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Human Kinetics
REVIEW

Pickleball Participation and the Health and Well-Being of Adults—A Scoping Review

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Background: Pickleball has grown tremendously in recent years, yet little evidence exists regarding pickleball-related injuries. This scoping review extends current work on pickleball participation by identifying positive and negative health effects associated with the sport. We summarize how pickleball impacts the health and well-being of adult participants. ***Methods:*** Searches were conducted on MEDLINE, CINAHL, ProQuest Nursing, ERIC, SPORTDiscus, PsycINFO, Scopus, CBCA Complete, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and ProQuest Dissertations and Theses. Selected studies considered aspects of health and/or well-being of adult pickleball participants. Using the population/concept/context framework, participants were healthy, able-bodied adults 18 years of age or over, who had played pickleball at least once. The positive and negative outcomes of pickleball on participants' health and well-being (concept) within the context of pickleball participation were examined. Full-text articles written in English since 2013 were included. Extracted data were tabulated, and a descriptive summary with thematic analysis was completed. ***Results:*** This scoping review comprised 27 articles that met the inclusion criteria. Pickleball is promising as an exercise intervention for all adults, and there is evidence of positive social and psychological effects, and health and fitness benefits to participating in pickleball by older adults. ***Conclusions:*** Although we are still in the early stages of studying pickleball, there have been some documented health benefits of using the sport as a physical exercise intervention for adults. More research is needed on the types, prevalence, and severity of pickleball injuries and the sport's impact on younger players.

Keywords: aging, involvement, paddle sport, serious leisure, welfare

The health and well-being of older adults have been studied extensively on a global scale. Given the increasing age of adults in most countries around the world,[1] researchers have looked to the benefits of low-intensity exercise as a means of improving the health and well-being of this growing demographic. Overall, the evidence suggests that low-intensity activities can have positive physical and cognitive health benefits to older adults.[2] As outlined in their systematic review, Tse et al[2] reported that 11 of 15 studies in their sample reported improvements to physical measures such as flexibility, balance, and strength in the lower extremities following low-intensity exercise. Improvements to depression symptoms were also generally realized.

Pickleball, a paddle sport that has been described as a hybrid between tennis, badminton, and table tennis, is viewed by many to be a form of low-intensity exercise, as it is played predominantly by older adults.[3] The sport is widely considered to be growing faster than any other in North America. A major appeal of pickleball is the ease of play and accessibility for a wide range of participants. It is a relatively inexpensive and easy game to learn and play, and quick to set up on any hard surface.[4] According to a recent report by the Sport and Fitness Industry Association, there are currently 4.8 million pickleball participants in America, which represents 1.6% of the US population aged 6 years and over.[5]

Between 2010 and 2016, there was a 385% increase in participation in pickleball[3] and the numbers have been rising steadily ever since. In Canada, there are 1 million players, representing nearly a tripling of participants in the last 2 years.[6] Pickleball participation has also seen a recent organizational surge in continents outside of North America. For example, the Asia Federation of Pickleball and the European Pickleball Federation were recently established in 2020 and 2023, respectively. The 2 formed an alliance in 2023 to advance pickleball on a continental scale and to address the increase in participation and interest in the sport.[7] This demonstrates the tremendous potential for further growth of the sport globally.[8] In 2021, pickleball exposure in the media increased by 168%,[8] which further speaks to its popularity.

With this recent rapid growth, there has been an increase in the reports of injuries associated with the game in the popular media.[9] However, there has been relatively little research conducted to date on the injuries that occur in pickleball. At the time of the launch of this scoping review, there were few published articles describing specific injuries related to the sport. During the course of our investigation, a scoping review examining the quality of studies on the epidemiology of pickleball injuries was published in January 2023.[9] This review analyzed only 4 articles. There is clearly a need for more published work in the area of pickleball injuries, due to the increase in injury occurrence and participation boom. In addition, the major governing body in the United States, the USA Pickleball Association, does not yet have a formal sports science department dedicated to injury assessment and risk reduction, like other major sports associations.[10] Given this lack of attention to the injuries and injury risk associated with the sport to date, opportunities for sports medicine research related to pickleball are considerable.

Historically, pickleball has been played primarily by those over 60 years of age, but participation among younger generations is on the rise.[8] Unlike other racquet sports, pickleball is not necessarily fast-paced nor does it have a high entry barrier.[4,11]

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Pickleball has recently been considered pertinent to research on aging because 40% of frequent players are aged 65 years and older.[8] According to Quail,[12] older adults may be injured directly during a match or indirectly by aggravating a preexisting condition, so understanding more about the specific injuries this population faces is critical. Some tennis players are also trading their racquets in for pickleball paddles, at all levels of play. Some speculate that this trend is due to the reduced stress on athletes' joints, less running distance required between shots, and a smaller court surface to cover when playing pickleball compared to tennis.[11] This may also contribute to the increased accessibility of the sport by different groups. For example, high-level wheelchair and hybrid pickleball (1 player in a wheelchair plays with a partner who is standing up) games are becoming more common.

Participation in the sport by older adults has been reported to improve quality of life and subjective well-being.[13] Some of the documented benefits of pickleball play include improvements in mental health,[14,15] increased social connections and sense of social community,[13,16,17] enriched feelings of life satisfaction,[13] and an opportunity to get both cognitive and physical exercise.[4,18,19] However, to date, there has not been a holistic review of the existing evidence on pickleball injuries and the effects of the game on the health and well-being of players. Therefore, the aim of this study was to perform a scoping review reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews guidelines[20] to identify the effects of pickleball participation on able-bodied adults 18 years of age or over. The physical, social, and psychological effects of participation were considered, as well as the health risks and benefits experienced by pickleball players.

Review Question

What are the physical, social, and psychological effects of pickleball participation on able-bodied adults over 18 years of age? The health risks and benefits experienced by pickleball players are also considered.

Eligibility Criteria

The eligibility criteria were outlined in an a priori protocol for the review.[21] Further clarification and refinement of the concepts are outlined below.

Participants

This scoping review included studies involving healthy, able-bodied adults 18 years of age or over, who play pickleball. Articles with participants under 18 years of age and those who were not able-bodied were excluded. Eighteen years of age is the age of majority in Ontario, Canada. Also, 78.8% of pickleball players are currently in this age range.[5] The mean age of pickleball participants was 38.1 years in 2021, but this has declined by 2.9 years since 2020.[5]

Concept

The concept of this scoping review is health and well-being. Both positive and negative outcomes were considered. Existing evidence focuses primarily on social and psychological effects of pickleball participation, and only minimally on the risks or negative effects (eg, injuries) to the health of participants.

Context

Pickleball participation was defined as having played pickleball at least one time previously. Participation could be at any level of play, either indoor or outdoor, and in singles, mixed doubles, men's doubles, or women's doubles format. Careful consideration was taken to ensure that the studies were specifically on pickleball participation. Research examining other paddle/racquet sports such as tennis, squash, and racquetball were not included, unless it was documented that most of their participation was in pickleball.

Types of Sources

A broad range of quantitative and qualitative research designs were considered for inclusion, such as randomized controlled trials, nonrandomized controlled trials, before and after studies, and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies, and cross-sectional studies were considered. This review also included descriptive observational study designs such as case series, individual case reports, and descriptive cross-sectional studies. Systematic reviews were considered if they met the inclusion criteria. Grey literature, text, and opinion papers were included if they referred to at least one academic source.

Methods

This scoping review followed the reporting guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews statement,[20,22] and was conducted according to an a priori protocol.[23]

Search Strategy

A 3-stage search strategy was employed. In the first stage, the librarian and subject experts collaborated to create a prospective search strategy in MEDLINE (Ovid). A search for specified terms in the titles, abstracts, and keywords was carried out and combined with appropriate controlled vocabulary. The prospective search was tested using several subject expert-supplied exemplar articles to ensure that they were being discovered by the strategy. The search strategy was peer reviewed by another librarian experienced with systematic reviews and with subject expertise in Kinesiology. In the second stage, the search strategy was adapted and run in each database to produce the list of results for title/abstract screening. The databases searched were MEDLINE (Ovid), Cochrane Central Register of Controlled Trials (Ovid), Cochrane Database of Systematic Reviews (Ovid), CINAHL (EBSCO), SPORTDiscus (EBSCO), ProQuest Nursing and Allied Health Database (ProQuest), PsycINFO (ProQuest), Canadian Business and Current Affairs Complete (ProQuest), ERIC (ProQuest), and Scopus (Elsevier). A search for gray literature was conducted in ProQuest Dissertations and Theses Global (ProQuest) and Google for association websites. In the third stage, the references and citations for all included studies were collected using Scopus and results not already discovered earlier were screened to ensure no key studies were missed.

Study/Source of Evidence Selection

The stages of the selection process are summarized in the PRISMA flowchart[24] (Figure 1). In the first phase, 243 articles were found in the various databases using the preidentified search terms and keywords. Five hundred and ninety-three additional references

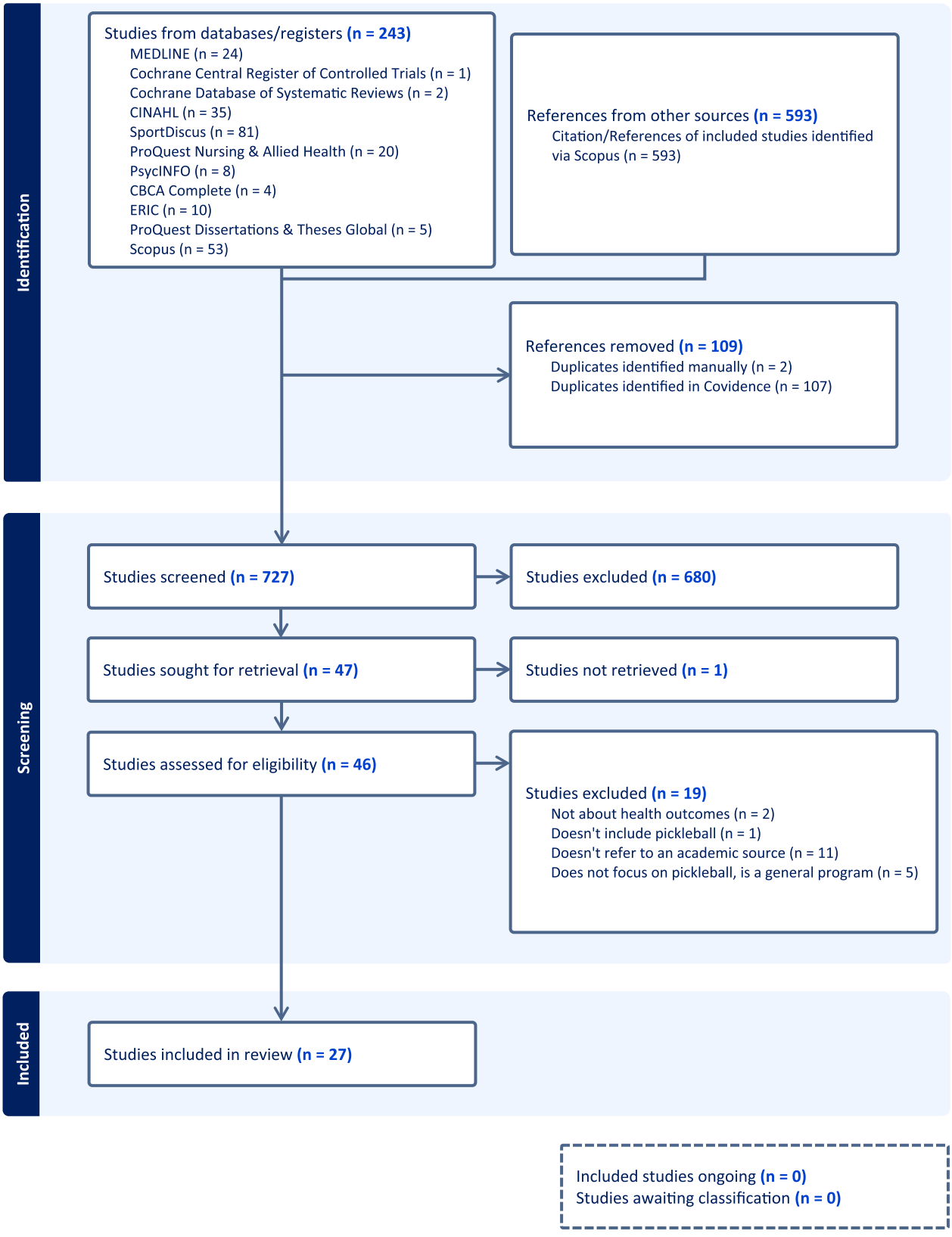

Figure 1 — Pickleball participation and the health and well-being of adults—a scoping review.

were found through citation searching. Of these, 109 duplicate references were removed. Seven hundred and twenty-seven were screened for title and abstract, and 680 of these were excluded since they did not match the inclusion criteria. Of these, 47 studies went to the full-text screening stage and were assessed for eligibility. From there, one study was not able to be retrieved, and 19 studies were excluded because they did not meet the inclusion criteria. Of these, 11 did not refer to an academic source, 5 did not focus on pickleball, 2 were not concerned with health outcomes, and 1 did not include pickleball. Finally, a total of 27 studies met the established inclusion criteria and were suitable to be included in the scoping review (Appendix 1). Information was collected (where available) on each article including the authors, year of publication, data sample, age, sex, study design (if applicable), data collection period, objective, results, and data collection method.

Data Extraction

The characteristics of the included studies were author, year of publication, country, aim, study population and sample size, and methods (Table 1). A data extraction instrument was created and used to chart variables from the included studies (Supplementary Material S1 [available online]). The instrument was tested on a single article prior to its use for the full review. Two researchers

Table 1 Characteristics of Included Studies

Author, year of publication, country of origin	Aims	Study population and sample size	Methods
Atkinson et al,[25] 2022, the United States	Descriptive case series of 2 instances of retinal tears due to an injury sustained while playing pickleball	2 cases	Case series
Buzzelli and Draper,[11] 2020, the United States	To examine the motivation and perceived benefits of pickleball participation in older adults	3012 participants completed a survey	A survey instrument that included items from the Sport Motivation Scale, the Task and Ego Orientation in Sport Questionnaire, and the Quality and Importance of Recreational Services
Casals et al,[9] 2023, Spain	To perform a scoping review following the PRISMA-SCR guidelines to identify the epidemiology and describe the main health problems and injury characteristics sustained in pickleball athletes	A total of 4 articles from different databases were found	Scoping review was carried out by following the guidelines of the PRISMA-SCR statement
Casper and Jeon,[3] 2019, the United States	To examine the psychological connection to the sport of pickleball by investigating active older adults (55 y and older) in relation to behavioral involvement and motives for participation	A total of 798 surveys were completed	Survey
Casper et al,[26] 2023, the United States	To determine the amount and intensity of physical activity older adults (65 y and older) get from pickleball participation	A total of 33 participants completed all study protocols	
Casper et al,[23] 2021, the United States	To examined how the COVID-19 pandemic has changed the physical activity, social connections, and psychological well-being of seniors who participate in the sport of pickleball	38 participants completing the initial study. For the follow-up phase, a new online survey was sent on November 2, 2020, to the 38 participants, 36 of whom completed the survey	An online survey that assessed physical activity (during COVID-19), pickleball participation, social connections, physical/mental health, loneliness, and life satisfaction measures
Cerezuela et al,[15] 2023, Spain	To systematically review and evaluate existing studies that have examined the relationship between pickleball and the mental and psychological health of individuals	The search resulted in 63 papers, of which 13 were selected. A total of 90.74% of the population were people over 50 y of age	A systematic review was conducted on articles found in Scopus, PubMed, Elsevier, WoS, PsyINFO, Dialnet, and Elton B. Stephens Company (EBESCO) from 1975 to the present. Eligibility criteria included: papers focused on pickleball, in English or Spanish, on mental health variables, without establishing an age range
Chen et al,[16] 2021, China, Taiwan	To investigate the effect of leisure involvement and leisure satisfaction on the well-being of pickleball players	260 of the 2019 International Pickleball NPRP Tournament participants were selected as test samples by means of voluntary sampling. A total of 250 pickleball participant questionnaires were recovered, for a recovery rate of 96%	Survey

(continued)

Table 1 *(continued)*

Author, year of publication, country of origin	Aims	Study population and sample size	Methods
Denning et al,[27] 2022, France	To identify the difference in physiological and activity demands of playing pickleball doubles and walking at a self-selected pace	Twenty-five healthy adults (10 female, 15 male; mean age = 38 y old; mean height = 1.8 m; mean mass = 78.3 kg), familiar with pickleball (played at least one time), were recruited via word of mouth	A movement sensor (provided by the manufacturer) was placed in a small pocket on the garment. Cardiac electrodes and movement sensors measured heart rate, step count, and caloric expenditure during each condition
Forrester,[28] 2020, the United States	To describe pickleball-related injuries treated in US EDs	Cases were pickleball-related injuries in NEISS during 2001–2017	Data were obtained from the NEISS operated by the US CPSC
Greiner,[29] 2019, the United States	To describe pickleball and the types of injuries experienced/being seen by a sports medicine practitioner in Missouri (the United States)	n/a	Description of rules, equipment, potential injuries, and prevention for pickleball
Heo et al,[30] 2018, South Korea, the United States	To investigate the contribution of a form of serious leisure, optimism, and social integration on the depression of older adults	153 older adults competing in pickleball tournaments	Survey
Heo et al,[13] 2018, United Kingdom	To address gaps in the literature and to contribute to the field of gerontology by exploring relations between financial status, loneliness, serious leisure, and SWB	A convenience sample of older adults (63 males and 90 females) who participated in pickleball competitions was recruited (n = 153)	Survey
Huang et al, 202312, the United States	To describe 2 cases of traumatic lens subluxation resulting from pickleball injury	2 case studies	Case series
Kim et al, 2021,[32] the United States, South Korea	To explore the mediating role of social capital on the relationship between sport participation and happiness among older adults	A convenience sample of 208 pickleball participants aged from 50 to 83 y completed a survey	Survey
Loria, 2022,[33] the United States	To describe the potential injuries and how physical therapy can help pickleball players get back on the court	n/a	Description of potential injuries to pickleball players
Quail,[12] 2019, the United States	An answer to a question on what patient education players need to avoid pickleball-related injuries is presented	n/a	Brief editorial narrative (Q and A format) about caring for pickleball injuries
Ryu et al,[34] 2022, the United States, Czech Republic, South Korea	To explore how personality and serious leisure activities, such as playing pickleball, contribute to eudaimonic well-being in middle-aged and older adults	A convenience sample of 105 men and 145 women aggregating to 250 respondents was selected from participants at pickleball events at the Huntsman World Senior Games (Utah, the United States)	Survey
Ryu et al,[35] 2018, the United States, South Korea	To examine how the psychosocial benefits (ie, life satisfaction, optimism, and social integration) of playing pickleball differ based on the participants' demographic characteristics (ie, age, gender, employment status, and marital status)	153 older adults (over 50 y of age) who competed in pickleball tournaments	Survey
Ryu et al,[14] 2020, the United States, South Korea	To investigate the level of authenticity while older adults are playing pickleball, and to explore the association between feeling authentic and positive psychological functioning (ie, lower perceived stress and greater happiness) among older adults	112 males and 96 females; age from 50 to 83 y recruited from the 2017 US Open Pickleball Championship	Survey

(continued)

Table 1 *(continued)*

Author, year of publication, country of origin	Aims	Study population and sample size	Methods
Smith et al,[18] 2018, the United States	To quantify the acute cardiovascular and metabolic responses to pickleball, and to determine the effectiveness of a 6-wk pickleball intervention at positively modifying cardiometabolic risk factors	15 middle-aged to older adult men and women (40–85 y of age)	Fifteen women and men (mean age, weight, percent body fat, and maximal oxygen uptake = 65.2 y, 76.3 kg, 30.3%, and 26.2 mL/kg/min, respectively) completed both a maximal graded exercise test and played a doubles match of pickleball on nonconsecutive days Cardiovascular and metabolic data were collected via a portable calorimetric measurement system. Cardiometabolic risk factors and cardiorespiratory fitness were measured at baseline and postprogram
Terrell and Ficquette,[36] 2023, the United States	To describe how pickleball is played and the benefits associated with participation. The 3 tenets of a needs analysis for pickleball are explored: movement demands, physiological demands, and an injury risk assessment (culminating in suggested strength and conditioning strategies for older pickleball athletes)	n/a	Description of pickleball movement analysis and recommendations for prevention and management of pickleball injuries
Vitale and Liu,[10] 2020, the United States	A case report of a pickleball injury is presented and the available literature on pickleball is reviewed	1 individual case	Case report and clinical recommendations for prevention and management of pickleball injuries
Walton-Mouw et al,[37] 2021, the United States	A descriptive exploration of the perceptions of older adults related to the benefits and risks of playing pickleball related to injuries	129 pickleball players from north Georgia (50 y of age or older)	Online survey. Study participants were obtained randomly by open solicitation from 2 large Georgia pickleball communities Survey included inquiries about level, frequency, and duration of pickleball play. Information was solicited regarding injuries sustained while playing pickleball and outside of playing pickleball including type and severity of pickleball-associated injuries
Webber et al,[38] 2022, Canada	To measure heart rate, activity intensity, and steps in adult recreational pickleball players during singles and doubles play	22 singles and 31 doubles players	Participants wore an ActiGraph GT3X+ accelerometer (ActiGraph LLC) on an elastic strap over the right iliac crest and a Garmin Fenix 5 smart watch on their nondominant wrist for the warm-up and during pickleball play. Heart rate was collected every second using the "Activity" function on the Fenix 5 watches
Weiss et al,[39] 2021, the United States	To understand and compare players' injury experience through analysis of a nationally representative hospital emergency department sample to help inform senior injury prevention and fitness goals	Publicly available online data from pickleball- and tennis-related injuries treated in the United States from 2010 to 2019	Cross-sectional descriptive study using publicly available online data from US CPSC's NEISS
Wray et al,[4] 2021, the United States, Canada	To evaluate the impact of a 6-wk pickleball intervention on measures of muscle function, cognitive function, perceived pain, and cardiometabolic risk, as well as several psychosocial factors contributing to adherence in sedentary rural participants	21 participants between the ages of 50 and 75 y From this group, 20 completed the study (17 females and 3 males)	To determine pickleball's feasibility as an exercise intervention in a rural community, participants completed a 6-wk intervention. Pretesting and posttesting sessions took approximately 2 h to measure muscle function, cognitive function, cardiometabolic risk, and perceived pain. Follow-up interviews were conducted to identify any lasting psychosocial impact of the intervention to determine whether participants continued to play (ie, adherence), and what factors influenced the decision to continue play

Abbreviations: CPSC, Consumer Product Safety Commission; ED, emergency department; NEISS, National Electronic Injury Surveillance System; NPRP, National Pickleball Rating Program; PRISMA-SCR, Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews; SWB, subjective well-being; WoS, Web of Science.

used the instrument independently to chart the collected data and then amalgamated the charts for thematic analysis. The variables collected from the final selected studies were grouped into different health and well-being categories: psychological effects, social effects, physiological effects, and injury/health risk. Additionally, sections related to movement demands and prevention strategies were provided.

Data Analysis and Presentation

Psychological Effects

Physical leisure activities offer psychological benefits to participants and enhance their well-being, quality of life, and life satisfaction.[3,13] Playing pickleball may have profound effects on the psychological well-being of people of all ages; however, the current literature shows a strong positive correlation between playing pickleball in older adulthood and many psychological benefits that can contribute to individuals' feelings of perceived well-being. A meta-analysis by Netz et al[40] indicated that moderately intense activities and aerobic training are the most beneficial form of activity for the psychological well-being of older adults.[40] Many argue that pickleball is such an activity.[4,19,36]

Playing pickleball as a form of sport involvement adds significant value to older adults' daily psychological well-being status, which can contribute to successful aging.[16] A study by Casper et al[23] examined how the COVID-19 pandemic changed the physical activity, social connections, and psychological well-being of seniors who previously participated in pickleball. Participants reported significantly lower mental health, greater loneliness, and lower life satisfaction during the pandemic when they were playing less pickleball or not playing at all. The study also reported a significant positive association between life satisfaction and continued pickleball playing frequency.[23] Considering the intertwined social and physical elements of playing pickleball, it is likely that both factors play a role in improved feelings of psychological well-being. There have been both cross-sectional and longitudinal studies showing that engaging in a physical activity regimen is associated with better physical health and social, emotional, and psychological well-being.[41] Furthermore, authenticity has been regarded as one of the most fundamental determinants of well-being. Authenticity can be described as being trustful with oneself, and leisure is an ideal context to experience authenticity.[14] Kernis[42] characterized authenticity as the unobstructed operation of individuals' true selves. Findings from Ryu et al[34] showed that higher levels of authenticity were associated with greater happiness and lower levels of perceived stress. The authors reported 2 noteworthy implications for leisure service providers working with older adults: (1) pickleball may be a vehicle in which to experience authenticity and (2) authenticity could be a vital determinant of happiness and coping with stress.

A large study examining the motivation and perceived benefits of pickleball participation in 3012 older adults found that, while the majority of participants were intrinsically motivated and task oriented in nature, their primary motivation for participation in the sport involved mastering difficult training techniques.[11] Respondents also noted that they benefitted most from the competition aspect of their participation. A possible interpretation of this finding offered by the authors was that, while participants were most driven by improving specific aspects of their individual game, the opportunity for competition provided a measurement from which they could reset their goals. Conversely, Casper and Jeon[3] studied psychological connection to pickleball where they assessed motives and participation in older adults. They reported that fitness and socialization were rated by participants as the most significant motives for playing pickleball, followed by skill mastery and diversion, and finally competition.[3]

Ryu et al[34] explored how personality and serious leisure activities, such as playing pickleball, contribute to eudaimonic well-being in middle-aged and older adults. Three personality traits, namely conscientiousness, neuroticism, and openness to experience, were found to be significant predictors of eudaimonic well-being. Of them, conscientiousness seemed to be the most important. Older pickleball players tended to exhibit personality traits of agreeableness and contentiousness,[34] so perhaps this age demographic is drawn to serious leisure sports such as pickleball, but the opportunity has to be available for them to take part. The idea that pickleball as a form of serious leisure is related to the subjective well-being of older adult players is supported by Heo et al,[30] who found that a measure of serious leisure can significantly predict life satisfaction and grants a positive perception of aging.[30] Overall, playing pickleball improves the mental health of older adults and contributes to successful aging.[34]

Physical activity and sport can certainly play a fundamental role in improving social inclusion and adapting healthy lifestyles in people with mental health concerns.[15] Pickleball is an enriching recreational activity that can help with coping as individuals transition into retirement, and it can very likely improve life satisfaction.[10] Pickleball is an activity that should be considered for intervention programs aimed at alleviating depression and improving the psychological health of older adults.[15,35]

Social Effects

Leisure activity, social integration, and optimism have been shown to reduce the risk of depression in later life.[30] One of the many benefits of playing pickleball is that players experience more social interaction. [43]Given the considerable social element inherent in the sport, pickleball may be an effective catalyst to help bridge intergenerational and socioeconomic divides between player groups. It may also improve players' physical health and offer an intensive social experience.[30] A study by Ryu et al,[30] whose aim was to understand pickleball as a leisure pursuit among older adults, demonstrated the feasibility of pickleball as a method of intervention to increase social integration by building networks of support and reducing social isolation. Pickleball participation resulted in high levels of enjoyment, which may be explained by the social aspect of the game.[27] Smith et al[18] explain that lack of enjoyment is frequently offered as one of the main reasons for physical inactivity in the older adult population. The "fun factor" associated with pickleball may increase the likelihood of a lifetime pursuit of physical activity.[18]

The smaller court dimensions in pickleball help to reduce the physical demand on participants relative to sports such as tennis, thereby fostering a more inclusive environment. This environment makes pickleball one of the best social sports for participants of all ages and for people with mobility limitations in particular, who may be otherwise left out of social or competitive sports.[11] Along with the physical benefits and improved fitness associated with the game, many older adults enjoy playing pickleball because it promotes competitiveness and socialization.[29]

There is compelling evidence that suggests that playing pickleball as a form of serious leisure adds significant value to older adults' daily lives and contributes to successful aging.[13] According to Heo et al,[13] pickleball players generate a unique social world around their pickleball activities. This makes it easier for older

adults to create community by playing the sport and develop a strong identity associated with pickleball and its subculture.[34] Most participants in this study agreed or strongly agreed that pickleball was part of their identity. Investigators have observed that older adults have been able to build a hospitable and sustainable community by playing pickleball, which suggests that they are constructing a strong identity with the sport.[17] These inherent social connections and feelings of belongingness are unique to sport, making sport and serious leisure activities such as pickleball important and relevant activities for improving the mental and physical health of older adults. In addition, an inverse relationship was found between serious leisure and depression, which suggests a greater commitment to serious leisure is associated with lower levels of depression in older adults.[30]

In a study examining the physiological and activity effects of playing 30 minutes of pickleball doubles or 30 minutes of self-paced walking, participants preferred to play pickleball.[27] The median reported enjoyment levels following pickleball play were rated 3 points higher (on a 5-point Likert scale) than after walking, an increase of 150%.[27] Enjoyment during physical activity is an important factor for continued participation, particularly in older adults.[27] Considering this, the psychological benefits, the intense social connections and environment, and the fun that people have when playing pickleball, participating in the sport is a way to keep older adults active and engaged, and enhance their well-being and socialization.

With respect to socialization and social integration, there may be notable sex differences regarding the importance of pickleball participation. One study showed that, although female participants tend to play fewer hours of pickleball, spend less money on pickleball equipment annually, and participate in fewer pickleball competitions compared with their male counterparts, female players were more likely to have positive relationships with others.[35] This finding suggests that pickleball may be an effective avenue to build social networks, particularly among older women.[35]

It is not necessarily advantageous to be younger or more fit to be successful as a pickleball player. Experienced players agree that older players can certainly keep up with younger, more physically agile, or powerful players by playing the game with more precision and control. This is why it is common to see players of all ages and sexes playing together. For this reason, pickleball is known for facilitating intergenerational interaction and camaraderie among players.[44,45] Swisher[46] notes that emphasizing such intergenerational social experiences will not only develop positive attitudes between generations, but it also lays the foundation for lifelong learning opportunities for older adults.

Physiological Effects

While the social and psychological benefits of pickleball seem clear, there is less evidence and understanding of the physical activity benefits the sport offers its participants.[26] The World Health Organization recommends at least 150 minutes of moderate-intensity physical activity per week for adults.[47] It has been established that participation in sport increases the amount of time spent in moderate to vigorous physical activity and contributes to participants achieving the recommended physical activity guidelines.[19] This appears to be the case for pickleball specifically.

Denning et al[27] considered differences in the physiological demand between playing pickleball doubles and walking at a self-selected pace. The mean and peak heart rates of participants were found to be significantly higher while playing pickleball. Contrary to what might be expected based on these results, walking produced 54% more steps on average than playing pickleball doubles. However, compared with walking, playing pickleball doubles increased participants' average caloric expenditure by 36%. Consistent with this finding was that players perceived playing pickleball doubles to be more strenuous than walking, with median ratings of perceived exertion after pickleball doubles being nearly 44% higher than after walking. Taken together, these results suggest that playing pickleball can have positive effects on players and may provide health benefits and improved quality of life.[27] Pickleball could also offer an alternative activity for achieving health-enhancing benefits such as reduced mortality.[27]

Further to this point, Casper et al[26] found that on days when participants played pickleball they averaged 10,495 steps per day, nearly 3000 more steps than they did when they did not play. Given that the recommended guideline for older adults over the age of 65 years is to average a minimum of 7000 steps per day,[48] introducing pickleball to an older adult population successfully raised their daily activity level as an intervention.[26] It also provided evidence that pickleball can contribute to cardiovascular health. On days that they played pickleball, participants averaged over 86 minutes in increased heart rate zones, almost half of which was spent in the cardio zone (70%–85% of maximum heart rate). Heart rates at this level help with cardiorespiratory fitness, fat loss, and increasing blood circulation to the muscles and heart.[49] Webber et al[38] also reported that both singles and doubles pickleball players spent just over 70% of play time in moderate and vigorous heart rate zones, and that there were no statistical differences between the groups in time spent in light, moderate, and vigorous heart rate zones.[38] These findings suggest that engaging in approximately 4.5 hours of pickleball per week (singles or doubles) would allow older adults to meet the physical guidelines of 150 minutes of moderate- to vigorous-intensity activity per week.[12] In addition to these benefits, players burn over 500 calories during an average pickleball session, which contributes to weight management and cardiovascular health.[26]

Participation in pickleball over a 6-week period has also been shown to yield a mean energy expenditure of 355 kcal per hour for middle-aged to older adult men and women (40–85 y of age).[18] This positive result suggests that pickleball is an effective method of achieving the recommended target energy expenditure of 150 to 400 kcal per day as set out by the American College of Sports Medicine for the maintenance and improvement of cardiorespiratory fitness.[50] Other notable findings from this study include improvements in overall maximal oxygen uptake, blood pressure, and lipid profile. Maximal oxygen uptake was improved on average by ~1.0 METs following the intervention, a magnitude that has been previously associated with an 18% reduction in deaths due to cardiovascular disease.[18] Systolic and diastolic blood pressure were significantly reduced by ~5 mm Hg and ~3 mm Hg, respectively. According to Chobanian et al,[51] blood pressure decreases as small as 2 mm Hg are associated with a 6% decrease in stroke mortality and a 4% decrease in coronary artery disease. Positive modification to high-density lipoproteins (mean increase of ~3 mg/dL) and low-density lipoproteins (mean decrease of ~4%) were also observed by Smith et al[18] after the 6-week intervention and could have the potential to yield important overall cardiovascular health benefits. These findings are significant because it has been estimated that for every 1 mg/dL increase in high-density lipoprotein cholesterol, the risk of a coronary heart disease event is reduced by 2% to 3%.[52] Additionally, it has been purported that for every 1% decrease in low-density lipoprotein cholesterol, there is a corresponding 1% reduced risk for significant heart disease events.[53]

In a similar 6-week intervention with a rural, highly sedentary population, pickleball participation resulted in significant improvements in jumping ability, cognitive performance, and self-perceived pain.[4] Participants increased their vertical jump height by 11% from their baseline levels, on average. Such improvements may be associated with improved fall prevention.[54] Considering the many older adults participating in pickleball today, this finding is of major significance as it may help to decrease morbidity and contribute to greater functional ability and independence in this population. In terms of cognitive performance, there was a small but statistically significant increase in Global Cognitive Score in the study participants following pickleball participation (although cognitive testing was only conducted on 11 of the 20 participants). The nature of the game itself poses a cognitive challenge by taxing the working memory through the monitoring of scores and service order during play.[4] This can act as a form of mental exercise to help improve cognitive functioning in the aging population.

Injury/Health Risk

It has been suggested by numerous authors that pickleball is a safe sport with a low prevalence of accidents and injuries, and generally one with few risks to people's health.[10,12,25,28,31,39] A literature review completed in 2019 revealed that there was no published research describing specific injuries related to pickleball.[29] Since this time, some limited research has been completed regarding the kinds of injury trends that we can expect from this growing sport.[9,10,28,31,36,37,39] Identifying and describing the most common types of injuries can help to inform prevention measures,[9] but it must be understood that the number of injuries occurring is likely much higher than what has been reported on to date in the literature or through hospital emergency departments. In an analysis of pickleball-related injuries documented in the National Electronic Injury Surveillance System of the US Consumer Product Safety Commission from 2001 to 2017, Forrester[28] revealed that the highest proportion of patients with pickleball injuries treated in a sample of US emergency departments were aged 60–69 years and 70–79 years, respectively, with equal representation between males and females.[28] Regarding the trends in pickleball injuries over this period, the number remained relatively small (ranged between 0 and 462) prior to 2012. Between 2013 and 2017, the estimated number of injuries increased each year, until in 2017, they accounted for nearly one-third of the total estimated injuries and almost 9 times the estimated number of total injuries reported during the period from 2013 to 2017 (688 in 2013, 1391 in 2014, 4359 in 2015, 4712 in 2016, and 6072 in 2017). In contrast, the number of injuries associated with tennis, squash, and racquetball declined each year over the same period.[28]

More recently, Weiss et al[39] compared the injury experiences of tennis and pickleball players, also based on National Electronic Injury Surveillance System data. Injury rates for senior pickleball players were noted to be on the rise, while tennis injuries have remained flat. This is most certainly due to the rapid growth in popularity of pickleball since 2021. Terrell and Ficquette[36] agreed with this sentiment noting the marked increase in reported annual pickleball injuries in the last 3 years.[36] While these data are enlightening regarding pickleball injuries generally, it is important to remember that the number of unreported injuries related to pickleball remains unknown[28] and is likely considerably higher than what has been reported officially to date.

In terms of the types of injuries, pickleball players most commonly suffer from strains or sprains, followed by fractures.[16,39] The most common mechanism of injury for both tennis and pickleball players was a slip/trip/fall or dive.[10,39] According to Greiner,[29] sprains of the ankle joint, particularly those to the lateral aspect of the joint, are caused by inversion, a mechanism which is also common in tennis. Knee injuries occur frequently among tennis players, a trend now being seen in pickleball. The case report published by Vitale and Liu[10] indicated that the most common pickleball injuries at local and regional tournaments and during open play have been overuse injuries of the knee (meniscal pathology, patellar tendinopathy, medial collateral ligament strains, and osteoarthritis flares), shoulder conditions, lateral epicondylitis, Achilles tendonitis, and plantar fasciitis.[10] By contrast, Weiss et al[39] reported that upper-body injuries, such as those to the wrist, were slightly more common than lower body injuries (35% vs 27.6%).[39]

Overall, pickleball may be less risky than tennis with respect to shoulder injuries, since the former is mostly played with more underhand strokes. However, at higher competitive levels and with players who prefer more of a power game, it is still possible to strain the rotator cuff with overhand volleys or repetitive stretching to reach for the ball during pickleball.[29] The movement and speed of the players in pickleball are generally lower than in tennis and characteristics of the game such as the smaller court, slower ball, and lower net can cause fewer demands on the dynamic stability of the shoulder during pickleball.[9] However, pickleball players are still at some inherent risk of injury at any level of play. For the upper extremity, the wrist, elbow, and shoulder are all susceptible to injury,[29] as in other racquet sports. The forearm flexors and extensors can become inflamed and irritated from the repetitive motion involved in the game, and the recurrence of gripping and swinging motions can inflame the flexor and extensor tendons at the humeroulnar joint, which can result in medial and/or lateral epicondylitis.[36] Consequently, what was once known famously as "tennis elbow" is now starting to be referred to as "pickleball elbow."

The hard polymer balls used in pickleball travel at speeds of up to 32 to 65 km/h (20–40 mph), which makes ocular injury a very serious concern.[25] As with other racquet and paddle sports, it is important to consider protecting the eyes from the ball and paddles during play.[10] This precaution is of particular note for anyone who is predisposed to ocular injury by conditions such as high myopia, lattice degeneration, previous retinal tears, or pseudophakia.[25] Considering the large population of older players who play pickleball, and that reflexes, agility, quickness, and visual acuity decrease with age, it may be more likely for this group to sustain an eye injury.[25] Two cases of traumatic lens subluxation resulting from eyes being hit by a pickleball have been reported to date in the literature in players 75 years of age or older.[31]

In both tennis and pickleball in the United States, the number of injuries tends to peak during the first 3 months of the season, and then decline until October.[39] Similar injury trends occur for most sports, with more injuries occurring at the start of the season. This makes sense given that many players start playing in a less physically conditioned state. This highlights the importance of maintaining fitness and training in the off-season. Regarding care for patients with pickleball injuries, Quail[12] recommends that everyone should be encouraged to employ pregame prevention and protection strategies. Elements of a prevention strategy should include warm-up exercises and stretches, proper eye protection and footwear, and the use of orthopedic bracing, as necessary. Appropriate joint mobility in ankles, hips, and the thoracic spine can facilitate optimal movement throughout the kinetic chain and should be incorporated into both on-court and off-court warm-up drills.[12,36]

Optimal hydration, recognizing one's own physical limitations, implementing frequent rest breaks, and keeping pertinent medications nearby to treat any preexisting conditions (eg, asthma) are all part of the comprehensive approach that everyone should take while participating in pickleball.[12] In addition, when beginning a sport like pickleball, players should consider appropriate footwear that fits properly and limits excess sliding or friction between the shoe and foot; proper footwear can help prevent acute and chronic injuries. Given the nature of the sport and the inherent need for lateral stability during pickleball play, a cross-training or court shoe would be preferred over a regular running shoe.[29]

Movement Demands

To create an appropriate sport-specific injury prevention strategy, the movement demands specific to the sport need to be understood. The movement demands of pickleball may be similar to other racquet sports, but the size of the court and distinctiveness of the hard plastic ball used in the game make pickleball unique when it comes to predicting injuries and mechanisms of injury. Pickleball does not place as much emphasis on technical skills as other racquet sports, but maintains a greater strategic and technical element.[15]

The "split-step" is the familiar athletic stance or "ready position" used by pickleball players. This position promotes stability and balance as players' weight is distributed between their feet. It can also help to reduce the risk of injury.[10] Pickleball requires athletes to move laterally as well as in a forward and backward direction while executing technical paddle skills employing a variety of swing variations similar to tennis.[10] The quick pivots, lunges, and lateral movements can place repetitive stress on certain joints, especially in singles when players have the entire court to cover.[12] Ballistic movements and changes of direction can place significant demands on the hamstrings, hip adductor muscles, the menisci of the knee, calcaneal tendons, and plantar fasciae. Pickleball often requires quick sprints toward the nonvolley zone to retrieve a "drop shot." In these instances, athletes should be careful with sudden stops when refraining from "stepping into the kitchen." This requires forceful eccentric contractions which can be a risk factor for lower-extremity musculotendinous tears and ankle sprains.[10] Another common shot in pickleball is the lob shot in which a player hits a high ball with the intention of it landing behind their opponents' backs. To retrieve a lob shot, players should avoid backpedaling on the heels and instead should turn and run forward toward the shot and then turn their body back toward the opposing players to execute the return. Older players who may have reduced physical agility, impaired balance, and proprioception are at further risk for falls, fractures, and possible head trauma when executing these types of shots.[10]

Pickleball is commonly "played at the net," which refers to the positioning of players just behind the nonvolley zone for the majority of rallies. This is in contrast to baseline play which is more typical in tennis. Playing at the net forces players to use more precision and controlled shots to ensure a nonattackable shot from their opponents. A nonattackable shot is called a "dink" and is a fundamental skill in pickleball since the aim is to make it difficult for the opponent to attack.[55] Settling into dinking battles at the net can cause players to be put into repetitive forward bending and rotation positions of the trunk. Lumbar strains are a common injury associated with these movement demands.[29] If players do not have adequate mobility and footwork to get in the right position, lumbar strains can lead to lower back injury over time.[12] Overuse injuries can be limited by ensuring proper form and avoiding muscular fatigue through training. Compared to tennis, serving and the majority of play at the net in pickleball are played below the waist. Casals et al[9] report that this predominantly underhand play corresponds with a lower incidence of back injuries.

Since pickleball is very popular with older adults, players with age-related musculoskeletal disorders such as osteoarthritis should be cautious when taking up pickleball, given the hard surfaces on which the game is played, and the repetitive impacts associated with stopping and starting quickly during shot making.[10] Older individuals may be more susceptible to age-related changes to the collagen in their tissues and the decreased elasticity of tendinous structures,[9] thereby contributing to increased risk of musculotendinous injuries.

Because pickleball is frequently played outdoors in countries with warmer climates, it is important to recognize heat as a significant contributor to injury or illness, particularly with respect to older adults. Heat stress may result in decreased muscle function through impaired neural drive to the muscles. Older adults may also be susceptible to potential autonomic nervous system impairment, which reduces the body's capability to properly thermoregulate.[12] Adequate hydration and electrolyte repletion are paramount for all athletes playing the sport.[10]

Prevention Strategies

Many pickleball-related injuries are similar to those experienced in other racquet sports, but there are several key differences that should be recognized when developing prevention and management strategies for pickleball injuries.[28] For example, the fast growth of the sport and higher average age of pickleball participants generally are additional factors that injury prevention and rehabilitation specialists must consider. There is very little published evidence that describes validated injury prevention techniques specific to pickleball. However, from what is known from other established racquet and paddle sports, and by way of movement demands analyses, recommendations can be provided that would benefit pickleball players. Whether playing singles or doubles, all players should have a comprehensive mobility system in place to satisfy the demands of the sport without injuring themselves. One of the most important aspects of preparation for any athlete, prior to participating in their sport, is to complete a dynamic warm-up. A dynamic warm-up allows the body to gradually increase body temperature, increase heart rate, range of motion in the joints, and improve mental focus for the upcoming activity. Pickleball athletes may refer to their associations or organizations (eg, USA Pickleball Association) for warm-up recommendations.[56] Warm-ups should include maximizing shoulder range of motion and quadriceps activation exercises prior to playing.[10] However, importance should be placed on warming up all major muscle groups and joints prior to the start of pickleball participation. More information on an active dynamic warm-up can be found in Terell and Ficquette.[36] Techniques that target the upper extremity should be completed prior to overhead shoulder swing execution. It has been suggested to refer to published data on rotator cuff activation exercises such as the Thrower's Ten program.[57] Conversely, a lower-extremity program called the FIFA 11+[58] was originally designed to reduce injuries in soccer players but could also be adopted by pickleball players to provide comprehensive muscle preparation and warm-up for the lower extremities.

A training structure targeting older pickleball athletes should prioritize strength, balance, power, and postural endurance of key core muscles through the use of resistance training.[10] Further ideas regarding resistance training for pickleball can be found in Terrell

and Ficquette.[36] Mobility and flexibility should also be kept as priorities.[10]

In addition to providing adequate hydration to combat heat-related issues during play, sun protection should be incorporated as a prevention strategy. During the heat of the summer on outdoor courts, pickleball tournaments can last many hours. Appropriate sun protection including sunscreen, lip balm, sunglasses, and a hat or sport visor should always be utilized.[10]

Proper court shoes are essential for pickleball play. It is imperative that the footwear provides adequate nonsagittal plane motion support and enough tread to help provide good traction and to minimize ankle sprain risk.[10]

Limitations

There are some inherent limitations when conducting scoping reviews. This type of analysis provides an overview of the available research and does not necessarily dive deep into the specifics of the current topic. Although care was taken to include every relevant resource related to the topic, it is possible that research was missed or has been published since the searches were conducted.

Conclusions

Compelling evidence exists that sport participation can provide health-related benefits for older adults.[59] Pickleball holds great promise as a physical exercise intervention for adults of all ages, due to the balance between physical challenge, comparably low injury risk, and ease of play characteristic of the sport. Although we are in the very early stages of studying pickleball, some promising findings point to the positive social and psychological effects of participation by older adults. There also appear to be links to positive health and fitness improvements in this age group. However, very little is known to date regarding the effects of the sport on younger populations, and there are no studies examining the prevalence of injuries outside of hospital emergency departments. These are major gaps in the current knowledge for the pickleball playing population. Improved documentation and understanding of the types, prevalence, and severity of pickleball injuries would be helpful for developing proper management strategies for these injuries, along with a better understanding of the movement demands of the sport. This would help sports medicine providers and other health care practitioners to deliver effective care.

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Appendix 1: Search Strategy

Platform: Ovid

Database: MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review and Other Non-Indexed Citations, Daily and Versions <1946 to February 14, 2023>

Date of Search: February 15, 2023

#	Query	Results from February 15, 2023
1	(pickleball or "pickle ball" or pickle-ball or pukaball or (paddle adj2 sport*)).mp.	27
2	"Quality of Life"/ or happiness/ or pleasure/ or motivation/ or health/ or men's health/ or women's health/ or exp physical fitness/ or athletic injuries/	459,049
3	(health* or wellness or wellbeing or well-being or welfare or "well being" or strength* or activ* or happiness or happy or content* or leisure or "quality of life" or "life quality" or motivat* or benefit* or injur* or review* or recommendation* or stress* or lifestyle or "life style" or "life change*" or enjoy* or recreation* or relax* or stimul* or ethus* or excit* or hobby or hobbies or interst or interests or entertain* or amus* or distract* or skill* or talent* or comfort or involve* or participat* or socializ* or confidence or empower* or self-esteem or "self esteem" or satisf* or anxiety or anxiousness or depress* or distress*).ti,ab,kw.	15,515,343
4	2 or 3	15,587,243
5	1 and 4	24