/10.1177/16094069221085056

Toyon, M. A. S. (2021). Explanatory sequential design of mixed methods research: Phases and challenges. *International Journal of*

Research in Business and Social Science, *10*(5), 253–260. https://doi.org/10.20525/ijrbs.v10i5.1262

Tsurugano, S., Nishikitani, M., Inoue, M., & Yano, E. (2021). Impact of the COVID-19 pandemic on working students: Results from the Labour Force Survey and the student lifestyle survey. *Journal of Occupational Health*, *63*(1), 1–7. https://doi. org/10. . 1002/1348-9585.12209

Tumin, T., Faizuddin, A., Mansir, F., Purnomo, H., & Aisyah, N. (2020). Working Students in Higher Education: Challenges and Solutions. *Al-Hayat: Journal of Islamic Education*, *4*(1), 79. https://doi.org/10.35723/ajie.v4i1.108

Ulriksen, L., & Nejrup, C. (2021). Balancing Time – University Students' Study Practices and Policy Perceptions of Time. *Sociological Research Online*, *26*(1), 166–184. https://doi.org/10.1177/1360780420957036

Watts, J., Crippen, K. J., Payne, C., Imperial, L., & Veige, M. (2022). The varied experience of undergraduate students during the transition to mandatory online chem lab during the initial lockdown of the COVID-19 pandemic. *Disciplinary and Interdisciplinary Science Education Research*, *4*(1), 14. https:// doi.org/10.1186/s43031-022-00055-0

Wilson, R., Joiner, K., & Abbasi, A. (2021). Improving students' performance with time management skills. *Journal of University Teaching and Learning Practice*, *18*(4), 230–250. https://doi.org/10.53761/1.18.4.16

Xu, A., Baysari, M. T., Stocker, S. L., Leow, L. J., Day, R. O., & Carland, J. E. (2020). Researchers' views on, and experiences with, the requirement to obtain informed consent in research involving human participants: a qualitative study. *BMC Medical Ethics*, *21*(1), 93. https://doi.org/10.1186/s12910-020-00538-7

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

CASE REPORT

Comprehensive functional and vocational rehabilitation of a kitchen worker with kienbocks disease

Sandeep SHİNDE[1*], Rutuja ARULEKAR[2], Sayalee DHANE[3], Radha BHENDE[4] and Apurva SAPTALE[5]

[*1]Krishna Institute of Medical Sciences University Karād / INDIA
[2,3,4,5]Faculty of Physiotherapy, Krishna Institute of Medical Sciences (Deemed to be University), Karad, Maharashtra / INDIA
*Corresponding author: drsandeepshinde24@gmail.com

Abstract
Background: A hand injury can be catastrophic because one needs to use their hand for many different tasks in day-to-day life. People who work in the kitchen on a regular basis must repeatedly move their hands, arms, wrists, and shoulders while stirring, chopping, lifting, and carrying heavy vessels. To perform all the activities of daily living complete or functional range of motion and grip strength are the important components. The present case study describes the case of post-operative wrist stiffness secondary to kienbocks disease. This impairment prevents the patient from working in the kitchen. The purpose of the study was to improve the range of motion and grip strength of her affected hand as she has to resume her work as soon as possible. **Case description:** A 30-year old female who is a kitchen worker has been complaining of pain, and weakness in her left hand was advised to have wrist surgery after the patient's investigations revealed that she had Kienbock's disease. The patient underwent proximal carpectomy of the wrist and was referred to physiotherapy after the sutures were removed. The patient initially complained of pain at the suture site and difficulty moving her left hand.Early physiotherapy was given to the reduce pain, improve the strength of the wrist and finger flexor extensors, improve the range of motion, and vocational rehabilitation to resume her work.

Keywords
Wrist Stiffness, Grip Strength, Functional Range Of Motion, Post-Operative Rehabilitation

INTRODUCTION

Kienbock's disease is well defined by osteonecrosis of the lunate with an expected pattern of lunate collapse, carpal change, and degeneration resulting from a combination of vascular, anatomic, and traumatic insults. Kienbock (1910) claimed that kienbocks disease of the lunate bone arises from interference of blood supply. This interference attributes to injuries such as subluxation of the lunate bone or fracture of the lunate bone(Cetti & Reuther, 1982). In their study, Gelberman et al. found that the lunate's peculiar vascular or mechanical environment puts it at risk (Gelberman & Akeson,1980). It has extraosseous and intraosseous vessels running in the dorsal and volar radiocarpal ligaments. Theoretically 70% of lunates, multiple vessels enter volarly or dorsally, whereas in 30%, only one vessel is present, putting these lunates at risk of losing vascular supply. One of the important aetiological factors to kienbocks disease is the relative shortening of the lower end of the ulna thereby exposing the lunate bone at greater stress.

Received: 19 October..2022 ; **Accepted:** 30 January 2023; **Published:** 28 February 2023
[1]**ORC**ID:0000-0002-6466-3888, [2]**ORC**ID:**:** 0000-0002-7501-4648, [3]**ORC**ID:0000-0002-5994-8766, [4]**ORC**ID:0000-0003-3141-7515,
[5]**ORC**ID: 0000-0001-8782-8668

How to cite this article: Shinde, S., Arulekar, R., Dhane, S., Bhende, R. and Saptale, A. (2023). Comprehensive functional and vocational rehabilitation of a kitchen worker with kienbocks disease. *Int J Disabil Sports Health Sci*;6(1):53-59. https://doi.org/10.33438/ijdshs.1191467

Kienbocks disease typically presents between the age of 20-40yrs and the most common symptoms are wrist pain, swelling, restricted range of motion, and difficulty performing activities of daily living (Bain, & Begg, 2006) . Lichtman's modification of Stahl's classification divides kienbock disease into five stages: Stage I Normal radiographs, stage II increased radiodensity of lunate with possible decrease of lunate height on radial side only, stage IIIa lunate collapse, no scaphoid rotation, stage III b lunate collapse with fixed scaphoid rotation, stage IV degenerative changes around the lunate (van Leeuwen & Ring, 2016). The early stages are I, II, IIIa while the late stages are III b and IV. Plain radiographs are negative in early disease, osteopenia can be seen generally followed by patchy sclerosis and rim calcification.

The late-stage surgical treatment falls under six categories-Vascularized bone graft (VBG), radial osteotomy, partial arthrodesis, proximal row carpectomy (PRC), tendon or muscle ball arthroplasty. Though Kienbocks disease is described many years ago the etiology remains uncertain, and radiographic and clinical findings do not always correlate (Innes & Strauch, 2010).

MATERIALS AND METHODS

History

A 30 year old female, kitchen worker with right hand dominance was apparently alright 5 months ago until she started experiencing pain, shivering and weakness in her left hand which was progressive in nature. Patient also had difficulty in lifting heavy objects with her left hand. She noticed a difference in the size of her left hand compared to the right hand. Then the patient visited Krishna Hospital on 12th March 2022 and consulted an orthopaedic surgeon who advised her to undergo all the necessary investigations like MRI, X-ray which were then carried out (Fig no 1,2).

The investigations were then studied by the orthopaedic surgeon and he advised the patient to undergo surgery of the wrist joint as soon as possible. Due to the patient's financial condition, the patient postponed the surgery. During the period of two months and 22 days the patient only applied a crepe bandage on her hand to get relief. Then the patient was operated on 4th June 2022 at the Krishna Hospital and after 8 days of surgery the patient was discharged. While discharge, the patient's left forearm and wrist was plastered and was kept ia n cast for 21 days after which it was removed. After removing the plaster patient said that the pin was removed and bandaging was done and the patient was called for follow-up after 5 days. On 7th July 2022, she went for the follow-up and the orthopedician advised her to go for physiotherapy treatment, after the removal of sutures.The patient also gave a history of fall 15 years back on her left hand while riding a bicycle. She had severe pain and swelling but did not consult any doctor. She gave a history of going to a lady and massaging the painful and swollen area with oil for 8 days.

The patient visited physiotherapy OPD on July 7, 2022. The patient complained of pain at the suture site which was on the extensor aspect of the hand, she was experiencing difficulty in performing activities of left hand. A detailed examination of the patient was done. On general examination the pulse rate was 78 beats per minute, respiratory rate was 23 breaths per minute, blood pressure was 120/80 mmHg and the temperature was 98.6°F. Pain assessment was done using VAS(visual analogue scale),VAS (on rest) was 2 while VAS (on activity) was 8.(Table 1) On observation and posture assessmentnt the left shoulder was elevated and the carrying angle of the left elbow was greater compared to that of the right elbow. Arm swing appeared to be reduced of the affected hand compared to the unaffected hand.On scar inspection, the scar was present on extensor aspect of the left forearm extending from the mid forearm up to the midway of the dorsum of hand (Fig no 5).The scar length was 13.5 cm and was adhered. Grade 1 tenderness was present on palpation. Active range of motion (Table 2). Manual Muscle testing (Table 3) and Grip strength (Table 4) were evaluated.

Diagnostic assessment

Visual analogue scale (VAS) – At the beginning of the first and last treatment sessions, the patient was asked to rate her pain on VAS scale where 0 indicates no pain at all and 10 indicates worst pain which requires immediate treatment.

Table 1. Visual Analogue Scale (VAS)

VAS	Pre-treatment	Post-treatment
Left wrist (At rest)	4.6/10	0/10
Left wrist (on activity)	7.5/10	0/10

Table 2. Active Range of motion

AROM*	Pre-treatment	Post-treatment
Wrist flexion	0-12°	0-58°
Wrist Extension	0°	0-37°
Ulnar deviation	0-7°	0-25°
Radial deviation	0-3°	0-12°
Forearm supination	0-8°	0-80°
Forearm pronation	0-7°	0-78°
MCP		
Flexion	0-3°	0-80°
Extension	0°	0-32°
Abduction	0-2°	0-23°
PIP		
Flexion	0-9°	0-98°
DIP		
Flexion	0°	0-82°
Thumb		
Flexion MCP	0°	0-48°
Flexion IP	0°	0-82°

*AROM-Active Range Of Motion

Table 3. Manual Muscle testing

MMT*	Pre-treatment	Post-treatment
Wrist flexors	1/5	+3/5
Wrist extensors	1/5	+3/5
Radial deviators	1/5	+3/5
Ulnar deviators	1/5	+3/5
Forearm supinator	-2/5	4/5
Forearm pronators	-2/5	-4/5
Finger flexors	1/5	-4/5
Finger extensors	1/5	-4/5
Finger adductors	1/5	-4/5
Finger abductors	1/5	+3/5
Thumb abductor	1/5	-4/5
Thumb adductor	1/5	-4/5
Thumb extensor	1/5	-4/5

*MMT-Manual Muscle Testing

Table 4. Grip strength using Digital Hand Dynamometer

Grip strength measurement using digital hand dynamometer	Pre-treatment	Post-treatment
	3.6 kgs	19.5 kgs

Treatment (Skirven & Amadio, 2011; and Shah and Shinde, 2018)

- **Day 1-14 (After suture removal)**
  1.Electrical muscle stimulation to wrist and finger extensors with faradic current (30 rep×3 sets).
  2.Motor point stimulation to flexor pollicis longus and lumbricals (30rep×3sets)
  3.Cross friction massage on suture sites on the dorsal aspect of the thumb.
  4.Desensitization
  4.Grade 1 Maitlandand mobilization for wrist and fingers (10 oscillations×3 sets)
  5.Desensitization
- **Day 15-28**
  1.Gentle isolated Active range of motion for wrist and fingers.
  2.Cross friction massage on suture site.
  3.Gentle isolated Active assisted range of motion exercises for wrist and fingers.

- **Week 5-week 7**
  1.Isometric exercises for wrist and fingers.
  2.Gentle strengthening exercises such as graded grip strengthening.(towel curls,squeezing of sponge ball,paper holding exercises)
  3. Thera putty exercises using clay.
  4. Isotonic exercises for the wrist and fingers.
- **Progressive resisted exercises begin at 8 weeks**
  Incorporating daily activities like buttoning and unbuttoning the shirt, tying shoe laces, and improving the grip.

Table 5. Functional testing of wrist and hand

	Starting Position	Action	Functional Test
1.	Foream supinated, resting on table	Wrist flexion	Lifts 1-2 lbs – Functionally poor
2.	Foream pronated, resting on table	Wrist extension lifting 1-2 lbs	1-2 reps - Functionally poor
3.	Forearm between supination and pronation, resting on table	Radial deviation lifting 1-2 lbs	1-2 reps - Functionally poor
4.	Forearm between supination and pronation, resting on table	Thumb flexion with resistance from rubber band around the thumb	3-4 reps – Functionally fair
5.	Forearm resting on a table, a rubber band around thumb and index finger	Thumb Extension with resistance from rubber band	3-4 reps – Functionally fair
6.	Forearm resting on the table,rubber band around thumb and index finger	Thumb Extension with resistance from rubber band	3-4 reps – Functionally fair
7.	Forearm resting on a table	Thumb adduction lateral pinch of piece of paper	Hold 3-4 sec – Functionally fair
8.	Forearm resting on table	Thumb opposition pulp to pulp pinch of piece of paper	Hold 3-4 sec – Functionally fair
9.	Forearm resting on table	Finger flexion, patient grasps mug or glass using cylindrical grasp and lifting off table	3-4 reps - Functionally fair
10.	Forearm resting on table	Patient attempts to put on rubber glove keeping fingers straight	10-20sec- Functionally poor
11.	Forearm resting on table	Patient attempts to pull fingers apart (finger abduction) against resistance of rubber band and holds	Hold 1-2 sec – Functionally poor
12.	Forearm resting on table	Patient holds piece of paper beetween fingers while examiner pulls on paper	Hold 1-2 sec – Functionally poor

RESULTS

The pain assessment was done using the visual analogue scale, pain on rest was 4.6/10 while pain on activity involving the wrist joint was 7.5/10 (Table 1). The pain was dull and aching. On posture examination, the left shoulder was slightly elevated. The carrying angle of the left elbow was greater as compared to the right elbow. The arm swing was reduced.On observation, the scar length was 13.5 cm (Fig 5). The muscle girth was assessed in both the upper limbs. The girth of the left arm was 27cm and left forearm was 19.5 cm while the muscle girth of right arm was 30cm and the right forearm was 23cm. Active range of motion, MMT (Table 3) and functional assessment(Table 5) was evaluated. She was screened according to ICF with these findings there was a significant impact on her activity limitation before the treatment (difficulty lifting and grasping utensils in the kitchen, Patient had difficulty in bathing, Patient had difficulty riding a scooter, Patient had difficulty holding a newspaper). The patient had difficulty resuming her work in the kitchen. By the 8^{th} week of physiotherapy treatment, the patient demonstrated a nearly complete range of motion of wrist flexion and extension (Table 2).On doing the functional testing, the patient was able to perform most of the functions without pain (Table 5). The patient was pain-free and had increased grip strength (Table 4).

Fig. 1. Showing pre-operative MRI of the wrist joint.

Fig. 2. Showing pre-operative X-ray of the wrist joint.

Fig. 3. Showing post-operative x-ray of the wrist joint.

Fig. 4. Showing a post-operative (proximal row carpectomy) x-ray of the left wrist joint.

Fig. 5. Showing post-operative extensor aspect Of left hand on 1st day of physiotherapy

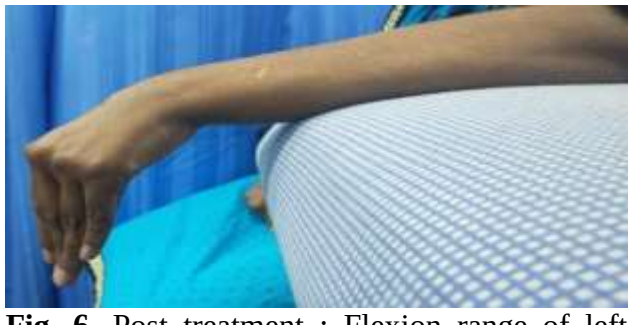

Fig. 6. Post treatment : Flexion range of left wrist joint

Fig .7 Post treatment : Extension of left wrist joint

Fig. 8 (a)

Fig. 8 (b)

Fig. 8(a) and (b) Post treatment : Hand grip.

Fig. 9. Post treatment: Ulnar deviation of left wrist joint

DISCUSSION

This case describes the physiotherapy management and its outcomes on post-operative wrist stiffness secondary to kienbocks disease of a 30-year-old female patient who is a kitchen worker. Use of hand is very essential for those who work in the kitchen on daily basis. The work in a kitchen involves repetitive motion of hands, arms, wrists, and shoulders for stirring, chopping, or lifting or carrying heavy vessels. An injury to the hand can be devastating as one needs to perform various tasks with their hand in day-to-day life. Physiotherapy goals are to restore the normal movements and functions of the hand (Shinde andGhadage, 2022).

Proximal row resection is an anatomical and simplification of the carpals consisting of removal of the scaphoid, lunate, and hamate (Richou et al. (2010). In the present case study the scaphoid, lunate, triquetrum, and hamate are resected. The major advantages of proximal row carpectomy are technical simplicity, short rehabilitation and immediate functionality of the wrist, and resumption of daily activities. David P. Green in his study has mentioned that though the surgery would appear to be destructive and totally unphysiological, it can provide a functional and pain-free wrist even in an individual who does reasonably heavy work (Green DP 1987). Normal biomechanics cannot be expected but the range of motion remains compatible with everyday life. Early rehabilitation can help in achieving range of motion and muscular strength of the wrist joint and might also help in returning to work and daily activities help in returning to work and daily activities (Edouard et al. (2010).

When the patient came to the physiotherapy center post-operatively the patient was unable to perform any activities with her left hand after 8 weeks of physiotherapy the patient was able to perform most of the activities of daily living and most importantly she could gradually resume her work in the kitchen. The patient's range of motion was near normal with no pain at rest and during activities. The adoption of suitable physiotherapy management contributed to an overall good functional outcome.

CONCLUSION

The post-operative physiotherapy management focuses on both functional and vocational rehabilation. All the effects enhanced patients overall functions of the wrist, and the patient was able to resume her kitchen work. In this case report, a 30-year-old female kitchen worker with post-operative wrist stiffness secondary to Kienbock's disease had a better outcome due to decreased post-operative complications and achieving nearby complete range of motion with improved grip strength.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics committee approval:

The study protocol was carried out in accordance with the Helsinki Declaration of 1975 and Written informed consent forms were obtained from all participants prior to the study. Informed consent form code: 9923919434

Author Contributions

Study Design: SS, RA, SD; Data Collection: SS, RA, SD, RB, AS; Statistical Analysis: SS; Data Interpretation: SS, RA; Manuscript Preparation: SS, RA, SD, RB; Final review and editing: SS and AS; Literature Search, SS, AS. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Bain, G. I., & Begg, M. (2006). Arthroscopic assessment and classification of Kienbock's disease. *Techniques in hand & upper extremity surgery*, *10*(1), 8-13.

Cetti, R., Christensen, S. E., & Reuther, K. (1982). Fracture of the lunate bone. *Hand*, (1), 80-84.

Edouard, P., Vernay, D., Martin, S., Hirsch, P., Bardoux, S., Grange, C., & Claise, J. M. (2010). Proximal row carpectomy: Is early postoperative mobilisation the right rehabilitation protocol?. *Orthopaedics & Traumatology: Surgery & Research*, *96*(5), 513-520.

Gelberman, R. H., Bauman, T. D., Menon, J., & Akeson, W. H. (1980). The vascularity of the lunate bone and Kienböck's disease. *The Journal of hand surgery*, *5*(3), 272-278.

Green DP. Proximal row carpectomy. Hand Clin. 1987 Feb 1;3(1):163-8.

Innes, L., & Strauch, R. J. (2010). Systematic review of the treatment of Kienböck's disease in its early and late stages. *The Journal of hand surgery*, *35*(5), 713-717.

Richou, J., Chuinard, C., Moineau, G., Hanouz, N., Hu, W., & Le Nen, D. (2010). Proximal row carpectomy: long-term results. *Chirurgie de la Main*, *29*(1), 10-15.

Shah, P.S., Shinde, S.B. (2018). Effect ofdesensitization methods during the earlymobilization phase in post-fractureconditions of upper extremity. *Asian journal of pharmaceutical and clinical research*; 11(7), 93-96.

Shinde, S. andGhadage, P. (2022). Return to Job of AConstruction Worker by ComprehensiveFunctional and Vocational Rehabilitation. Int JDisabil Sports Health Sci;5(2):97-104

van Leeuwen, W. F., Janssen, S. J., Ter Meulen, D. P., & Ring, D. (2016). What is the radiographic prevalence of incidental Kienböck disease?. *Clinical Orthopaedics and Related Research®*, *474*(3), 808-813.

Skirven, T. M., Osterman, A. L., Fedorczyk, J., & Amadio, P. C. (2011). *Rehabilitation of the hand and upper extremity, 2-volume set E-book: expert consult*. Elsevier Health Sciences.

International Journal of
Disabilities Sports and Health Sciences
e-ISSN: 2645-9094

REVİEW

The physical and mental health benefits of lifestyle sports for disabled people: a scoping review

Lewis YOUNGSON[1*], Charlie FOSTER[2] and Jeffrey LAMBERT[3]

[*1,3]Current PhD student at University of Bath, University of Bath / UK
[2]Centre for Exercise, Nutrition and Health Sciences School for Policy Studies University of Bristol / UK
*Corresponding author: ly732@bath.ac.uk

Abstract
There is growing evidence to suggest the physical and mental health benefits of lifestyle sports (LS) in disabled people. However, disabled people are less likely to participate in sports than those without disabilities and the evidence base is sporadic. We conducted a scoping review to explore the range and quality of this evidence base. **Methods:** Eligible studies consisted of participants participating in LS with a physical, intellectual, mental or sensory disability and included both adults and children. Descriptive, thematic and quality assessment techniques were used to provide a comprehensive summary of all evidence. **Results:** We identified 57 studies, across seven different sports, with numerous physical and mental health benefits to disabled people, including improved strength, fitness and balance as well as confidence, self-esteem and overall psychological wellbeing. Key emergent themes were that participation in LS promoted the development of social skills and building of community. **Conclusions:** Our scoping review was the first to explore this field of research, revealing a unanimously positive association between lifestyle sports and physical and mental health. Future research could focus on understanding the relationship and mechanisms between the sport, being in nature, or participating as part of a group that creates health benefits; and identifying appropriate duration, intensity and quantity of participation needed for long-term improvements.

Keywords
Lifestyle Sports', Disability, Mental Health, Physical Health, Social

INTRODUCTION

Participating in regular physical activity (PA) is an established protective factor for the prevention and treatment of noncommunicable diseases, including heart disease, stroke, diabetes and breast and colon cancer (World Health Organisation, 2020). Benefits range from improving cardiorespiratory fitness and muscular strength (Appelqvist-Schmidlechner et al., 2020), to reducing obesity (Henriksson et al., 2020). PA has consistently been shown to reduce levels of anxiety and depression, help people develop relationships and a sense of community, and improve general wellbeing and quality of life (Public Health England, 2018). Despite these health benefits, 1 in 4 adults globally does not meet the recommended public health guidelines for PA (WHO, 2020). This physical inactivity causes approximately 3.2 million deaths worldwide each year and accounts for an estimated $53.8 billion in worldwide healthcare costs (Katzmarzyk et al., 2021).

Disability is a global health and human rights issue (United Nations, 2006) with an estimated 1.5 billion people with disabilities

Received: 21 Nowember..2022 ; **Accepted:** 31 January 2023; **Published:** 28 February 2023
[1]**ORCID:**0000-0001-8009-4163 , [2]**ORCID:**: 0000-0002-5041-0601, [3]**ORCID:**0000-0003-4774-9054,

How to cite this article: Youngson, L., Foster, C. and Lambert, J. (2023). The physical and mental health benefits of lifestyle sports for disabled people: a scoping review. *Int J Disabil Sports Health Sci*;6(1):60-81. https://doi.org/10.33438/ijdshs.1197978

worldwide (WHO, 2011). There are various definitions of disability and ways of identifying as disabled exist across the globe. Some use the term 'disabled people', whereas others prefer 'people with disabilities' or 'people with an impairment'. However, for the purposes of this paper we will use the term 'disabled people' aligning more with a social model of disability whilst representing a more inclusive language (GOV.UK, 2016).

No data exists on what patterns or types of PA are performed by active disabled adults in the UK as they are not included in UK national health surveillance surveys. According to the latest Public Health England data (2018), disabled people are twice as likely to be inactive when compared to non-disabled people with 43% of all disabled adults doing less than 30 minutes of PA a week (PHE, 2018). Disabled people are also less likely to participate in sports than those without disabilities (Jaarsma et al., 2014), despite research showing that engaging in PA poses no increased risk of harm to disabled people (Smith & Wightman, 2019). This lack of participation may be due to several physical, environmental and social barriers facing disabled people, or may simply reflect the global decline in mainstream team sports participation (Hajkowicz et al., 2013). Therefore, it could be helpful to explore promoting the non "typical sports". These activities might be more accessible, of more interest and could provide disabled people with more chance to improve their physical and mental health – lifestyle sports.

This new class of sport has emerged in the last few decades, variously called extreme, adventure, action, and lifestyle sports (Brymer et al., 2020). Typically occurring on water, land and in the air these sports are not governed by the same rules and regulations in mainstream sports. They often involve being in a natural environment and away from the manicured surroundings of traditional sports. Sport England (2021) states that 3.2 million adults participated in adventure sports between November 2019 to November 2020 and for children and young people, active play and informal activity is now the most common type of activity above team sports, running, walking and swimming.

Whatever type or extremity of lifestyle sports' undertaken, all offer a new and alternative way of being active and these lifestyle sports' are now seen as one of the important 'mega trends' of the twenty-first century sport-scape which contrasts with the decline of most team sports (Hajkowicz et al., 2013). Furthermore, these sports have started to be understood for their ability to act as therapeutic interventions for addictions and substance abuse. Roderique-Davies et al. (2018) found that the thrill of rock climbing acted as a replacement for drugs, while Roberts et al. (2018) concluded mountain biking could become a coping strategy for mental health issues.

In 2019 the UK Chief Medical Officer published the first guidelines on PA and sedentary behaviour that acknowledged people living with disability (Department of Health and Social Care, 2019). This was followed in 2020 by the World Health Organisation (Carty et al., 2021). However, in order to achieve these goals as well as meet the PA guidelines, it is important to look at new, modern and inclusive sports as a means to encourage participation for disabled people.

There is growing evidence to suggest the mental and physical health benefits of lifestyle sports for disabled people, but, to date, the research is sporadic and covers a range of methodologies. Our scoping review maps the literature on lifestyle sports and health, exploring how these sports can benefit the physical and mental health of disabled people. By comprehensively reviewing all available literature, identifying gaps in evidence and proposing future areas of research, this paper aims to map the evidence-base that could help to influence disabled people's sports and PA choices and impact upon future policy.

MATERIALS AND METHODS

The methodological framework for this scoping review was conducted using the established five-stage process by Arksey and O'Malley (2005) incorporating adaptations suggested by Daudt et al. (2013). It followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al., 2018).

The following outlines our approach to each stage.

Stage 1: Identifying the research question

The research question was designed according to the following frameworks: Feasible, Interesting, Novel, Ethical and Relevant (FINER) (Farrugia et al., 2010). Alongside this, the PCC

mnemonic (population, concept and context) was used in order to help refine a clear and meaningful title (Peters et al., 2015). A broad research question was set in order to capture all of the study population, sports and subsequent benefits:
"What are the physical and mental health benefits of lifestyle sports for disabled people?"

Stage 2: Identifying relevant studies

The list of lifestyle sports is extensive and so initially this review narrowed the search down to the most prominent sports (Figure 1). Our pilot searches identified that many modern lifestyle sports, such as kitesurfing, skydiving and freediving, do not have any research on their health benefits for disabled people. We expanded to include all types of lifestyle sports in order to broaden the scoping net and ensure fair coverage.

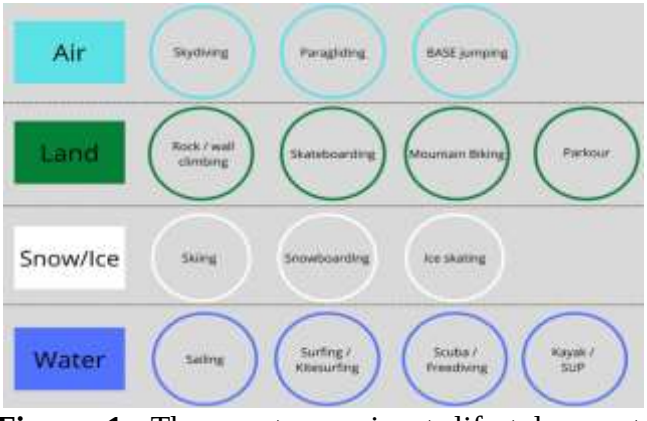

Figure 1. The most prominent lifestyle sports (adapted from Cohen et al., 2018; Wheaton, 2013)

Potential articles were screened against the following inclusion criteria:

- Research articles conducted in English but not limited by geographical location or setting.
- All types of lifestyle sports based on inclusion definitions set by Wheaton. (2013).
- Any form of disability including mental health disorders.
- All age groups and all gender identities.
- Research that considers the physical and/or mental health benefits of these sports for disabled people including specialist therapy-based interventions.
- Sources of information, including primary research studies, reviews, systematic reviews, scoping reviews, meta-analyses, guidelines, as well as grey literature to include unpublished and ongoing trials annual reports, dissertations and conference proceedings.

Databases

We searched four databases, PubMed, Ovid, Scopus, and Web of Science An earliest record/open date limit was set, and searches included doctoral and master's degree theses to ensure the greatest scope of available literature. The search end date was June 2021. In addition to this, a hand-search was conducted using the references list of the most relevant research papers and further cross referencing was conducted upon reviewing chosen research papers' 'Introduction' and 'Discussion' sections to ensure no papers were missed.

Search terms

Key terms were selected to locate relevant studies. To keep the search scope as broad as possible the term "disability" was used as the main search term in order to include all aspects of disability. Once this search was done, it was combined initially with broad sports terms such as "lifestyle sports" OR "extreme sports" OR "action sports" OR "adventure sports", all of which encapsulate the meaning of lifestyle sports. However, this pilot search process initiated limited results and so more refined lifestyle sports terms were used such as: "surfing", "skiing", "rock climbing" etc. These sports were then combined individually with the term "disability" and entered into the databases with an AND. For example, "surfing" AND "disability". As the process evolved the search terms were further refined, using "disability" AND "the chosen sport" combined with "physical health" and "mental health".

Stage 3: Study selection

All research titles were screened for relevance based upon the research question of the scoping review. Papers were discarded if any duplicates were found and abstracts were then evaluated against the strict eligibility criteria. Other lifestyle sports not initially considered such as 'Ice Skating' and 'Kayaking / Stand Up Paddle (SUP)', were included to enhance the breadth of the research findings.

Stage 4: Charting the data

The fourth stage of the scoping review process was to organise all of the data from the selected papers. A data extraction table, using Microsoft Excel version 16, was utilised for this stage. A priori categories were charted as were

emergent themes. The collected data points were author(s), sports type, disability type, study population, physical health benefits, mental health benefits, reduction in symptoms of disability, injuries, costs, barriers to participation, longevity of benefits, impact on family members / caregivers, emergent themes, areas for future research, aims / purpose, methods, outcomes, key findings. See Table 1for an abbreviated table, illustrating study characteristics and key findings related to the research question.

Several outcomes were identified as being associated with physical and mental health and thus, to ensure consistency with the studies found, data were extracted to reflect what the authors of those studies identified as important outcomes. These improved outcomes including physical, mental and social health were reported in this review using the same terminology.

Methodological quality appraisal

Although scoping reviews do not require a quality assessment of included papers, as the aim of a scoping review is to map all the research comprehensively, this review attempted to critically appraise all included research in terms of their methodological quality and generalisability (Peters et al., 2015). Quality of evidence including overall confidence in results was graded (high, moderate, low) by the reviewer based upon design, relevance, validity of measurements and conduct of study (Glasziou et al., 2004). Generalisability was graded (high, moderate and low) by population size, population type and setting characteristics (Burchett et al., 2020).

Stage 5: Collating, summarising and reporting the results

The final stage was to collate all of the relevant findings detailed in the data extraction table and then summarise and present the most pertinent information based on the relevance to the research question.

1. A descriptive analysis, mapping the data, on the country of origin, year of publication, distribution of sports, study population, type of disability and type of study.
2. A thematic summary identifying the key themes that are throughout the studies and their relevance to the research question.

RESULTS

Descriptive analysis

A PRISMA scoping review flow diagram (Figure 2) details the results from the search and subsequent study selection process. In total, 16,046 studies were identified across all five databases. After duplicates were excluded, alongside any papers that did not meet inclusion criteria, 68 studies remained. In addition to this, 10 papers were hand-picked through the review process leaving a total of 78 studies for full text screening. In the process of full text review, 15 studies were excluded due to being 'pay per view' as well as six studies removed for not meeting our explicit eligibility criteria. Overall, the scoping review identified 57 eligible studies that are used in the analysis.

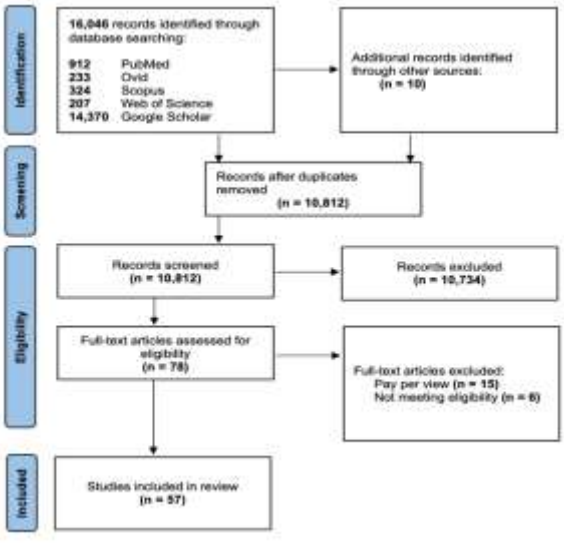

Figure 2. Scoping review flowchart

Overview of included studies

Fifty-seven articles reported studies from 21 different countries. We identified seven different lifestyle sports. Physical disability was the most common type of disability (18 studies) with spinal cord injury (7 studies) being the most prevalent in that group. This was followed closely by the 'mixed disabilities' grouping with 16 studies in total, of which 11 were multiple disabilities. There were 11 studies that included participants with intellectual and learning disabilities and 11 studies on those with mental disorders, with 1 study focussing on those with sensory impairments. See ancillary material for detail.

Quality and designs of studies

Overall, the majority of studies had moderate quality (34/57 studies; 59%) and low generalisability (33/57 studies; 68%). Four studies were deemed of high quality all of which were RCTs, two in rock climbing (Velikonja et al., 2010; Stelzer et al., 2018) and two in sailing (Carta et al., 2014; Sancassiani et al., 2017). There were seven studies that were assessed to have high generalisability, five in surfing (Clapham et al., 2021; Devine-Wright & Godfrey, 2020; Glassman et al., 2021; Van Ewijk et al., 2020; Walter et al., 2019), one for scuba diving (Henrykowska et al., 2021) and one for sailing (Broadbent & Swalwell, 2018). See Appendix 1 for these grades alongside a breakdown of the improved health outcomes.

Fifty-one studies (89.5%) were primary research with quantitative methods being used for over half of all studies (28 studies; 53.8%). The largest proportion of study designs used were experimental (14 studies; 24.6%), cross sectional (12 studies; 21.1%) and longitudinal (10 studies; 17.5%). Surveys were the most used instrument for collecting data (66.7% of studies). There were only four randomised controlled trials conducted, highlighting a need for more research with this strong form of evidence. Of the secondary research, four were reviews, none of which were systematic reviews. No grey literature was found. Table 1 outlines the overall breakdown of all study type, methods, design and instruments used.

Table 1. Summary of key findings

	Author (Year), Country	Disability category (type)	Study population / sample size	Aims/purpose of the study	Study type, method, design, instruments	Key benefits
SURFING	Clapham et al. (2020), USA	INTELLECTUAL & LEARNING DISABILITY (multiple disabilities)	N=91, Mage 12.55, 75% male	To explore the effects of an eight-week surfing intervention on various physical fitness measures in 71 children with disabilities.	Primary, quantitative, causal comparative, surveys	Physical, mental, social and positive impact on family/caregivers
	Schmid et al. (2019), USA	MIXED (4 with Spinal Cord Injury + 2 with neurological disability)	N=6, age range = 30-64, 50% male	To assess the outcomes of a surf camp on disabled people	Primary, qualitative, case study, interviews	Physical, mental, social and positive impact on family/caregivers
	Caddick et al. (2015), UK	MENTAL DISORDER (PTSD)	N=15, age range = 27-60, 100% male	Assessing male combat veterans narratives of PTSD after a surfing intervention	Primary, Qualitative, Longitudinal, interviews	Social
	Moore et al. (2017), USA	INTELLECTUAL (Representing children of a range of disabilities from Clapham et al. (2020) study)	N=11, parents/caregivers	Parents perspectives on surf therapy for children with disabilities	Primary - qualitative- cross sectional - interviews	Physical, mental, social and positive impact on family/caregivers
	Caddick and Smith. (2017), UK	MENTAL DISORDER (PTSD)	N=15, age range = 27-60, 100% male	A narrative study of male combat veterans surfing and war trauma	Primary- qualitative- longitudinal - interviews narrative	Mental, Social
	Glassman et al. (2021), USA	MIXED (Physical and/or mental disorders - depression)	N=74, Mage = 28, 55% male	Examined the outcomes of a therapeutic surf therapy programme for active military staff including looking at gender differences in outcomes.	Primary - Quantitative - experimental - survey	Mental, social

Ewijk et al. (2020), Netherlands	INTELLECTUAL (Down syndrome, autism spectrum disorder or attention-deficit/hyperactivity disorder)	N=84, Mage = 12.5, 76% male	Investigated the effects of surfing on the Quality of life of children with developmental difficulties.	Primary - Mixed - experimental - survey	Mental, social, home-life
Devine-Wright & Godfrey (2020), UK	MIXED (Vulnerable people experiencing long term illness, disability or mental ill health)	N=324, age range = 18-21	Examined the impact of the 'wave project' surfing programme for vulnerable young people.	Primary - Mixed - Longitudinal-instruments = mixed	Mental, social, home-life
Rogers et al. (2014), USA	MENTAL DISORDER (PTSD)	N=14, 93% males	Assessed the effectiveness of surf therapy for the treatment of PTSD for combat veterans	Primary - Quantitative-Cohort-Survey	Mental
Fleischman et al. (2011),USA	PHYSICAL (Amputee)	N=1, age = 24, male	Looked at if surfing is a means of therapy for combated related poly-trauma	Primary-Qualitative-case-survey	Physical
Crawford (2016), USA	MENTAL DISORDER (PTSD)	N=14, 93% male	To determine the effect of surf therapy on combat veterans with PTSD. The focus was to determine if the therapy reduced PTSD symptoms, decreased depression and increased self-efficacy among veterans.	Primary-Quantitative-longitudinal-survey	Mental, social
Walter et al. (2019), USA	MENTAL DISORDER (PTSD, MDD)	N=74, Mage = 28, 55% male	This study examined psychological outcomes among 74 active duty service members participating in the Naval Medical Center San Diego surf therapy program.	Primary-Quantitative-longitudinal-survey	Mental
Otis et al. (2020), USA	MENTAL DISORDER (PTSD, MDD)	N=47, Mage = 29, 53% male	This study compared changes in depression/anxiety and positive affect during surf therapy sessions between active duty service members with co-morbid PTSD and MDD and those with either disorder alone.	Primary – quantitative - longitudinal - survey	Mental
Lopes et al. (2018), Portugal	MIXED (Multiple disabilities)	Children (unspecified amount)	To demonstrate how adaptive surfing can be an important tool to promote physical health and well-being, mental health and psychological well-being along with the social interaction and inclusion of persons with disabilities,	Secondary - Qualitative-case-survey	Mental, social

				regardless of their age or disability		
	Benninger et al. (2020), USA	MIXED (Multiple disabilities)	13 studies on disability - mixed ages	Scoping review of surf therapy as a form of treatment for a wide range of people.	Secondary - review	Physical, mental, social
	Armitano et al. (2015), USA	INTELLECTUAL (Multiple disabilities)	N=16, age range 6-15, 69% male	Assess the effectiveness of an 8-week surf intervention for disabled children	Primary – quantitative - experimental - survey. Pre-post test	Physical
	Van de Merwe & Yarrow. (2020), S.Africa	INTELLECTUAL (Autism spectrum)	N=45, age range = 13-17, 89% male	Assessing the impact of surfing for children with autism in South Africa	Primary -mixed - case study - survey	Mental, social, home-life
	Stuhl & Porter (2015), USA	INTELLECTUAL (Autism spectrum)	6 studies (children)	Review of surfing as a means of therapy for children with autism	Secondary - review	Physical, mental, social
	Britton et al. (2020), Ireland	INTELLECTUAL (Autism spectrum)	N=12, age range = 8-17, 40% male	To understand the Embodied and Therapeutic Experiences of Young Surfers with Autism.	Primary - qualitative - longitudinal - other	Mental, social, home-life
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED (78% dysfunction of the musculoskeletal system - the rest with vision dysfunction and neurological disease)-	N=182, age range = 22-75, 69% men	The exploration of the potential therapeutic benefits of scuba diving for the mental and physical health of people with physical disabilities.	Primary – quantitative - cross sectional - survey	Physical, mental, social
	Morgan et al. (2018), UK	MIXED (life-changing physical or mental health injury resulting from military service)	N=15, 100% male	To explore the effectiveness of scuba diving in providing therapeutic and rehabilitative benefit to ex-service personnel who have experienced traumatic physical and/or psychological injuries resulting from combat.	Primary – quantitative - cross sectional - survey	Mental, social, home-life
	Carin-Levy & Jones, (2007), UK	PHYSICAL (2x spinal cord injury, 1x amputation)	N=3, age range = 33-53,	This project investigated the psychosocial benefits of scuba diving for individuals with acquired physical impairments	Primary- Qualitative- phenomenological -survey	Mental, social
	Stefania et al. (2019), Italy	MIXED (Down syndrome (n=14), autism, paraplegia and cognitive delay)	N=23, age range = 16-30, 70% male	Assessment of the impact of an inclusive diving program, on subjects with cognitive disability	Primary - quantitative experimental- survey	Mental

	Yarwasky & Furst (1996), USA	MIXED (3 paraplegic, 1 quadriplegic, 2 cerebral palsy, 1 amputee, 1 cognitive disability)	N=16 (8 disabled and 8 able bodied), Mage = 35	To understand the motivations and experiences of disabled people in SUBA diving.	Primary-Qualitative-cross sectional-survey	Fun and a thrill
	Naumann et al. (2021), Australia	MIXED (SCI, depression, cerebral palsy , spina bifida, quadriplegia, multiple brain trauma)	N=6 adults, age range = 24-54, 66% male	The aim of this study was to produce a descriptive overview of Immersion Therapy and explore measures used to capture physical and psychosocial experiences.	Primary -mixed-experimental case-survey	Physical, mental, social
	Blumhorst et al. (2020), USA	MIXED (Major depression, PTSD, SCI, Anxiety, amputation)	N=28, Mage = 45, 89% male	The purpose of this study was to examine the effects of a single 45-minute adaptive scuba diving session on veterans' psychological well-being, specifically state-level mindfulness	Primary – quantitative - experimental (pre and post test) - survey	Mental
	Krpalek et al. (2020), USA	MENTAL (PTSD, anxiety, depression, stress)	N=15, Mage 42, 100% male	To explore whether an occupational therapy program in combination with SCUBA diving can enhance occupational performance and mental health outcomes for veterans more than SCUBA diving alone.	Primary - mixed - pre/post experimental-mixed	Mental, home-life
	Abdelkarem (2019), Egypt	PHYSICAL (Paraplegic)	N=10, Mage = 27, 100% male	To assess the psychosocial impact of diving for 10 male divers	Primary – quantitative - pre/post experimental - survey	Physical, mental, social
	Agnovic (2019), Qatar	PHYSICAL (Amputees)	N=12, Mage 33, 100% males	To determine the attainment of the elements of diving techniques, and the effects of programmed instruction of diving on the psychosocial status of war veterans with amputations.	Primary – quantitative - experimental - survey	Mental, social
ROCK / WALL CLIMBING	Delgrande et al. (2019), USA	PHYSICAL (SCI)	N=1, age = 61, male	The purpose of this case report was to document outcomes following a rock climbing program for an individual with an incomplete spinal cord injury (SCI).	Primary - quantitative - longitudinal - survey	Physical, mental
	Bibro & Zarow (2021), Poland	INTELLECTUAL (Mild to moderate intellectual disability. Mostly	N=68, age range = 18-25	The aim of the study was to determine the influence of climbing activities on the	Primary - quantitative experimental (RCT)-other	Physical

	unknown atielogy)		physical fitness of people with ID.		
Steimer & Weissert (2017), Germany	PHYSICAL (Multiple sclerosis)	10 studies - mixed ages and genders	To look at health benefits of rock climbing for people with MS	Secondary - review	Physical, mental, social
Oriel et al. (2018), USA	INTELLECTUAL (Autism spectrum disorder)	N=10, Mage =13, 90% males	The purpose of this pilot study was to: (a) explore the impact of a community-based rock climbing intervention on adolescents with ASD, and (b) examine the social validity of rock climbing as a community-based activity for adolescents with ASD.	Primary -mixed - experimental - other	Mental
Angelini et al. (2020), USA	INTELLECTUAL (ADHD)	N=5, Mage =10, 90% male	Purpose of study was to to explore the effects of rock climbing on attention with children with ADHD	Primary - quantitative - pre/post experimental - survey	Mental
Zielinski et al. (2018), Poland	MENTAL (Depression and / or anxiety)	5 studies - Mixed ages and genders	To assess the influence of sport climbing on depression and anxiety levels	Secondary - review	Mental
Koch et al. (2015), Brazil	PHYSICAL (Cerebral Palsy)	N=8, age range = 4-14, 50% male	The aim of this study was to evaluate the effects of this intervention on handgrip strength, postural control, functional mobility, and the spasticity control of children with cerebral palsy.	Primary - quantitative - case series - survey	Physical
Christensen et al. (2017), Denmark	PHYSICAL (Cerebral Palsy)	N=17, age range = 11-13,	The aim of this study was therefore to test the feasibility of an intensive 3 weeks indoor-climbing training program in children with CP and typically developing (TD) peers.	Primary - quantitative - cross sectional- survey	Physical, social
Biatowas (2018), USA	MIXED (Multiple disabilities)	N=8, age range = 18-21, 66% male	To assess the effects of an indoor rock climbing on highs school aged students with developmental disabilities	Primary -mixed- cross sectional- survey	Mental, social
Velikonja et al. (2010), Slovenia	PHYSICAL (Multiple sclerosis)	N=20, age range = 26-50	Influence of sports climbing and yoga on mood, fatigue and cognitive function in patients with multiple sclerosis	Primary- quantitative - Randomised experimental- survey	Physical

	Stelzer et al. (2018), Germany	MENTAL (MDD)	N=47, Mage = 45, 42% male	To assess if bouldering can reduce symptoms of depression	Primary-quantitative -RCT experimental-survey	Mental
SAILING	Rojhani et al. (2017), USA	PHYSICAL (SCI)	N=1, age =27, male	To demonstrate the mechanisms, adaptability, accessibility, and benefits the sport of sailing creates in the rehabilitative process	Primary-mixed-case study-other	Physical, mental, social, home-life
	Sancassiani et al. (2017), Italy	MENTAL (Severe mental disorders including schizophrenia, affective psychoses, personality disorders)	N=51, Mage = 37, 78% male	This study aimed to assess the efficacy of a psychosocial rehabilitative intervention focused on sailing on quality of life, self-efficacy and sense of coherence in people with severe psychosocial disabilities.	Primary - quantitative - RCT experimental-survey	Mental
	Broadbent & Swalwell. (2018), Australia	PHYSICAL (Multiple Sclerosis)	N=94, Mage = 42, 50% male	Exploring the psychosocial outcomes of a 17 month sailing voyage for people living with multiple sclerosis.	Secondary-qualitative - analysis of data - other	Mental, social, home-life
	Clarke et al. (2020), USA	MIXED (ADHD, Down syndrome, autism, CP, Anxiety)	N=15, age range = 5-18	The current research reviewed the benefits of a sailing program for children with disabilities.	Primary - mixed - cross sectional-survey	Physical, mental, social
	Cappelletti et al. (2020), Italy	PHYSICAL (Epilepsy)	N=58, Mage =15, 48% male	The main aim of our study was to examine the empowerment effects on quality of life of adolescents with epilepsy attending sailing activities, and to compare the results perceived by adolescents and their parents.	Primary – quantitative - cross sectional-survey	Physical, mental
	Carta et al. (2014), Italy	MENTAL (Severe mental disorders (schizophrenia, affective psychoses, personality disorders)	N=40, Mage = 38.5, 95% male	This study set out to evaluate the effectiveness of a sailing and learning-to-sail rehabilitation protocol in a sample of patients diagnosed with severe mental disorders	Primary-quantitative - RCT experimental - survey	Physical
SKIING	Degache et al. (2018), Switzerland	MIXED (Profound intellectual and multiple disability - mainly CP and severe polymalformative syndromes)	N=40, Mage =14, 45% males	The objective of study was to determine the effect of tandem ski activity on postural control and cardiac activity in children with profound intellectual and multiple disabilities	Primary-quantitative -cross sectional descriptive-survey	Physical

	Pasek & Schkade (1995), USA	PHYSICAL (Limb deficiencies)	N=14, age range = 13-19, 50% male	Effects of a 6-day snow skiing trip on 14 adolescents with limb deficiencies were explored. The purpose was to determine whether components of mastery and self-esteem could be identified.	Primary-Qualitative-phenomenological -survey	Mental
	Gimunova et al. (2020), Czech Republic	INTELLECTUAL (Intellectual Disability)	N=47, Mage = 36, 60% male	Purpose of this study was to analyse differences in postural stability between athletes with ID competing in Alpine and Cross country (XC) skiing to assess the effect of special sports training on postural stability in persons with ID	Primary - quantitative - experimental - survey	Physical
	Tangen & Kudlacek (2014), Belgium	PHYSICAL (SCI)	N=4, age range = 55-60, 100% male	To understand the reasons why disabled people partake in extreme skiing	Primary-Qualitative-phenomenological -survey	Social, thrill
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED (Autism, CP, development delay, behavioural disorders)	N=22, age range = 5-12, 45%	To describe an adaptive ice skating programme designed by paediatric therapists.	Primary -mixed-longitudinal - other	Physical, mental, social
	Dursun et al. (2014), Turkey	SENSORY (Visually impaired and hearing impaired)	40 (aged 8-16) 60% girls	In this study, we assessed the effects of ice skating on the psychological well-being, self-concept, and sleep quality of children with hearing or visual impairment.	Primary – quantitative - longitudinal - survey	Mental
	Walsh & Scharf (2013), USA	PHYSICAL (Cerebral Palsy)	N=1, age =5, female	The purpose of this study was to describe the effects of an ice skating program on the ambulation, strength, posture and balance of a child with cerebral palsy (CP).	Primary-quantitative - case report-survey	Physical
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED (wheelchair users, use of crutches)	N=11, Mage = 26, 63% male	The goal of this study was to explore the experiences of kayakers and paddle boarders in two adaptive paddling programs.	Primary-Qualitative-longitudinal - mixed	Physical, mental, social
	Casey et al. (2009), UK	PHYSICAL (SCI)	N=6, age = adults, 50% male	This study aims to gain an insider's perspective on the meaning of engaging in kayaking as a leisure pursuit for six adults with a SCI.	Primary-Qualitative-cross sectional-interview	Physical, mental

	Taylor & mcgruder (1996), USA	PHYSICAL (SCI)	N=3, age range = 23-38, 66% male	The objective of this study was to identify meaningful components of the experience of sea kayaking as described by persons with spinal cord injury (sci).	Primary-Qualitative-cross sectional-interview	Physical, mental, social
	Bjerkefors et al. (2007), Sweden	PHYSICAL (SCI)	N=10, Mage = 38, 70% male	To assess if postural stability of ppl with SCI could be improved with a 10 week kayak training programme	Primary-quantitative - experimental-survey	Physical

Thematic summary

Physical health benefits

General

Overall, 28 studies (49%) presented data on the physical health benefits of participating in the lifestyle sports included in this review (Appendix 1), with seven key outcomes most commonly reported (Table 2). Improvements in body strength and fitness (including cardiorespiratory and overall fitness) were most prevalent, in particular for surfing, rock climbing and kayak/SUP. Handgrip strength (n=4) and overall postural control (n=3) was found to be mainly the domain of rock climbing and sailing. The physical health benefits with the greatest spread across all sports were fitness and balance, occurring in six out of the seven sport types. Surfing had the most reported health benefits (15). Rock climbing was the only study that had at least one reported benefit in each of the seven physical health outcomes. In total physical health benefits were reported 50 times across all studies showing a strong association between physical health and lifestyle sports for disabled people. One study reported no positive change in physical wellbeing (Van Ewijk et al., 2020). A study on scuba diving (Morgan et al., 2018) found some participants suffered from slight abrasions upon entering the water and those with post-traumatic stress disorder (PTSD) sometimes had flashbacks underwater.

Table 2. Total number of physical health outcomes mentioned across all studies

	Surfing	Scuba Diving	Rock Climbing	Sailing	Skiing	Ice Skating	Kayak/SUP	Total
Strength (Body)	4	1	3			2	3	13
Fitness (Overall)	3	2	3	1	1		1	11
Flexibility	2	1	1					4
Endurance/Stamina	4		1			2	1	8
Balance	2		1		1	1	2	7
Grip Strength			3	1				4
Postural Control			1		1	1		3
Total	15	4	13	2	3	6	7	50

Clinical

All seven sports types showed physical benefits that were of clinical importance to disabled people. Most prominent was how the changes in physical health brought about by participation in these sports helped with activities of daily living (ADL). They ranged from reduction in use of crutches (Schmid et al., 2019), enhanced ability to walk more independently (DelGrande et al., 2019) or use prosthetics (Fleischmann et al., 2011). Others reported an increased ability to transfer from floor to stand (Walsh & Scharf, 2013) or from chair to bed (Casey et al., 2009). Aspects of life were also enhanced such as being able to hold a glass (Koch et al., 2015) or open a door (Christensen et al., 2017). These ADL were reported to be done with less tiredness and fatigue (Velikonja et al., 2010; Steimer & Weissert, 2017). Better control of the body was reported across four studies (Bjerkefors et al., 2007; Rojhani et al., 2017; Degache et al., 2018; Gimunová et al., 2020).

There was a reduction in pain found from participating in lifestyle sports in five studies across four of the five disability groups (Fleischmann et al., 2011; Britton et al., 2020; Krpalek et al., 2020; Naumann et al., 2021; Henrykowska et al., 2021). This was particularly the case with amputees when scuba diving due to the weightlessness of the sport.

Mental health benefits

General

The mental health benefits of lifestyle sports for disabled people were a particularly prominent theme with 43 studies (75%) (Appendix 1) reporting benefits across 11 different mental health outcomes. The evidence suggests that improved confidence is a key mental health outcome of participating in lifestyle sports for disabled people (Table 3). Multiple studies highlighted the opportunity to master a new skill as being a facilitator of participants' confidence that was translated into a new 'can do it' mindset (Pasek & Schkade, 1996; Taylor & McGruder, 1996; Casey et al., 2009; Schmid et al., 2019). This confidence, self-esteem, self-efficacy and self-worth was a common by-product of almost every sport. Water sports offered the greatest accumulation of reported mental health benefits (58 of a total 74), with scuba diving in particular scoring on 10 out of the 11 reported mental health outcomes. This manifests into a general improvement in psychological wellbeing (happiness, mood, quality of life, positivity and mindfulness) that was another common outcome across this mental health theme. One ice-skating study (Dursun et al., 2014), focusing on people with sensory impairment, found that self-concept improved for the hearing impaired but decreased for the visually impaired.

Table 3. Total number of mental health outcomes mentioned across all studies

	Surfing	Scuba Diving	Rock Climbing	Sailing	Skiing	Ice Skating	Kayak/ SUP	Total
Confidence	8		4	2	1	1	1	17
Anxiety (Decreased)	5	2	1					8
Stress (Decreased)	1	1						2
Self Esteem	5	2	1		1	1	1	11
Depression (Decreased)	4	2	1					7
Psychological Wellbeing	2	4	3	3				12
Self Efficacy	2		1					3
Self Concept		1						1
Sense of Freedom	2						2	4
PTSD (Decreased)	5	1						6
Focus		1		1				2
Total	32	16	11	6	2	2	4	74

Clinical

Alongside the general mental health benefits, there were strong clinical mental health benefits found in participating in lifestyle sports. A reduction in symptoms of depression, anxiety, stress and PTSD were reported across a range of studies (Glassman et al., 2021; Rogers et al. 2014; Caddick et al., 2015; Crawford, 2016; Caddick & Smith, 2017; Morgan et al., 2018; Zieliński et al., 2018; Stelzer et al., 2018; Walter et al., 2019; Krpalek et al., 2020; Otis et al., 2020). This was mainly when the study was focusing on these mental disorders, but does display the power that these sports have on a clinical level. People with autism were also found to have an improvement in ability to learn and interact with new people (Moore et al., 2017; Van Ewijk et al., 2020).

Impact on family / caregivers

The benefits gained from lifestyle sports for disabled people also impacted family and caregivers. This scoping review found an overall improvement in family life (Schmid et al., 2019) ranging from better communication with family (Moore et al., 2017; Clapham et al., 2020) to increased participation in home activities like cooking (Broadbent and Swalwell, 2019) to improved behaviour and less aggression

shown to loves ones (Moore et al., 2017; Devine-Wright & Godfrey, 2020). In some cases, marriages and relationships were deemed to have been saved as a result of scuba diving (Morgan et al., 2018; Krpalek et al., 2020). Devine-Wright & Godfrey (2020) in an evaluation spanning five years (2013-2017) of 'The Wave Project', a UK wide surf therapy programme for young people, found that surfing acted as an experience that all the family could share thus creating a stronger family bond. Four studies across sailing, surfing and scuba diving, reported participants being happier people at home with better mood (Rojhani et al., 2017; Morgan et al., 2018; Britton et al., 2020; Van der Merwe & Yarrow, 2020).

Emergent themes

Social

A strong theme that emerged through this research process was the social and community aspect that was developed through participating in lifestyle sports. In total 30 out of the 57 studies (52%) reported these benefits (Appendix 1). These sports allowed disabled people to make friends, build social networks and interact with other people. A sense of belonging and community encouraged participants to talk openly about their disabilities and in some cases to improve their social skills in a safe environment. This safe social environment was created through the groups' successful interaction with the challenging aspects and dangers inherent in lifestyle sports. Surfing, rock climbing, scuba diving and sailing harnessed thenecessity of safety in the sport such as, to 'buddy up' and work as a team, to form strong social interactions (Van der Merwe & Yarrow, 2020; Abdelkarem, 2019; Steimer & Weissert, 2017; Broadbent & Swalwell, 2019). While skiing, ice skating and kayaking encouraged joviality and camaraderie amongst participants through chatting during the sport (Tangen & Kudlacek, 2014; Fragala-Pinkham et al., 2009; Merrick et al., 2020). Carin-Levy & Jones, 2007, during a scuba diving intervention, found participants perceptions of social support (family, friends, community) improved to a level of statistical significance ($p \leq 0.01$). This was echoed across the studies but summed up in particular by Moore et al. (2017) who found that surfing works where team sports don't in being inclusive without being forceful, welcoming people into a 'surf community'.

Thrill of sport / the environment

Synonymous with the health benefits garnered from lifestyle sports was the thrill and adrenaline of participation (Crawford, 2016; Yarwasky & Furst, 1996; Oriel et al., 2018; Tangen & Kudlacek, 2014). These thrills manifested in numerous ways, offering disabled people a reason to engage in physical activity (Christensen et al., 2017), develop coping strategies to deal with their disabilities (Rojhani et al., 2017) and to help reconstruct identity after life changing experiences (Tangen & Kudlacek, 2014). Carta et al. (2014) found that the unpredictable and lively environment of sailing at sea could act as a substitute of important joyful or thrilling experiences that people with severe mental disorders miss because of their illness.

Effect on society

Participation in lifestyle sports was found to not only impact the disabled person and their family and caregivers, but also wider society. Engaging in a sport such as kayaking, which is often seen as the realm of the non-disabled, helped to challenge the perceptions of onlookers (Merrick et al., 2020). By enabling disabled people to participate in public places it helped to raise awareness of disability and promoted a sense of equality amongst participants (Casey et al., 2009).

DISCUSSION

To our knowledge, this scoping review is the first of its kind to document the physical and mental health benefits of lifestyle sports for disabled people. A total of 57 studies were found, across seven different sports, highlighting these benefits alongside emergent themes such as the development of social skills and building of community that lifestyle sports afforded people (Appendix 1).

Our results are consistent with previous literature showing the benefits gained by disabled people from participation in other non-lifestyle sports. A recent systematic review by Martin Ginis et al. (2021), covering 36 meta-analysis studies, found there were significant physical health benefits of any type of PA for disabled people, but with mixed mental health benefits. Another systematic review (Aitchison et al., 2021), on the perceived health benefits of sports for disabled people overlooked all but one lifestyle sport

– scuba diving (Carin-Levy & Jones, 2007). They reported few physical benefits but with distinct mental health and social improvements. This scoping review goes beyond these most current findings by highlighting the ability of lifestyle sports to positively affect all three health outcomes for disabled people.

Our review also showed that the physical and mental health benefits of lifestyle sports had far reaching clinical benefit. Participants reported increased capability of walking independently (DelGrande et al., 2019; Schmid et al., 2019), transferring from wheelchair to bed (Casey et al., 2009; Walsh & Scharf, 2013) and in some cases a reduction in general pain (Fleischmann et al., 2011; Britton et al., 2020; Krpalek et al., 2020; Naumann et al., 2021; Henrykowska et al., 2021). Lifestyle sports have been successful in treating the symptoms of depression, anxiety, stress and PTSD whilst giving confidence to disabled people through mastering a new skill (Glassman et al., 2021; Rogers et al. 2014; Caddick et al., 2015; Crawford, 2016; Caddick & Smith, 2017; Morgan et al., 2018; Zieliński et al., 2018; Stelzer et al., 2018; Walter et al., 2019; Krpalek et al., 2020; Otis et al., 2020). However, these benefits were not always long lasting and in a few instances depression and PTSD returned to baseline levels after completion of the intervention, highlighting the need for ongoing support (Moore et al., 2017; Carta et al., 2014, Morgan et al., 2018).

This review found additional strength in the findings through the testament of the disabled persons family or caregivers. People were described as happier (Rojhani et al., 2017; Morgan et al., 2018; Britton et al., 2020; Van der Merwe & Yarrow, 2020), family life was improved (Schmid et al., 2019; Moore et al., 2017; Clapham et al., 2020) and in some instances marriages were even saved as a consequence of participation in lifestyle sports (Morgan et al., 2018; Krpalek et al., 2020). Although this scoping review does not seek to address the benefits to family and caregivers, there may be a duality to any benefits between the disabled person and family/caregiver. For children, or those with disabilities that require constant care, it could prove life changing to have an effect from sport that can also enhance the life of the family/caregiver given it is they who have the power to influence this person's life, either positively or negatively. In promoting a sense of family inclusion in sport and excitement from the benefits, there is a chance for these lifestyle sports to have a lasting impact.

We acknowledge that there was a circular nature to many of the themes found within this scoping review. Not only can the perceptions of the disabled person, their family or caregivers be changed through participation in lifestyle sports, but also society's (Casey et al., 2009; Merrick et al., 2020). Similarly, other research has shown how sports can help manage stigma and challenge public perceptions of disability (Lindemann & Cherney, 2008; Lundberg et al., 2011). The societal impact of seeing disabled people participating in extreme, outdoor, adventure or active sports, although under researched, has the potential to greatly improve the provision of adaptive sports, their equipment and the opportunity to participate. However, this should not be at the expense of the disabled person. The concept of ableism is perpetuated by the media who help to shape society's attitudes toward disability by creating a socially acceptable notion of health that can act as a barrier to participation in sport for some disabled people (Rees et al., 2017). However, they also have the power to change attitudes. Images of disabled people competing at elite sports can help to challenge outdated preconceptions of what being disabled means. On the other hand, this media portrayal can also marginalise disabled people. The non-disabled world is full of stories that emphasis disabled sportspersons as the 'supercrip' (Clare, 2009). This label focuses on disabled people 'overcoming' their disabilities and celebrates normal people as heroes merely for participating in sports (Hardin & Hardin 2004). It turns disabled people into symbols of inspiration, instead of focusing on them as individuals who face societal struggles with their disability.

Through interacting with the more extreme and outdoor nature of these sports, disabled people found a commonality and safe space to express themselves (Van der Merwe & Yarrow, 2020; Abdelkarem, 2019; Steimer & Weissert, 2017; Broadbent & Swalwell, 2019; Tangen & Kudlacek, 2014; Fragala-Pinkham et al., 2009; Merrick et al., 2020). This is in agreement with studies on non-disabled youth that highlighted the importance of skateparks and mountain bike trails as spaces where young, like-minded people can congregate and build friendships (King, 2010; Taylor & Khan, 2011). For disabled people these

shared experiences and opportunities to mix brought with them friendship and in some cases a safe domain to share some of their mental health issues. This therapeutic element of the lifestyle sports experience was found to positively impact people with PTSD, depression or anxiety (Rogers et al., 2014; Crawford, 2016; Caddick et al., 2015; Caddick & Smith, 2017; Stelzer et al., 2018; Zieliński et al., 2018; Walter et al., 2019; Otis et al., 2020; Blumhorst et al., 2020; Krpalek et al., 2020), whilst the group based social element proved valuable to those people on the autism spectrum in particular (Stuhl & Porter, 2015; Oriel et al., 2018; Van der Merwe & Yarrow, 2020; Britton et al., 2020).

Taking part in lifestyle sports may provide a place to fit in and express oneself without scrutiny or judgement. Our review finds a more complex answer. Whilst the thrill and adrenaline of these alternative sports was an attraction (Carta et al., 2014; Crawford, 2016; Oriel et al., 2018; Tangen & Kudlacek, 2014; Yarwasky & Furst, 1996), offering difference to traditional sports, there was no evidence to suggest it was anti-establishment. Disabled people took part in lifestyle sports that now have formal associations. They were able to participate with non-disabled people and subsequently improve their life and the views of others in mainstream society.

Studies relating to just seven lifestyle sports, focusing on the benefits for disabled people, were found in this review. This may owe to the relatively recent emergence of these sports in a healthcare context as one third of all included studies were published in the last two years (2020-2021). Surfing provided the greatest amount of research on benefits to disabled people (19/57 studies) which is in accordance with a scoping review of the evidence base for surf therapy (Benninger et al., 2020). This review builds on that evidence, finding an additional seven studies since then (Clapham et al., 2020; Britton et al., 2020; Van Ewijk et al., 2020; Devine-Wright & Godfrey, 2020; Otis et al., 2020; Van der Merwe & Yarrow, 2020; Glassman et al., 2021) whilst also highlighting two studies that were missed within Benninger et al.'s search dates (2008-2019) (Stuhl & Porter, 2015; Schmid et al., 2019). A recent study by Marshall et al. (2020) found that surfing is an adaptable vehicle for promoting wellbeing and social skills in a post-conflict setting. The sport is now being socially prescribed in the UK (The Wave Project, 2021) to treat depression, anxiety and stress in young people and it is apparent that this nascent area has the potential to reach a wide array of disabled people and provide a benchmark for other lifestyle sports to become socially prescribed.

Study limitations and recommendations

Our review found that the majority of studies had methodological limitations such as small sample sizes, no uniform length of study for each sport type, a poorly represented population, a lack of comparison groups and not enough RCTs. Until these limitations are addressed, it will be hard to state with any certainty whether these positive results are true effect, or simply an artefact of the small and underpowered studies.

There was a wide variety of outcomes across the studies with no consensus or consistency in the gradation of levels of severity of disability, or how to measure the effects of these sports for disabled people. This may stem from difficulty in collecting data from those disabled people who are unable to fully express their feelings, pointing toward a need for a more standardised measure. Researchers need to adopt more creative means of collecting data such as the use of pictograms and other creative arts-based ways of analysing effect. Progress is being made and a recent study by Britton et al. (2020) used body mapping, a novel participatory evaluation method, to analyse effect from a surfing intervention for young people with autism.

Our review critically appraised the studies for quality and generalisability and found an overall moderate to low scoring for both areas across the majority of studies. At present there is a lack of quality evidence because there are not enough RCTs. With very few RCTs, confounding factors such as the skill level of the coach/facilitator, the equipment used, variability in participants medication, and their mood or even their energy levels at different times of the day may also impact results. The scarcity of RCTs may be because there are currently too many outcomes parameters and measures used. To break this circle there needs to be greater consultation with disabled people to understand the real-life outcomes that are required from lifestyle sports studies. Research should be conducted with disabled people and not on them, using an integrated knowledge translation approach to ensure findings are relevant, useful and useable (Jull et al., 2017).

There is no one-size-fits-all approach and thus involving disabled people, researchers, policy makers, parents/caregivers and health-care workers will help to provide a more unified body of evidence.

Research gaps and areas for future research

Future research is needed that consults with disabled people, researchers, policy makers, parents/caregivers and health-care workers to develop more specific outcomes using established measures to evaluate these outcomes across all lifestyle sports. This would enable a more rigorous assessment of lifestyle sports' impact. Gaining a better understanding of the appropriate duration, intensity and quantity needed for long-term improvements would also enable a better understanding of its effectiveness. Alongside this, future studies should look at whether it is the sport, being in nature, or participating as part of a group that creates these benefits.

Overall, more studies of the kind found in this review are needed to help drive policy and bring the level of evidence in line with non-disabled research on lifestyle sports. Relatively few studies on health for disabled people are accepted by medical journals despite disabled people's growing numbers and healthcare costs (Iezzoni, 2013). It is hoped that by encouraging more research into the exciting field of lifestyle sports and disability it will help to develop the overall quality of studies, forcing journals to accept more submissions and ultimately facilitating change on a societal level through increased readership.

Conclusion

The findings from this review highlight the physical and mental health benefits of lifestyle sports for disabled people at both a general and clinical level. However, results must be framed against the overall moderate to low level quality of evidence. Our scoping review was the first of its kind to piece together the information from this burgeoning field of research and, importantly, we hope the findings can challenge researchers and practitioners to do more, whilst simultaneously influencing disabled people's sport and PA choices and ultimately impact future policy.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Author Contributions

Study Design: LY, CF, JL; Data Collection: LY, CF; Statistical Analysis: LY; Data Interpretation: LY, JL; Manuscript Preparation: LY, CF, JL; Final review and editing: LY and CF; Literature Search, LY, JL. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Abdelkarem, K. (2019). Relation between Scuba Diving and the happiness among paraplegia Persons. In *Assiut Journal For Sport Science Arts*. https://ajssa.journals.ekb.eg/article_135365_dc2212fbf8fb7fdd6441f6aef113d07c.pdf#page11

Aitchison, B., Rushton, A., Martin, P., Soundy, A., & Heneghan, N. R. (2020). Experiences and perceived health benefits of individuals with a disability participating in sport: A systematic review protocol. *BMJ Open*, *10* (11). https://doi.org/10.1136/ bmj open-2020-038214

Appelqvist-Schmidlechner, K., Vaara, J. P., Vasankari, T., Häkkinen, A., Mäntysaari, M., & Kyröläinen, H. (2020). Muscular and cardiorespiratory fitness are associated with health-related quality of life among young adult men. *BMC Public Health*, *20* (1). https://doi.org/10.1186/s128 89-020-08969-y

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19–32. https ://doi.org/10.1080/1364557032000119616

Benninger, E., Curtis, C., Sarkisian, G., Rogers, C., Bender, K., & Comer, M. (2020). *Surf Therapy: A Scoping Review of the Qualitative and Quantitative Research Evidence*.https://www.gjcpp.org/pdfs/BenningerEtAl-Final.pdf

Bjerkefors, A., Carpenter, M. G., & Thorstensson, A. (2007). Dynamic trunk stability is improved in paraplegics following kayak ergometer training. *Scandinavian Journal of Medicine & Science in Sports*, *17*(6),672–679. https://doi.org/10.1111/j.1600-0838.2006.00621.x

Britton, E., Kindermann, G., & Carlin, C. (2020). Surfing and the Sense: Using Body

Mapping to Understand the Embodied and Therapeutic Experiences of Young Surfers with Autism. Global Journal of Community Psychology Practice, 11(2),1–17. Accessed 5th August 2021 from (http:// www. gjcpp. org/).

Britton, E., Kindermann, G., Domegan, C., & Carlin, C. (2018). Blue care: a systematic review of blue space interventions for health and wellbeing. *Health Promotion International*, *35*(1).https://doi.org/10.1093 /heapro/day103

Broadbent, F. J., & Swalwell, J. M. (2019). "I can do more than I thought I could": exploring the online blogs from the Sailing Sclerosis Oceans of Hope journey. *Disability and Rehabilitation*, *42*(6),880–886. https://doi. org/10.1080/09638288.2018.1510046

Brymer, E., Feletti, F., Monasterio, E., & Schweitzer, R. (2020). Editorial: Understanding Extreme Sports: A Psychological Perspective. *Frontiers in Psychology*, *10*.https://doi.org/10.3389/fpsy g.2019.03029

Burchett, H. E. D., Kneale, D., Blanchard, L., & Thomas, J. (2020). When assessing generalisability, focusing on differences in population or setting alone is insufficient. *Trials*, *21*(1).https://doi.org/10. 1186/s13063-020-4178-6

Caddick, Nick and Smith, Brett. (2017), "Combat Surfers: A Narratıve Study Of Veterans, Surfıng, And War Trauma." Movimento, Vol. 23, núm.1, pp.25-38 Accessed 4th August 2021 from https://www.redalyc. org/articulo.oa?id=115350608003

Caddick, N., Smith, B., & Phoenix, C. (2015). Male combat veterans' narratives of PTSD, masculinity, and health. *Sociology of Health & Illness*, *37*(1), 97–111. https:// doi.org/10.1111/1467-9566.12183

Carin-Levy, G., & Jones, D. (2007). Psychosocial Aspects of Scuba Diving for People with Physical Disabilities: An Occupational Science Perspective. *Canadian Journal of Occupational Therapy*, *74*(1), 6–14. https:// doi.org/10.2182/cjot.06.07

Carta, M. G., Maggiani, F., Pilutzu, L., Moro, M. F., Mura, G., Cadoni, F., Sancassiani, F., Vellante, M., Machado, S., & Preti, A. (2014). Sailing for Rehabilitation of Patients with Severe Mental Disorders: Results of a Cross Over Randomized Controlled Trial. *Clinical Practice & Epidemiology in Mental Health*, *10*(1), 73–79.https://doi.org/10.2174/1745017901410 010073

Carty, C., van der Ploeg, H. P., Biddle, S. J. H., Bull, F., Willumsen, J., Lee, L., Kamenov, K., & Milton, K. (2021). The First Global Physical Activity and Sedentary Behavior Guidelines for People Living With Disability. *Journal of Physical Activity and Health*, *18*(1),86–93.https://doi.org/10.112 3/jpah.2020-0629

Casey, N., O'Broin, D., & Collins, B. (2009). *The Meanıng Of The Experıence Of Kayakıng For Persons Wıth Spınal Cord Injury*. http://eprints.bournemouth.ac.uk/21427/1/e xperience%20of%20kayaking.pdf

Christensen, M. S., Jensen, T., Voigt, C. B., Nielsen, J. B., & Lorentzen, J. (2017). To be active through indoor-climbing: an exploratory feasibility study in a group of children with cerebral palsy and typically developing children. *BMC Neurology*, *17* (1).https://doi.org/10.1186/s12883-017088 9-z

Clapham, E. D., Lamont, L. S., Shim, M., Lateef, S., & Armitano, C. N. (2020). Effectiveness of surf therapy for children with disabilities. *Disability and Health Journal*, *13*(1),100828. https://doi.org /10. 1016/j.dhjo.2019.100828

Clare, Eli. (2009). *Exile and pride: Disability, queerness, and liberation*. Durham: Duke University Press.

Clarke, J. (2011). What is a systematic review? *Evidence-Based Nursing*, *14*(3), 64–64.https://doi.org/10.1136/ebn.2011. 00 49

Crawford, R. (2016). The impact of ocean therapy on veterans with posttraumatic stress disorder. *Journal of Traumatic Stress*, 11(4), pp.811–819.

Daudt, H. M., van Mossel, C., & Scott, S. J. (2013). Enhancing the scoping study methodology: a large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology*, *13*(1). https://doi. org/10.1186/1471-2288-13-48

Degache, F., Bonjour, A., Michaud, D., Mondada, L., & Newman, CJ. (2018). The effects of

tandem skiing on posture and heart rate in children with profound intellectual and multiple disabilities. *Developmental Neurorehabilitation*, *22*(4), 234–239. https://doi.org/10.1080/17518423.2018.1462268

DelGrande, B., LaCoppola, C., Moriello, G., & Sanicola, K. (2019). Outcomes following an adaptive rock climbing program in a person with an incomplete spinal cord injury: A case report. *Physiotherapy Theory and Practice*, *36*(12), 1466–1475. https://doi.org/10.1080/09593985.2019.1587799

Department of Health and Social Care. (2019). UK Chief Medical Officers' Physical Activity Guidelines. In *gov.uk*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832868/uk-chief-medical-officers-physical activity-guidelines.pdf

Devine-Wright, H., & Godfrey, C. (2020). *The Wave Project: Evidencing Surf Therapy for Young People in the UK*. https://www.gjcpp.org/pdfs/Devine-Wright_Godfrey-Final.pdf

Dursun, O. B., Erhan, S. E., Ibiş, E. Ö., Esin, I. S., Keleş, S., Şirinkan, A., Yörük, Ö., Acar, E., & Beyhun, N. E. (2014). The effect of ice skating on psychological well-being and sleep quality of children with visual or hearing impairment. *Disability and Rehabilitation*, *37*(9), 783–789. https://doi.org/10.3109/09638288.2014.942002

Farrugia, P., Petrisor, B. A., Farrokhyar, F., & Bhandari, M. (2010). Research questions, hypotheses and objectives. *Canadian Journal of Surgery*, *53*(4), 278–281. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2912019/#__ffn_sectitle

Fleischmann, D., Michalewicz, B., Stedje-Larsen, E., Neff, J., Murphy, J., Browning, K., Nebeker, B., Cronin, A., Sauve, W., Stetler, C., Herriman, L., & McLay, R. (2011). Surf Medicine: Surfing as a Means of Therapy for Combat-Related Polytrauma. *JPO: Journal of Prosthetics and Orthotics*, *23*(1), 27–29. https://doi.org/10.1097/JPO.0b013e3182065316

Fragala-Pinkham, M. A., Dumas, H. M., Boyce, M., Peters, C. Y., & Haley, S. M. (2009). Evaluation of an adaptive ice skating programme for children with disabilities. *Developmental Neurorehabilitation*, *12*(4), 215–223. https://doi.org/10.1080/17518420902980100

Gimunová, M., Skotáková, A., Grün, V., Jenčíková_, K., Daněk, L., Hlinský, T., Svobodová, L., Kalichová, M., & Válková, H. (2020). The differences in postural stability between cross-country and Alpine skiers with intellectual disabilities. *Acta of Bioengineering and Biomechanics*, *22*(4). https://doi.org/10.37190/abb-01690-2020-04

Glassman, L. H., Otis, N. P., Michalewicz-Kragh, B., & Walter, K. H. (2021). Gender Differences in Psychological Outcomes Following Surf Therapy Sessions among U.S. Service Members. *International Journal of Environmental Research and Public Health*, *18*(9), 4634. https:// doi. org /10.3390/ijerph18094634

Glasziou, P., Vandenbroucke, J., & Chalmers, I. (2004). Assessing the quality of research. *BMJ : British Medical Journal*, *328*(7430),39–41.https://www.ncbi.nlm.ni .gov/pmc/articles/PMC313908/

Hajkowicz, S., Cook, H., Wilhelmseder, L., & Boughen, N. (2013). *The future of Australian sport Megatrends shaping the sports sector over coming decades A consultancy report by CSIRO for the Australian Sports Commission*. https://www.sportanddev.org/sites/default/files/downloads/the_future_of_australian_sport-full_report.pdf

Hardin, Marie, and Brent Hardin. 2004. "The "supercrip" in sport media: Wheelchair athletes discuss hegemony's disabled hero." *Sociology of Sport Online* 7(1).

Henriksson, H., Henriksson, P., Tynelius, P., Ekstedt, M., Berglind, D., Labayen, I., Ruiz, J. R., Lavie, C. J., & Ortega, F. B. (2020). Cardiorespiratory fitness, muscular strength, and obesity in adolescence and later chronic disability due to cardiovascular disease: a cohort study of 1 million men. *European Heart Journal*, *41*(15),1503–1510.https://doi.org/10.1093/eurheartj/ehz774

Henrykowska, G., Soin, J., & Siermontowski, P. (2021). Scuba Diving as a Form of Rehabilitation for People with Physical Disabilities. *International Journal of*

Environmental Research and Public Health, *18*(11).https://doi.org/10.3390/ijerph18115678

Iezzoni, L. I. (2013). Imperatives for HSR Addressing. *Medical Care*, *51*(2), 133–136. https://doi.org/10.1097/mlr.0b013e31827da9b9

Jaarsma, E. A., Dijkstra, P. U., Geertzen, J. H. B., & Dekker, R. (2014). Barriers to and facilitators of sports participation for people with physical disabilities: A systematic review. *Scandinavian Journal of Medicine & Science in Sports*, *24*(6), 871–881. https://doi.org/10.1111/sms.12218

Jull, J., Giles, A., & Graham, I. D. (2017). Community-based participatory research and integrated knowledge translation: advancing the co-creation of knowledge. *Implementation Science*, *12*(1). https://doi.org/10.1186/s13012-017-0696-3

Katzmarzyk, P. T., Friedenreich, C., Shiroma, E. J., & Lee, I-Min. (2021). Physical inactivity and non-communicable disease burden in low-income, middle-income and high-income countries. *British Journal of Sports Medicine*, bjsports-2020-103640. https://doi.org/10.1136/bjsports-2020-103640

King, K. (2010). *Lifestyles, identity and young people's experiences of mountain biking*. Www.forestry.gov.uk. http://eprints.bournemouth.ac.uk/19016/

Koch, H. G. B., Peixoto, G. de O., Labronici, R. H. D. D., Silva, N. C. de O. V. e, Alfieri, F. M., & Portes, L. A. (2015). Therapeutic climbing: a possibility of intervention for children with cerebral palsy. *Acta Fisiátrica*, *22*(1), 30–33. https://doi.org/10.5935/0104-7795.20150008

Krpalek, D., Achondo, N., Daher, N., & Javaherian, H. (2020). Reducing Veterans' Symptoms of Depression, Anxiety, Stress, and Posttraumatic Stress, and Enhancing Engagement in Occupations with SCUBA Diving and Occupational Therapy. *Journal of Veterans Studies*, *6*(1), 98. https://doi.org/10.21061/jvs.v6i1.158

Lindemann, K., & Cherney, J. L. (2008). Communicating In and Through "Murderball": Masculinity and Disability in Wheelchair Rugby. *Western Journal of Communication*, *72*(2), 107–125. https://doi.org/10.1080/10570310802038382

Marshall, J., Ferrier, B., Ward, P.B., & Martindale, R. (2020). "I feel happy when I surf because it takes stress from my mind": An Initial Exploration of Program Theory within Waves for Change Surf Therapy in Post-Conflict Liberia. *Journal of Sport for Development.* Retrievedfrom https://jsfd.org/

Martin Ginis, K. A., van der Ploeg, H. P., Foster, C., Lai, B., McBride, C. B., Ng, K., Pratt, M., Shirazipour, C. H., Smith, B., Vásquez, P. M., & Heath, G. W. (2021). Participation of people living with disabilities in physical activity: a global perspective. *The Lancet*, *398*(10298), 443–455. https://doi.org/10.1016/s0140-6736(21)01164-8

Merrick, D., Hillman, K., Wilson, A., Labbé, D., Thompson, A., & Mortenson, W. B. (2020). All aboard: users' experiences of adapted paddling programs. *Disability and Rehabilitation*, 1–7. https://doi.org/10.1080/09638288.2020.1725153

Moore, A. M., Clapham, E. D., & Deeney, T. A. (2017). Parents' Perspectives on Surf Therapy for Children with Disabilities. *International Journal of Disability, Development and Education*, *65*(3),304–317.https://doi.org/10.1080/1034912x.2017.1400660

Morgan, A., Sinclair, H., Tan, A., Thomas, E., & Castle, R. (2018). Can scuba diving offer therapeutic benefit to military veterans experiencing physical and psychological injuries as a result of combat? A service evaluation of Deptherapy UK. *Disability and Rehabilitation*, *41*(23), 2832–2840. https://doi.org/10.1080/09638288.2018.1480667

Naumann, K., Kernot, J., Parfitt, G., & Davison, K. (2021). Exploring the physical and psychosocial experience of Immersion Therapy for people living with a disability. *F1000Research*, *10*, 135. https://doi.org/10.12688/f1000research.27889.1

Oriel, K. N., Kanupka, J. W., Fuehrer, A. T., Klumpp, K. M., Stoltz, K. N., Willey, D. W., & Decvalcante, M. L. (2018). The Impact of a Rock Climbing Program for Adolescents with Autism Spectrum

Disorder: A Pilot Study. *International Journal of Kinesiology in Higher Education*, *2*(4), 113–126. https://doi.org/10.1080/24711616.2018.1425601

Otis, N. P., Walter, K. H., Glassman, L. H., Ray, T. N., Michalewicz-Kragh, & Thomsen, C. J. (2020). Global Journal of Community Psychology Practice, 11(2), 1-23. Retrieved 06/01/2021, from (http://www. gjccp.org/).

Pasek, P. B., & Schkade, J. K. (1996). Effects of a Skiing Experience on Adolescents With Limb Deficiencies: An Occupational Adaptation Perspective. *American Journal of Occupational Therapy*, *50*(1), 24–31. https://doi.org/10.5014/ajot.50.1.24

Peters M, Godfrey C, McInerney P, Soares C, Khalil H, Parker D. (2015). The Joanna Briggs Institute reviewers' manual 2015: methodology for JBI scoping reviews.

Public Health England. (2018). *Physical activity for general health benefits in disabled adults: Summary of a rapid evidence review for the UK Chief Medical Officers' update of the physical activity guidelines*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/748126/Physical_activity_for_general_health_benefits_in_disabled_adults.pdf

Rees, L., Robinson, P., & Shields, N. (2017). Media portrayal of elite athletes with disability-a systematic review. *Disability and Rehabilitation*, *41*(4), 374–381. https://doi.org/10.1080/09638288.2017.1397775

Roberts, L., Jones, G., & Brooks, R. (2018). Why Do You Ride?: A Characterization of Mountain Bikers, Their Engagement Methods, and Perceived Links to Mental Health and Well-Being. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.01642

Roderique-Davies, G., Heirene, R. M., Mellalieu, S., & Shearer, D. A. (2018). Development and Initial Validation of a Rock Climbing Craving Questionnaire (RCCQ). *Frontiers in Psychology*, *9*. https://doi.org/10. 3389/fpsyg.2018.00204

Rogers, C.M., Mallinson, T. and Peppers, D. (2014). High-Intensity Sports for Posttraumatic Stress Disorder and Depression: Feasibility Study of Ocean Therapy With Veterans of Operation Enduring Freedom and Operation Iraqi Freedom. American Journal of Occupational Therapy, [online] 68(4), p.395. Accessed 5th August 2021 from https://ajot.aota.org/article.aspx?articleid=1884509.

Rojhani, S., Stiens, S. A., & Recio, A. C. (2017). Independent sailing with high tetraplegia using sip and puff controls: integration into a community sailing center. *The Journal of Spinal Cord Medicine*, *40*(4), 471–480. https://doi.org/10.1080/10790268.2016.1198548

Sancassiani, F., Cocco, A., Cossu, G., Lorrai, S., Trincas, G., Floris, F., Mellino, G., Machado, S., Nardi, A. E., Fabrici, E. P., Preti, A., & Carta, M. G. (2017). "VelaMente?!" - Sailing in a Crew to Improve Self-Efficacy in People with Psychosocial Disabilities: A Randomized Controlled Trial. *Clinical Practice and Epidemiology in Mental Health : CP & EMH*, *13*, 200–212. https://doi.org/10.2174/1745017901713010200

Schmid, S. M., Short, C. T., & Nigg, C. R. (2019). Physical Activity & People with Disabilities-A Qualitative Process and Outcome Pilot Evaluation of the Non-Profit Organization AccesSurf Hawai'i. *Hawai'i Journal of Medicine & Public Health*, *78*(2), 52–60. https://www. ncbi. nlm.nih.gov/pmc/articles/PMC6369885/#fnsectitle

Sport England. (2021). Sport England. https://www.sportengland.org/know-your-audience/data/active-lives/active-lives-data-tables?section=children and young people surveys

Steimer, J., & Weissert, R. (2017). Effects of Sport Climbing on Multiple Sclerosis. *Frontiers in Physiology*, *8*. https://doi.org/10.3389/fphys.2017.01021

Stelzer, E. M., Book, S., Graessel, E., Hofner, B., Kornhuber, J., & Luttenberger, K. (2018). Bouldering psychotherapy reduces depressive symptoms even when general physical activity is controlled for: A randomized controlled trial. *Heliyon*, *4*(3), e00580. https://doi.org/10.1016/j.heliyon.2018.e00580

Stuhl, A., & Porter, H.R. (2015). Riding the Waves: Therapeutic Surfing to Improve

Social Skills for Children with Autism. *Therapeutic recreation journal*, *49*.

Tangen, S., & Kudlacek, M. (2014). Extreme sport and reconstruction of identity in persons with spinal cord injury (SCI). *European Journal of Adapted Physical Activity*, *7*(2), 3–12. https://doi.org/10.5507/euj.2014.006

Taylor, L. P. S., & McGruder, J. E. (1996). The Meaning of Sea Kayaking for Persons With Spinal Cord Injuries. *American Journal of Occupational Therapy*, *50*(1), 39–46. https://doi.org/10.5014/ajot.50.1.39

Taylor, M. F., & Khan, U. (2011). Skate-Park Builds, Teenaphobia and the Adolescent Need for Hang-Out Spaces: The Social Utility and Functionality of Urban Skate Parks. *Journal of Urban Design*, *16*(4), 489–510. https://doi.org/10.1080/13574809.2011.586142

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., & Lewin, S. (2018). Prısma Extension for Scoping Reviews (Prısma-ScR): Checklist and Explanation. *Annals of Internal Medicine*, *169*(7), 467. https://doi.org/10.7326/m18-0850

United Nations. (2006) Convention on the Rights of Persons with Disabilities Preamble. (2006).https://www.un.org/disabilities/documents/convention/convention_accessible_pdf.pdf

Van der Merwe, N., & Yarrow, P. (2020). More than Surfing: Inclusive Surf Therapy Informed by the Voices of South African Children with Autism Spectrum Disorder. Global Journal of Community Psychology Practice, 11(2), 1 – 14. Accessed 5 August 2021, from (http://www.gjcpp.org/).

Van Ewijk, H., Wansink-Lokerman, M., Lamerz, A., & Van Den Broek, S. (2020). *Positive Effects of Surfing on Psychological Wellbeing for Children with Developmental Difficulties*. https://www.gjcpp.org/pdfs/VanEwijkEtAl-Final.pdf

Velikonja, O., Čurić, K., Ožura, A., & Jazbec, S. Š. (2010). Influence of sports climbing and yoga on spasticity, cognitive function, mood and fatigue in patients with multiple sclerosis. *Clinical Neurology and Neurosurgery*, *112*(7), 597–601. https://doi.org/10.1016/j.clineuro.2010.03.006

Walsh, S. F., & Scharf, M. G. (2013). Effects of a recreational ice skating program on the functional mobility of a child with cerebral palsy. *Physiotherapy Theory and Practice*, *30*(3), 189–195. https://doi.org/10.3109/09593985.2013.863414

Walter, K.H., Otis, N.P., Ray, T.N., Glassman, L.H., Michalewicz-Kragh, B., Powell, A.L. and Thomsen, C.J. (2019). Breaking the surface: Psychological outcomes among U.S. active duty service members following a surf therapy program. *Psychology of Sport and Exercise*, 45(45), p.101551.

Wheaton, B. (2013). The Cultural Politics of Lifestyle Sports. London: Routledge.

World Health Organisation (2011). World report on disability. https://www.who.int/disabilities/world_report/2011/report.pdf (accessed August 19, 2021).

World Health Organisation (2020). *Physical activity*.Who.int;https://www.who.int/news-room/fact-sheets/detail/physical-activity

Yarwasky, L., & Furst, D. M. (1996). Motivation to Participate of Divers with and without Disabilities. *Perceptual and Motor Skills*, *82*(3_suppl),1096–1098. https://doi.org/10.2466/pms.1996.82.3c.1096

Zieliński, G., Byś, A., Baszczowski, M., Ginszt, M., Suwała, M., & Majcher, P. (2018). The influence of sport climbing on depression and anxiety levels - literature review. *Journal of Education, Health and Sport*, *8*(7), 336–344. https://doi.org/10.5281/zenodo.131822

Addition:

Appendix 1. Summary of study characteristics, quality and generalisability and improved outcomes for health benefits

	Author (Year), Country	Disability category	Improved outcomes	Quality	Generalisability
			Physical benefits		
SURFING	Clapham et al. (2020), USA	INTELLECTUAL	Core strength, upper body strength, cardio respiratory fitness, flexibility and endurance.	Moderate	High
	Schmid et al. (2019), USA	MIXED	Improved strength, endurance, and flexibility.	Moderate	Low
	Moore et al. (2017), USA	INTELLECTUAL	Increased balance, muscle tone, stamina	Moderate	Moderate
	Fleischman et al. (2011), USA	PHYSICAL	Improved balance	Low	Low
	Benninger et al. (2020), USA	MIXED	Improvements in physical fitness,	Moderate	N/A
	Armitano et al. (2015), USA	INTELLECTUAL	Overall improvement in upper body strength, core strength and cardiorespiratory endurance	Moderate	Low
	Stuhl & Porter (2015), USA	INTELLECTUAL	General improvement in physical health	Moderate	N/A
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED	Mixed results on physical fitness, but improvements in motor skills, respiratory fitness,	Moderate	High
	Naumann et al. (2021), Australia	MIXED	Improved fitness and strength, increased heart rate, rating of perceived exertion and affect, stretching,	Moderate	Low
	Abdelkarem (2019), Egypt	PHYSICAL	Flexibility, increased movement and improved sensation from being in the water	Moderate	Low
ROCK / WALL CLIMBING	DelGrande et al. (2019), USA	PHYSICAL	Increased muscle strength and arm girth.	Moderate	Low
	Bibro & Zarow (2021), Poland	INTELLECTUAL	Significantly improved balance, upper body strength and handgrip force. All physical fitness improved.	Moderate	Moderate
	Steimer & Weissert (2017), Germany	PHYSICAL	Cardiorespiratory fitness and muscular endurance.	Moderate	N/A
	Koch et al. (2015), Brazil	PHYSICAL	Improvements in the handgrip strength, postural control, functional mobility, and spasticity control of these children.	Low	Low
	Christensen et al. (2017), Denmark	PHYSICAL	Improvements in the sit to stand tests, improvement in pinch grip strength. Physical fitness and strength can be improved with people with CP after a 3 week climbing intervention.	Low	Low
	Velikonja et al. (2010), Slovenia	PHYSICAL	Improved flexibility	High	Moderate
SAILING	Rojhani et al. (2017), USA	PHYSICAL	Sailing improved his mobility	Low	Low
	Clarke et al. (2020), USA	MIXED	Significant increase in grip strength	Low	Low

	Cappelletti et al. (2020), Italy	PHYSICAL	Improvement in general physical health	Low	Moderate
	Carta et al. (2014), Italy	MENTAL	Statistically significant improvement of their clinical status and of their general functioning.	High	Moderate
SKIING	Degache et al. (2018), Switzerland	MIXED	Better rest and recovery heart rate after skiing.	Low	Moderate
	Gimunova et al. (2020), Czech Republic	INTELLECTUAL	Better postural stability, enhanced balance skills	Moderate	Moderate
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED	Leg strength, endurance, balance	Moderate	Low
	Walsh & Scharf (2013), USA	PHYSICAL	Improvements in standing posture, increased strength	Low	Low
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED	Improvements in core strength and fitness	Moderate	Low
	Casey et al. (2009), UK	PHYSICAL	Upper body strength, fitness and balance	Moderate	Low
	Taylor & McGruder (1996), USA	PHYSICAL	Increased strength and stamina, improved balance	Moderate	Low
	Bjerkefors et al. (2007), Sweden	PHYSICAL	Improved upper body stability	Moderate	Low
	Mental benefits				
SURFING	Clapham et al. (2020), USA	INTELLECTUAL	Improved self confidence, and decreased anxiety.	Moderate	High
	Schmid et al. (2019), USA	MIXED	Decline in social anxiety and stress. Increase in self-confidence and independence.	Moderate	Low
	Moore et al. (2017), USA	INTELLECTUAL	Improvement in self esteem and self confidence.	Moderate	Moderate
	Caddick and Smith. (2017), UK	MENTAL DISORDER	Respite from PTSD	Low	Low
	Glassman et al. (2021), USA	MIXED	Significant increases in positive affect and decreases in symptoms of depression/anxiety.	Moderate	High
	Ewijk et al. (2020), Netherlands	INTELLECTUAL	Significant improvement was seen in overall quality of life as well as three specific domains: Psychological well-being, growth in self-esteem, self-confidence and autonomy.	Moderate	High
	Devine-Wright & Godfrey (2020), UK	MIXED	Improvement in overall wellbeing, self esteem. Positive emotions, coping and self strategy, confidence and motivation,	Moderate	High
	Rogers et al. (2014), USA	MENTAL DISORDER	Participants reports of PTSD significantly lower after 5 week intervention. A renewed sense of self - efficacy in a non combat arena.	Low	Low
	Crawford (2016), USA	MENTAL DISORDER	Improvements in self efficacy, reductions in depression and lessening of symptoms of PTSD	Moderate	Low
	Walter et al. (2019), USA	MENTAL DISORDER	Significant decrease in depression, anxiety, PTSD and negative affect while positive	Moderate	High

			affect significantly increased.		
	Otis et al. (2020), USA	MENTAL DISORDER	Improvements in depression/anxiety and positive effect following surf therapy	Low	Moderate
	Lopes et al. (2018), Portugal	MIXED	Autonomy, self esteem	Low	Low
	Benninger et al. (2020), USA	MIXED	Self confidence	Moderate	N/A
	Van de Merwe & Yarrow. (2020), S.Africa	INTELLECTUAL	Confidence and self esteem	Low	Moderate
	Stuhl & Porter (2015), USA	INTELLECTUAL	Self esteem	Moderate	N/A
	Britton et al. (2020), Ireland	INTELLECTUAL	Confidence and self esteem	Moderate	Low
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED	Positive mental health impact (78% of participants), massive impact on self esteem, improvement in self belief,	Moderate	High
	Morgan et al. (2018), UK	MIXED	Improvement in levels of anxiety, depression. Being underwater offered them a sense of freedom from their physical impairments	Low	Low
	Carin-Levy & Jones, (2007), UK	PHYSICAL	Improved self concept.	Moderate	Low
	Stefania et al. (2019), Italy	MIXED	Improved cognitive ability after scuba diving	Moderate	Low
	Naumann et al. (2021), Australia	MIXED	Sense of freedom and relaxation	Moderate	Low
	Blumhorst et al. (2020), USA	MIXED	Post scuba increased mindfulness as diving allowed them to focus on only one thing. Contentment massively increased post dive.	Moderate	Low
	Krpalek et al. (2020), USA	MENTAL	Improvements in PTSD, depression, anxiety and stress scores. Participants reported increased self-awareness, increased regulation, decreased anxiety, and improved mood. improved concentration, increased focus, decreased stress, and decreased anxiety	Moderate	Low
	Abdelkarem (2019), Egypt	PHYSICAL	Improved QoL after 3 week training. Significant positive differences in the happiness score post test.	Moderate	Low
	Agnovic (2019), Qatar	PHYSICAL	Improved self esteem	Moderate	Low
ROCK / WALL CLIMBING	DelGrande et al. (2019), USA	PHYSICAL	Improvement in the overall being	Moderate	Low
	Steimer & Weissert (2017), Germany	PHYSICAL	Feelings of success, increase self-confidence and self-esteem	Moderate	N/A
	Oriel et al. (2018), USA	INTELLECTUAL	Confidence and focus	Moderate	Low
	Angelini et al. (2020), USA	INTELLECTUAL	Improvements in confidence, problem solving and perseverance.	Moderate	Low

	Zielinski et al. (2018), Poland	MENTAL	Practicing climbing can benefit depression treatment by controlling the feeling of fear and anxiety, which may also occur during depression	Moderate	Low
	Biatowas (2018), USA	MIXED	Improved mental well-being , confidence	Low	Low
	Stelzer et al. (2018), Germany	MENTAL	Improved mood	High	Moderate
SAILING	Rojhani et al. (2017), USA	PHYSICAL	The participant noted improvements in mood, self-worth. Sea had a calming effect.	Low	Low
	Sancassiani et al. (2017), Italy	MENTAL	Self-efficacy significantly increased after the sailing course and decreased after treatment	High	Moderate
	Broadbent & Swalwell. (2018), Australia	PHYSICAL	Feeling stronger and more confident	Moderate	High
	Clarke et al. (2020), USA	MIXED	Increase in self confidence, increase on positive outlook on life.	Low	Low
	Cappelletti et al. (2020), Italy	PHYSICAL	Improvement in emotional functioning	Low	Moderate
SKIING	Pasek & Schkade (1995), USA	PHYSICAL	Positive self-evaluation, self-esteem, confidence.	Moderate	Low
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED	Self esteem/confidence	Moderate	Low
	Dursun et al. (2014), Turkey	SENSORY	Self-concept, behavioural and emotional problems	Moderate	Moderate
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED	Sense of freedom and equalising effect of being on the water.	Moderate	Low
	Casey et al. (2009), UK	PHYSICAL	Sense of freedom, sense of achievement, kayaking generated optimism about the future.	Moderate	Low
	Taylor & McGruder (1996), USA	PHYSICAL	Improvement in self-esteem and confidence from trying something new."I can do this" sense of achievement from kayaking.	Moderate	Low
			Social benefits		
SURFING	Clapham et al. (2020), USA	INTELLECTUAL	Gains in social development	Moderate	High
	Schmid et al. (2019), USA	MIXED	The surfing helped participants with their families, friends, and among the community (social outcomes).	Moderate	Low
	Caddick et al. (2015), UK	MENTAL DISORDER	The social aspect of surfing helped encourage banter and talk about their problems.	Moderate	Low
	Moore et al. (2017), USA	INTELLECTUAL	This social and inclusive environment of the 'surf community' seems to generate interactions with others, which parents suggest improve children's social skills and feelings of inclusion.	Moderate	Moderate

	Caddick and Smith. (2017), UK	MENTAL DISORDER	Social bonds formed through surfing	Low	Low
	Glassman et al. (2021), USA	MIXED	Women responded well to the positive group norms formed through surf therapy.	Moderate	High
	Ewijk et al. (2020), Netherlands	INTELLECTUAL	Socio-emotional impact of surfing intervention. Children were part of a team whilst still surfing individually and were rewarded / given prizes at end of each session.	Moderate	High
	Devine-Wright & Godfrey (2020), UK	MIXED	Social trust - making friends when usually wouldn't do. Improved social skills.	Moderate	High
	Crawford (2016), USA	MENTAL DISORDER	Social connections made through surfing important.	Moderate	Low
	Lopes et al. (2018), Portugal	MIXED	Social relationships improved	Low	Low
	Benninger et al. (2020), USA	MIXED	Social development	Moderate	N/A
	Van de Merwe & Yarrow. (2020), S.Africa	INTELLECTUAL	Helped to build friendships	Low	Moderate
	Stuhl & Porter (2015), USA	INTELLECTUAL	Significant improvement in social skills	Moderate	N/A
	Britton et al. (2020), Ireland	INTELLECTUAL	Built rapport with others	Moderate	Low
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED	Diving improved scope and quality of social interactions	Moderate	High
	Morgan et al. (2018), UK	MIXED	Social interaction ("bonding") with like-minded individuals	Low	Low
	Carin-Levy & Jones, (2007), UK	PHYSICAL	Enhancement of social experiences. 'Buddy' system etc allowed them to engage with others.	Moderate	Low
	Naumann et al. (2021), Australia	MIXED	Socially supportive aspect of SCUBA	Moderate	Low
	Abdelkarem (2019), Egypt	PHYSICAL	Sense of community found with a led bodied people with the 'buddy' system used in diving.	Moderate	Low
	Agnovic (2019), Qatar	PHYSICAL	Perceived social support significantly rose after the scuba diving intervention	Moderate	Low
ROCK / WALL CLIMBING	Steimer & Weissert (2017), Germany	PHYSICAL	Improved ability for social interaction	Moderate	N/A
	Christensen et al. (2017), Denmark	PHYSICAL	Mental and social skills improved	Low	Low
	Biatowas (2018), USA	MIXED	Social emotional benefits	Low	Low
SAILING	Rojhani et al. (2017), USA	PHYSICAL	Sense of community belonging	Low	Low
	Broadbent & Swalwell. (2018),	PHYSICAL	Teamwork and camaraderie	Moderate	High

	Australia				
	Clarke et al. (2020), USA	MIXED	Social skills	Low	Low
SKIING	Tangen & Kudlacek (2014), Belgium	PHYSICAL	Strong social benefits	Moderate	Low
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED	Ability to participate in a group after participating in the ice skating programme.	Moderate	Low
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED	Prominent social component to paddling as most paddlers chatted jovially throughout their session	Moderate	Low
	Taylor & McGruder (1996), USA	PHYSICAL	Kayaking helped socialising with emphasis shifted from disability to the sport.	Moderate	Low