COMPARISON OF RANGE OF MOTION, REACTION TIME, FLEXIBILITY AND BALANCE ABILITY BETWEEN PHYSICALLY ACTIVE AND WHEELCHAIR USER: A SCOPING REVIEW

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By

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CERTIFICATE

This is to certify that dissertation entitled

COMPARISON OF RANGE OF MOTION, REACTION TIME, FLEXIBILITY AND BALANCE ABILITY BETWEEN PHYSICALLY ACTIVE AND WHEELCHAIR USER:A SCOPING REVIEW

Is the bonafide record of research work by

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DECLARATION

I hereby declare that this dissertation is the result of my investigation, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or currently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional propose.

Signature

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Muhammad Nashihin Bin Zoel Fadli

Date:23.6.2021

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List of Abbreviations

WHO	=	World Health Organization
ROM	=	Range of Motion
PA	=	Physical Activity
RE	=	Resistance Exercise
BADL	=	Basic Activity daily Living
IADL	=	Instrumental Activity Daily Living
MWC	=	Manual Wheelchair
RCT	=	Randomise Control trial
SD	=	Standard Deviation
WCU	=	Disable
NWCU	=	Able-body

PERBEZAAN JULAT PERGERAKKAN,MASA TINDAK BALAS,FLEXIBILITI DAN KESEIMBANGAN ANTARA ORANG AKTIF DAN PENGGUNA KERUSI RODA:KAJIAN SKOP

ABSTRAK

Tujuan penyelidikan ini adalah untuk mencari perbezaan data pengguna kerusi roda dan orang aktiv fizikal.Sebanyak 15 jurnal dari tahun 2010-2021 telah dipilih dari jumlah 444 pilihan asal. Dari situ didapati perbezaan bahawa orang aktif fizikal mempunyai julat pergerakkan, reaksi masa dan flexibiliti yang lebih baik berbanding pegguna kerusi roda. Namun telah dibuktikan bahawa dengan latihan, pengguna kerusi roda juga dapat memperoleh peningkatan dari segi julat pergerakkan, masa tindak balas, flexibiliti dan keseimbanggan. Data bagi pegguna kerusi roda kami terhad kepada mereka yang tidak mempunyai penyakit. Pengguna kerusi roda sihat badan dan tidak mempunyai penyakit, Kami mengharapkan lebih banyak jurnal dan kajian dibuat berkenaan pengguna kerusi roda yang sihat. Dengan data ini, kita dapat memberi panduan untuk penambahbaikan pergerakan mereka yang akan membuatkan kehidupan mereka lebih aktif.

COMPARISON OF RANGE OF MOTION, REACTION TIME, FLEXIBILITY AND BALANCE ABILITY BETWEEN PHYSICALLY ACTIVE AND WHEELCHAIR USER:A SCOPING REVIEW

ABSTRAK

The purpose of this study is to find the comparison in data between the wheelchair user and physically active. Several 15 journals were chosen from year 2010-2021 from the initial number 442. From this research, we find that physically active people have a better range of motion, reaction time and flexibility compared to wheelchair users. It is also proven that with training, the wheelchair users can increase their range of motion, flexibility and balance ability. The exclusion criteria for this review are those with diseases will be excluded. We hope in future, much more journals and research will be conducted on wheelchair users. With the data, we can guide them to improve their movement and produce a more active lifestyle.

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

An active lifestyle is the best lifestyle to practice. Physical activity is any body movement that works your muscles and requires more energy than resting. Walking, running, dancing, swimming, yoga, and gardening are a few examples of physical activity A lot of health benefits can be found in the past research. Most of the previous research concentrates on healthy lifestyle for healthy individuals. A healthy lifestyle has both short-term and long-term health benefits. Long term, eating a balanced diet, taking regular exercise and maintaining a healthy weight can add years to our life and reduce the risk of certain diseases including cancer, diabetes, cardiovascular disease, osteoporosis and obesity. In the short term it can also make us feel and look our best, give us more energy and help us maintain a healthy weight. WHO defines physical activity as any bodily movement produced by skeletal muscles that require energy expenditure including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits. The term "physical activity" should not be confused with "exercise", which is a subcategory of physical activity that is planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness. Beyond exercise, any other physical activity that is done during leisure time, for transport to get to and from places, or as part of a person's work, has a health benefit. Further, both moderate- and vigorous-intensity physical activity improve health

Many health-related components can be monitored to show that the individuals practice a healthy lifestyle. These components including engagement in a physical activity, eating healthier food and sleeping habits. (M.J.Lamonte 2002). Quality of active lifestyle can also be monitored in terms of the range of motion, reaction time, flexibility and standing ability. These also will be monitored in this study to compare the components between the wheelchair user and physically active individuals. Limited research can be found about a person with special needs especially a wheelchair user. Most of the previous research mostly concentrated on

wheelchair technology to ease the usage of the wheelchair especially automatic wheelchair or powered wheelchair. A few researched by the Architecture department mostly concentrated on providing access to wheelchair users in public places (Jefferds AN 2016). There are not many studies that had been done on this topic(meaning on comparison data between wheelchair users and physically active people).As explained above from WHO, the term physical activity is not to be confused with exercise,so in this research context physically active people meaning people that are doing exercises. I believe with the data that will be gather soon, it is important to know are there any differences in data. When we know why and how, enhancement could be made in order to improve the quality of life for both wheelchair users and non-wheelchair users. Sedentary lifestyles are common among wheelchair users, resulting in poor cardiometabolic profiles (high BMI, increased body fat percentage and abnormal lipid and glucose concentrations). So with the data, we are able to identify the subtopic and ways to help wheelchair users to start an active lifestyle or even maintaining an active lifestyle in an organize manner, so that the maximum positive effects could be achieve.

1.2**Problem Statement**

A lot of previous studies concentrate on normal and healthy people in various research fields limited study was done on special needs population. So this study would concentrate on wheelchair users which are healthy or minimal pain, not the disease type. To understand more and compare of data between them and active individuals.

1.3 Research Objectives

1.3.1 General Objective

To review the data of the range of motion, reaction time, flexibility and balance ability between the wheelchair user and healthy individuals.

1.3.2Specific Objectives

1)To review the data on the range of motion of the upper limb for wheelchair users and healthy individuals.

2)To review the data on reaction time for the wheelchair user and physically active individuals

3)To review data on flexibility between the wheelchair user and physically active individuals.

4) To review data on balance ability between wheelchair users and physically active individuals.

1.4 Significant of the Study

A limited study was done on the effect of low physical activity on wheelchair users. Movement limitation faced by wheelchair users will affect their ability and daily activities to achieve recommended daily physical activity. This study tries to compare the difference in data of a range of motion, reaction time, flexibility and standing ability compared to the physically active individuals. The health status and effect of using a wheelchair can be assessed, the information from this study can be used to help wheelchair user to improve their lifestyle in which area they are lacking. The information also can be used to understand more about capability of the human body that can be applied to the new wheelchair use

CHAPTER 2 LITERATURE REVIEW

2.1 Range of motion

Measurements of the motion of joints are an accepted clinical technique for evaluating a disability; but normative data or baseline data for the disabled are sparse. The best-known source for average ranges of joint motion is the handbook of The American Academy of Orthopaedic Surgeons. Data analysis in the repeated study was undertaken as outlined by Valevicius et al. and Lavoie et al. (2018) (Gritsenko,Valeriya,Russel, 2016). Movements are the product of interactions between neural control signals and the musculoskeletal dynamics that depend on limb anatomy

2.2 Reaction time

The reaction time of an organism is a measure of how rapidly it can respond to a certain stimuli. Reaction time has been extensively researched since its practical ramifications can be significant; for example, a slower than average reaction time when driving might have disastrous consequences. Age, gender, physical fitness, exhaustion, distraction, alcohol, personality type, and whether the stimulus is auditory or visual have all been proven to alter reaction times. A stimulus is converted into an electrochemical signal by sensory neurons, which then travels the length of the sensory neuron(s), then through a neuron or neurons in the central nervous system, and finally through the length of the motor neuron (s). Examples are diving to save a rebound ball for a goalkeeper or lifting our hands when told so (left or right).

2.3 Flexibility

Physical fitness requires a high level of flexibility. The capacity to move a joint across its complete range of motion (ROM) with ease is referred to as flexibility. Flexibility varies by joint. This means that joint flexibility is not always connected to joint flexibility in other joints. For example, a person's shoulders may have a tremendous range of motion, but her hips may be restricted. Gymnasts and hurdlers, for example, clearly require an extraordinary range of motion to compete in their competitive disciplines, but high flexibility makes everyday movements easier for everyone. Although flexibility is frequently promoted as a preventive factor against injury, empirical data to support this claim is limited. With data from several different papers, we could use it to make better improvement for wheelchair users in future.

2.4 Balance

Posture and balance control are fundamental in daily life to safely accomplish any type of movement and motor task that involves the displacement of body segments or the entire body. Balance is the process of maintaining the body's centre of gravity (CoG) vertically over the base of the support, and it relies on rapid and continuous feedback from visual, vestibular and somatosensory structures for the subsequent execution of smooth and coordinated neuromuscular actions (Winter, 1995; Zatsiorsky and Duarte, 1999). Efficient postural balance not only reduces the risk of body imbalance, fall, or subsequent injuries, but also contributes to the optimization of motor performance in several athletic disciplines (Hrysomallis, 2007)

Prospective studies indicate that 30–60% of community-dwelling older adults fall each year (Berg, Alessio, Mills, and Tong, 1997; Campbell et al, 1990; Luukinen, Koski, Hiltunen, and Kivela, 1994; Maki, Holliday, and Topper, 1994; Tinetti, Speechley, and Ginter, 1988); and falls are the leading cause of injury-related morbidity and mortality in this population (Web-based Injury Statistics Query and Reporting System, 2008). Moreover, the number of falls

among residents of aged care facilities is reported to be three times greater than community-dwelling older adults in the literature (Hewitt et al, 2014). The fall incidence was found to be 33.9% in a recent prospective study for older adults living in nursing homes in Turkey (Apaydın Kaya et al, 2012). Balance and gait impairments were stated as the most important risk factors for falls in older adults (Cho and An, 2014). As falls are the most common cause of non-fatal injuries and fall-related injuries can result in mobility limitation, loss of confidence, and declines in physical activity and community participation in older adults, interventions that address identified risk factors appear to be the most beneficial in preventing falls and reducing the health care burden (Granacher, Gollhofer, and Strass, 2006; Sherrington et al, 2008). Exercise programs show promise among effective fall prevention strategies (Kannus et al, 2005; Noohu, Dey, and Hussain, 2013; Rendon et al, 2012; Rubenstein, 2006; World Health Organization, 2007), and the preventive effect of balance training is accepted as an integral part of the management of older adults with fall risk or fall history (Kannus et al, 2005; Noohu, Dey, and Hussain, 2013; Rendon et al, 2012; Rubenstein, 2006). Conventional balance exercises are one of the most preferred exercise options for improving balance safely and decisively in the geriatric population. Conventional exercise programs that provide appropriate challenges to balance with appropriate dose were declared to be effective in improving balance and preventing falls (Sherrington et al, 2011).

It has become almost routine practice to incorporate balance exercises into training programs for athletes from different sports, fall prevention programs for the elderly and rehabilitation programs. The objectives and benefits seem obvious, e.g., performance improvement and injury prevention as commonly cited goals (Hrysomallis 2011; Kümmel et al., 2016; Lesinski et al., 2015). However, the type of training that is most efficient remains unclear, and the frequency, intensity and duration of exercise that would be most beneficial have not yet been determined. One of the purposes of this review was to compare the methods used and findings of balance measurement, and to check which is the most efficient.

2.5 Physically active

To get the most benefits in our life, we are suggested to follow an active lifestyle. Evaluation of the best practice also compared to the active lifestyle. In this study, the health-related assessment of wheelchair users was compared to the active individuals, to compare the effect of the wheelchair activities to the standard activities. Room for improvement will be identified to benefit wheelchair users.

CHAPTER 3 METHODOLOGY

3.1. Data sources

Ebscohost, Scopus, Proquest, and Science Direct were used to conduct an electronic search for related studies. This is because the content are appropriate with the research question of this scoping review In a nutshell, the chosen studies were hand-searched using the same selection criteria outline below. In addition, to gain more information, cross-referencing on similar studies was done. Articles from February 2012-2021 were used to review, and there are not no attempts were tried to contact the author.

Preferred Reporting Items for Scoping Reviews and Meta-Analyses (PRISMA) criteria were used to search .During the search, the following keywords were used : #Comparison of range of motion, #reaction time,# flexibility #balance ability (physically active)(wheelchair user). Studies were screened on the data on physically active and wheelchair users. Those data were used in the report. PRISMA flow was created using a set of pre-determined steps, which include identification, screening, and eligibility. The databases yielded 444 possible articles during the initial search. After deleting duplicates, 442 publications were evaluated against the selection criteria based on their titles and abstracts. A total of 427 publications were omitted from the study because they did not look into wheelchair users, a physically active and healthy wheelchair user. After spending time evaluating which is the best articles, only 15 articles were chosen for this study.

To decide whether complete texts were required for additional analysis, the titles and abstracts of retrieved publications were examined using the criteria stated. The following criteria were used to evaluate each full-text manuscript: (1) study objectives, (2) study characteristics (study design, participants, age, and sample size), and (3) intervention content (intervention types),4) the duration of the intervention or the type of exercise that was tried, the targeted outcome/s, and the 5) major findings. Because of the nature of this systematic

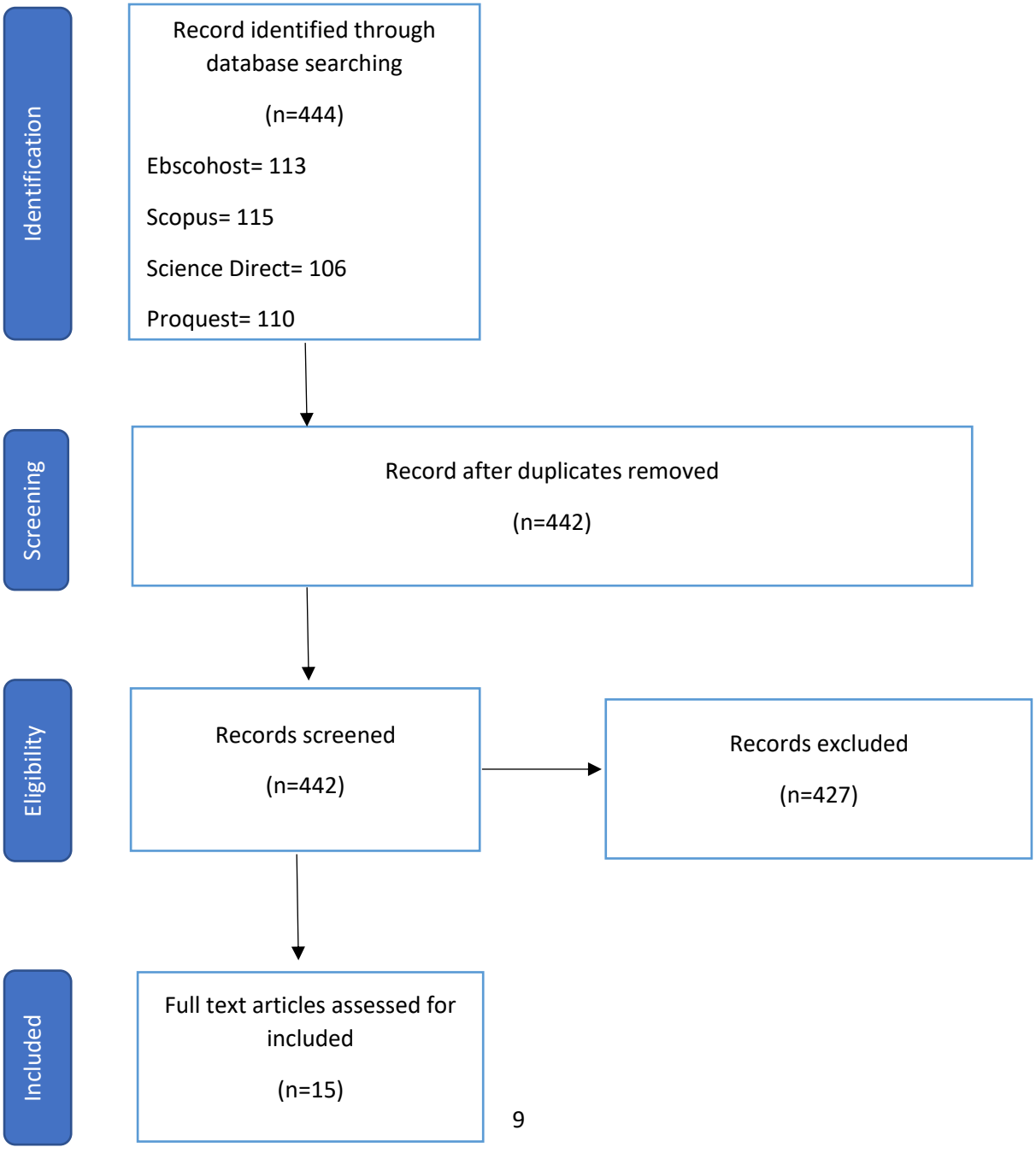
review, the findings from those studies were not pooled, reanalyzed, or altered. Results from each paper is extracted for this scoping review.

3.2 Research Design

Scoping review

3.3 Study Flowchart

Figure 3.1 Prisma Flow



CHAPTER 4 RESULT

The list of the journal selected for this review was listed in Table 4.1. The method of measurements, main findings and comments based on the review were listed in the table.

Table 4.1 15 Journals that are reviewed

No.	Authors and year	Study target/target population	Outcome Measures	Main finding	Comment
1.	(Cíntia Aparecida Garcia Meneguci; Meneguci, Joilson; Jeffer Eidi Sasaki; Tribess, Sheilla; Jair Sindra and Virtuoso Júnior. Jan 2021) Physical activity, sedentary behaviour and functionality in older adults: A cross-	Individuals aged 60 and up who lived in urban areas and were registered in the Family Health Strategy, a programme that attempts to reform primary healthcare in the country according to the precepts of the Brazilian Unified Health System, were included in the study population. The following were the exclusion criteria: being	In four domains, the IPAQ questionnaire evaluates moderate-vigorous physical activity (MVPA) (occupation, transportation, housework, and leisure time). The sum of total moderate activity (including walking) plus two times the number of minutes of vigorous activity was used to create a total physical activity score. The duration of physical activity was measured in minutes/week as the time spent in moderate to vigorous intensity activities.	There were no direct impacts of physical activity and sedentary behaviour on impairment in basic activities of daily living (BADL).Instrumental activities of daily living(IADL) disability (= -0.037) and aerobic endurance (= 0.012) mediated an indirect effect of physical activity. Sedentary behaviour exhibited an indirect influence	All the subjects are healthy and not many impacts(although there are) were recorded.

	sectional path analysis	bedridden, hospitalised, or a long-term institution resident; having severe visual and hearing acuity that makes communication with the interviewer difficult; being wheelchair dependent; having musculoskeletal or neurological diseases that prevent physical function measurements; failing to get a total of 13 points in the Mini-Mental State Examination (MMSE) ; and not agreeing to participate in the study by signing		that was mediated by aerobic resistance (= 0.028) and lower limb flexibility (= 0.020).	

		the informed consent form.			
2.	(Giesbrecht, Edward M; Miller and William C,Oct 5, 2017) A randomized control trial feasibility evaluation of a mHealth intervention for wheelchair skill training among middle-aged and older adults	The mHealth intervention and control groups were compared using a 2 2 factorial design randomised controlled trial (RCT), with increased wheeling time as a second factor. The participants were community-dwelling Manual Wheelchair(MWC) users aged 55 and up who had been using their MWC for less than two years and propelled it with two hands. Process, resource, management, and treatment	. The participants were community-dwelling MWC users aged 55 and up who had been using their MWC for less than two years and propelled it with two hands. Process, resource, management, and treatment criteria feasibility outcomes were collected	Overall, the study procedure allowed for a safe, efficient, and acceptable administration of the Intervention. Recruitment of participants proved difficult, especially gaining access to those who would benefit. For the administration of the intervention, resource issue requests were acceptable. The findings indicate that a full-scale RCT evaluating the clinical impact of the Enhancing Participation in the Community by Improving Wheelchair Skills (EPIC Wheels) intervention is	This is a training session for them to use their wheelchair with lots of benefits that could help them in future.

		criteria feasibility outcomes were collected.		warranted, assuming that recruitment issues are addressed through collaborative partnerships and active recruitment strategies. Eighteen people were hired, with a 94 per cent retention rate. The first and second in-person training sessions had a mean (SD) duration of 90.1 20.5 and 62.1 5.5 minutes, respectively. Over four weeks, 78 per cent of the treatment group completed the required amount of home training (300 minutes) and 56 percent completed the desired training threshold (i.e., 600 min).	

3.	(Ilie, Mihai; Adela, Prioteasa and Ana-Maria, 2017) : Aspects of balance ability in Swimming	The study looked at seven people (three men and four women) who were approached as case studies, high-performance swimmers, and National Championship medalists. The research was conducted at the Human Performance Research Center, and employed the Sensamove Balance Miniboard platform as a testing tool	. The subjects were assessed for static and dynamic balance while receiving real-time visual feedback by looking at the notebook's display. Each test lasts 30 seconds, while the subject has to stay as balanced as possible; to move the body mass from left to right, front and back.	The goal of this study was to determine the level of balance ability in swimmers through case studies that measured static and dynamic balance as a sensory reaction to visual cues. The results were interpreted using data provided by the platform software, which was expressed in four different ways (front,back,left and right) correspond to the frontal and sagittal Planes, respectively. The best results were found in the front-to-back dynamic balancing measurement,	Swimmers have good ability of balance , this is due to their training which makes them have good balance.

				with three of the participants obtaining percentages of over 90%.	
4	(Nejc Šarabon and Žiga Kozinc ,2020) Effects of Resistance Exercise on Balance Ability: Systematic Review and Meta-Analysis of Randomized Controlled Trials	13 papers were included for this meta-analysis	The target demographic comprised people of all ages and genders. As a result, children and adolescents (18 years old), adults (18–65 years old), and elderly persons (65 years old) were taken into account. Participants with neurological (e.g., Parkinson's disease, multiple sclerosis) or musculoskeletal problems were excluded from studies (e.g., osteoarthritis, choric pain).	RE treatments were found to significantly improve balance skills in adult and older adult participants in this comprehensive study. This discovery has significant practical ramifications, as RE might be used to improve muscular strength and power while also improving balance.	With resistance exercise, there are effects on balance ability.
5	(Valerio Bonavolontà, Francesca Greco , Umberto Sabatini ,Francisco J. Saavedra ,Francesco Fischetti,Carlo Baldari ,Laura Guidetti ,Maria Grazia Vaccaro and Gian Pietro	The study included thirty-one experienced middle-aged people. At T6, 24 people (age: 59.4 11.6 years, 11 females, 13 males) were tested, and 18 persons were reviewed at T10. All of the participants came from Catanzaro's "Free Dance" Dance School.	The goal of this study was to see how six months of ballroom dancing (three times per week) affected physical fitness and reaction time (RT) in 24 experienced middle-aged people (age: 59.4 11.6 years).	Inexperienced middle-aged people, six-month ballroom dance practice had positive effects on response speed but no effects on PF. Furthermore, the RT improvement was sustained four months later. As a result, a dancing practice could be a beneficial technique for ageing well. More	It needs time to increase in reaction time, reaction time comes with training and it needs months, it cant happen in a short time.

	Emerenzian i ,2021)Effec ts of Ballroom Dance on Physical Fitness and Reaction Time in Experienced Middle-Aged Adults of Both Genders			research is needed to look into the effects of different types of dances on PF and RT results.	
6	: (Anh Luu, Avory Winans, Rema Suniga & Vicki A. Motz,2021) Reaction Times for Esport Competitors and Traditional Physical Athletes are Faster than Noncompeti tive Peers	The Reaction Times of healthy 18 to 22-year-old college football athletes, esports competitors, and a control group (n = 12 for each group) were studied in this study.	In duplicate, Reaction Timess to visual (colour cue test, ruler drop test), auditory (sound cue test), and tactile stimuli (probe grabbing test) were recorded. ANOVA and post hoc t-tests were used to compare individual test RTs and derived composite RTs between groups.	The responses of all individuals were remarkably consistent. The mean RT of esport competitors (269.83 23.46 ms) was significantly lower than the control group (290.83 36.50 ms) in the colour cue test (Fig. 1A), showing faster RTs. However, the RT of sport athletes (276.50 28.02 ms) did not differ significantly from that of football players. In the ruler drop test (Fig. 1B), esport athletes (174.58 26.14 ms) and football players	Training people have better reaction time compared to untrained people.

				(186.94 20.30 ms) had considerably faster reaction times than the control group (223.47 31.11 ms); nevertheless, football and esport were not significantly different.	
7	(SalmanNazary-Moghadam , Esmaeel Imani , Sayyed HadiSayyed Hosseinian , Afsaneh Zeinalzadeh , Samira Karimpour and Hosein Negahban, 2021) Visuomotor reaction time difference between patellofemoral pain syndrome and healthy individuals: Cross-sectional study	The current study included 25 PFPS patients (20 women and 5 men, mean age 29.28 years, SD 5.59) and 25 healthy controls (19 women, 6 men, mean age 29.32 years, SD 5.30). Upper extremity response time, upper extremity error rate, knee extension reaction time in both involved and uninvolved legs, and plantar flexion reaction time in both involved and uninvolved legs were the dependent variables.	Patients with PFPS had slower upper extremity reaction time (P=0.047, Effect size (ES)=0.39) and plantar flexion reaction time (symptomatic side) (P0.001, ES=0.77) than healthy controls, according to the results of a one-way multiple analysis of variance. Although the problematic knee extension reaction time was slower than the corresponding healthy limb, the difference was not statistically significant.	This may provide insight into cerebral mechanisms of neuromuscular control and injury prevention by considering neurocognitive reaction time, adding to current research attempting to connect neurocognitive reaction time with cortical mechanisms monitoring the motor programme in patients with musculoskeletal disorders. The upper extremity visuomotor reaction time of PFPS patients was slower than that of healthy controls. This observation is particularly	Note that this study has results for healthy individuals and patellofemoral pain syndrome, and my study is on wheelchair users, but it clearly states that healthy individuals have better reaction time for the upper extremity. There are differences in data for people with patellofemoral pain syndrome and healthy individuals.

				intriguing because PFPS patients were previously classified as having peripheral dysfunction. According to the findings of this study, the PFPS can be classified as peripheral and central impairments.	
8	(M.Ghasemi & N Arjmand, 2021)Spinal segment ranges of motion, movement coordination, and three-dimensional kinematics during occupational activities in normal-weight and obese individuals	The study included nine healthy young normal-weight (23.6 1.1 years, 178.1 5.7 cm, 75.9 7.1 kg, and BMI = 23.9 1.3 kg/m2) and nine age/height matched obese (26.9 3.9 years, 176.6 4.0 cm, 110.1 10.6 kg, and BMI = 35.3 2.6 kg/m2) male volunteers with no recent back/knee/hip pain ($p > 0.05$ for differences in age and height but p 0.0001 for their Body Mass Index (BMI)	The goal of this study was to measure/compare trunk, lumbar, and pelvis primary RoM in all anatomical planes/directions, lumbopelvic ratios (lumbar to pelvis rotations at different trunk angles) in all anatomical planes/directions, and three-dimensional spine kinematics in healthy normal-weight and obese individuals during twelve symmetric/asymmetric static load-handling activities.	In most cases, variations between the two groups in segmental complete RoM in different planes/directions were found to be less than 5° (10%), with no statistical significance.	There are differences in spinal segments and range of motion (ROM), but not that much between obese and normal people.
9	Keiichi Moromizato , Ryosuke Kimra,	On Okinawa Island in Japan, 78 healthy	Ranges of motion (ROMs) at limb and trunk joints of young	Body structures influence ROMs, as evidenced by	Women generally have better range

	Hitoshi Fukae,Kyoko Yamaguchi &Hajime Ishida,2016)Whole-body patterns of the range of joint motion in young adults: masculine type and feminine type	participants (42 males and 36 females) were recruited. The passive range of motion (ROM) of the left and right side limbs, as well as the trunk, was assessed at different joints across the body (31 measurements).	people were examined in this study to better understand the covariation patterns of diverse joint motions and to identify factors that influence ROM variation.	comparisons between males and females, dominant and non-dominant sides, and antagonistic motions. The first principal component (PC1) in principal component analysis (PCA) on the ROM data represented the sex difference, and a similar covariation pattern showed in the analysis within each sex.	of motion (ROM) compare to men.
10	(Mateus, Ana,; Rebelo, Jessica, Silva & Anabela G, 2020) Effects of a Multimodal Exercise Program Plus Neural Gliding on Postural Control, Pain, and Flexibility of Institutionalized Older Adults: A	Institutionalized older persons (n = 26) were randomly assigned to either a multimodal exercise programme with neural gliding or a multimodal exercise programme alone.	Both interventions were given twice a week for a total of eight weeks. Pain, gait velocity, balance, flexibility, and TUG were all measured before and after the intervention.	Pain intensity (F1,24 = 8.95, P =.006), balance (F1,24 = 10.29, P =.004), and gait velocity (F1,24 = 5.51, P =.028) all had a significant main effect of time, showing that both therapies had a favourable influence. There were no other significant effects (TUG and flexibility; P >.05).	There was an immediate beneficial and significant influence on pain intensity, static balance, and gait speed after the intervention, but no effect on Timed Up and Go(TUG) or lower limb flexibility.

	Randomized, Parallel, and Double-Blind Study				
11	(Grinko, V, Kudelko, V, Yefremov A , & Klokova S, 2020) Effect of aerobic direction on the flexibility of students. dynamics and forecasting ,	Eighty-one fourth grade students ($\bar{X}$age = 9.23 ± 0.62; 39 girls; 54.3% African American, 30.9% Non-Hispanic White, 14.8% other) participated in this study from 2014–2015	In sports groups (sectional courses) of table tennis, a formative educational experiment was done to determine the impact of cardiovascular exercise on students' flexibility. Participants were split into two groups for the pedagogical experiment: control and experimental.	Such physical qualities as flexibility have become qualitative for students after statistical processing and comparison of the resulting data with data from earlier studies. Authors of works are only restricted in their research by the impact of aerobic activities on overall health. Meaning it has an impact on flexibility.	Several students were taken to do aerobic exercise and then test the students do they have an increase in flexibility or not.
12	(Ryan N. Moran, Steven P. Broglio, Karla K. Francioni & Jacob J. Sosnoff, 2020)Exploring Baseline Concussion-Assessment Performance in Adapted Wheelchair Sport Athletes	Twenty-one athletes (age = 22.1 3.0 years) from a collegiate adapted athletics programme at one school.	Before the start of their respective seasons, athletes undertook baseline Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) and the Wheelchair Error Scoring System (WESS). Total symptoms, symptom severity ratings, and baseline symptom factors were the symptom reporting variables (eg, vestibular-somatic, sleep arousal, cognitive-sensory, and affective).	17 (81%) of adapted athletes reported more symptoms than normative reference values, and 20 (95%) performed at or below average on at least one neurocognitive composite score. The WESS had a mean error rate of 3.14 2.9, with 81 per cent of participants making at least	Most of them scored fewer than 10 symptoms. These people are wheelchair athletes.

				one mistake. There were no gender differences in symptoms, cognition testing, or balance measurements.	
13	(Agnieszka Wiśniowska-Szurlej, et al.,2019) Association between Handgrip Strength, Mobility, Leg Strength, Flexibility, and Postural Balance in Older Adults under Long-Term Care Facilities	This is a cross-sectional study conducted in southeastern Poland's care homes. The study included 209 older persons aged 65 to 85 after examining the inclusion criteria. The stabilometric platform CQ Stab 2P was used to collect sociodemographic data and perform assessments of muscular strength, mobility, flexibility, and postural balance.	The stabilometric platform CQ Stab 2P was used to collect sociodemographic data and perform assessments of muscular strength, mobility, flexibility, and postural balance.	HGS is linked to mobility, lower-limb strength, and dynamic balance in both men and women. Early diagnosis, made possible by simple technologies, will aid in the design of suitable interventions in long-term care institutions, reducing disability and mortality.	Handgrip strength does effect muscular strength. Cognitive impairment does weaken hand grip strength.
14	(Paul Starrs, Ambreen Chohan, David Fewtrell, Jim Richards and James Selfe,2012)	Eleven subjects, two males and nine females, with an average age of 9.2 years (5–15years) and an average height of 1.3 m (1.2 m–1.5 m)	This study used a multiple measures cohort design to compare healthy individuals to impaired individuals.	Eleven patients were evaluated (WCU = 7, NWCU = 4) and were all included in the outcome measure analysis. However, due to technical	Able-bodied perform better than non-able bodied.

	Biomechanical differences between experienced and inexperienced wheelchair users during sport.	were recruited, seven in the WCU group and four in the NWCU. (disabled WCU and able-bodied NWCU) A set of standard questions including 'Would you use your wheelchair to participate in sport?' were asked to determine which category each of the subjects was placed into. Other questions were asked such as 'How long have you attended the Cheetahs?', 'What is your disability?' and 'How often daily would you use your wheelchair?'		difficulties, only eight participants (WCU = 4, NWCU = 4) were used for biomechanical analysis. The NWCU were slightly younger on average than the WCU, with an average age of 9.4 years compared to 8.75 years for the WCU. The WCU and NWCU have similar average heights of 1.3 m and 1.36 m. The subjects had been attending the Cheetahs for an average of 8.5 months for the WCU and 6.8 months for the NWCU on their testing day. In the agility test, the WCU completed 4.14 turns on average in the 30 second time period, but the NWCU accomplished six turns in the same time (P = 0.059). In the sprint test, the WCU took 11.70 seconds on average to finish the 10 metres,	

				compared to 7.66 seconds for the NWCU (P = 0.299).	
15	(Karla K,Wessels,Jennifer L. Brown, Kyle T,Sebersole, Jacob J,Sosnoff, 2013) Sex,Shoulder Pain and range of motion in manual wheelchair users	30 people (18 men, 12 women) who relied on ergonomically designed manual wheelchairs as their major mode of transportation. All of the participants were wheelchair athletes who competed regularly. They were 18 to 35 years old, with a mean age of 21.93 3.77 years. The average amount of time spent in a wheelchair every day was 13.6 ± 4.14 hours, and the average length of time spent in a wheelchair was 11.57 The average amount of time spent in a wheelchair every day was 13.6 ± 4.14 hours, and the average length of time spent in a wheelchair was 11.57 5.89 years. Based on self-reports of shoulder pain, participants were separated into two groups (pain and no pain). Participants were asked if they were experiencing shoulder discomfort right now, and then	To assess ROM, digital goniometer was used. The following joint motions were assessed bilaterally on the active and passive ROMs of the participants' shoulders: flexion, extension, abduction, adduction, internal rotation, and external rotation. A visual analogue scale is used to assess shoulder pain. Shoulder pain was reported by 47 per cent of the subjects.	Females with more range of motion than males may be more prone to injury. Females have a higher frequency of anterior crucate ligament injuries due to increased laxity and range of motion. Females may be more susceptible to accidents because of their increased joint laxity. Because of the ROM and injury differences between men and women, there may be a need for sex-specific shoulder pain therapy and prevention**.**	Women have better flexibility compare to men.

		they were asked to complete a visual analogue scale (VAS) for current shoulder pain in each shoulder. 5.89 years. Based on self-reports of shoulder pain, participants were separated into two groups (pain and no pain). Participants were asked if they were experiencing shoulder discomfort right now, and then they were asked to complete a visual analogue scale (VAS) for the current shoulder . There were 14 participants in the pain group (9 men, 5 females), and 16 participants in the no pain group (9 males, 7 females) pain in each shoulder.			

Table 4.1 summarize the data on both healthy individual and wheelchair user. Most data above is on healthy individuals. As we know with time and training, those skills (range of motion, flexibility and balance ability) could be increase and improve. Data are stating that healthy individuals exhibit a better range of motion, flexibility and balance compare to those who are not healthy individuals.