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Long-term Tennis Participation and Health Outcomes: An Investigation of "Lifetime" Activities

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ABSTRACT

International Journal of Exercise Science 13(7): 1251-1261, 2020. Lifetime sports, such as tennis, provide opportunities for participation throughout the lifespan and has been linked with lower risk of cardiovascular disease, obesity, and depression. The objective of this study was to consider the influence of chronic tennis participation on various parameters of health. Members of the International Tennis Federation (ITF) completed a survey consisting of questions from International Physical Activity Questionnaire (IPAQ), Behavior Risk Factor Surveillance System (BRFSS), Satisfaction With Life Survey (SWLS), and specific tennis participation questions. Descriptive characteristics were calculated for all variables and a chi-squared analysis was used to compare prevalence of health variables of this sample and recent BRFSS data. Compared to the BRFSS greater proportion of study participants 45yrs and older frequently reported being in good or better health (χ^2=7.946, p = 0.005); lower obesity rates (χ^2=19.92, p = 0.0001); and a lower prevalence of heart disease than those of similar age who completed BRFSS (χ^2= 8.759, p = 0.003). This study highlights the importance of activities that continue throughout the lifespan such as tennis.

KEY WORDS: Lifetime sports, physical activity, leisure

INTRODUCTION

The age-related decline of physical activity is a major public health obstacle. Farooq et al. reports the decline of physical activity levels beginning early in childhood(9). Likewise, several studies have suggested the tracking of physical activity from childhood to adulthood is weak at best (17, 18). Physical inactivity is a well-established risk factor for obesity and related co-morbidities. Given the present obesity epidemic and the chronic diseases associated with obesity, activities that encourage opportunities for participation throughout the lifespan could be a pathway of promoting maintenance of physical activity levels. Lifetime sports are defined as sports or leisure time activities one can participate in over the span of the life and include activities such as bicycling, golf, and jogging (4). Tennis has been referred to as a "lifetime sport", because it promotes competition and overall participation throughout all ages of life (26).

Previous research suggests tennis participation is associated with general health benefits such as improved aerobic fitness, lower body fat percentage and decreased risks of diabetes and cardiovascular disease (13, 24). Research by Swank et al. agreed that the increased physical activity of tennis players serves as a protective influence in the maintenance of aerobic capacity and healthy body composition specifically in adults 45 years and older (26). Further, tennis participation has been linked to psychological benefits such as increased self-esteem and stress reduction, which may also contribute to long-term participation (13).

The present investigation considered the potential health impact of involvement in sports that have a cultural propensity towards lifetime participation and long-term adherence specifically tennis. The present investigation evaluated the potential health impacts of involvement in tennis among adults aged 21 to 72 years.

METHODS

Participants

One Hundred and fifty-one adults, affiliated with the International Tennis Federation, participated in the present investigation. Nine Participants were excluded from final analysis due to non-response on relevant survey questions. The final analyses included 142 participants. Participants ranged in age from 21 to 72 years, with a mean age of 47.6 years (SD = ± 13.53). Of this sample, 89 participants were 45 years or older. Analyses investigated the total sample as well as a sub-sample of only these participants who were 45 years and older. Participants were emailed a link to an online questionnaire, which consisted of 114 questions that were compiled from previously validated questionnaires and surveys. Details of each measure are provided. Before completing the survey, all participants provided informed consent. This study was approved by the Institutional Review Board at Mississippi State University.

Protocol

A questionnaire developed from the International Physical Activity Questionnaire, the Behavior Risk Factor Surveillance System, the Satisfaction with Life Scale, and seven questions developed by the ITF was sent to all participants. Details of each questionnaire are below.

Demographic questions from the BRFSS were used to determine general anthropometric and demographic information of participants. Self-reported height (reported to the nearest centimeter with imperial conversions to the side) and weight (reported to the nearest kilogram with imperial conversions to the side) values were used to calculate the participants' body mass index (BMI). Weight status and obesity prevalence was determined using BMI, which is commonly used as an indicator of body composition and strongly correlated with several chronic diseases (10, 30).

The International Physical Activity Questionnaire (IPAQ) was used to determine physical activity levels of participants (2, 6). The IPAQ consists of four major sections and provides indications of vigorous physical activity, moderate physical activity, time spent walking, and sedentary time. In the current study, IPAQ (slightly modified to address length of overall survey) was utilized to provide an overall snapshot of physical activity habits of participants.

Questions included were Part 1 (Questions 2-7), Part 2 (Questions 8-9, 11-13), Part 3 (Questions 14-16), Part 4 (Questions 20-25), and Part 5 (Questions 26-27). Questions were removed if they asked duplicate questions. Participants also selected drop down time frames for time of each activity instead of writing out times.

The Behavioral Risk Factor Surveillance System (BRFSS) is a telephone surveillance system in the United States (20). The purpose of the BRFSS is to collect data about health-related risk behaviors at the state and national levels. When the current study was conducted, the 2014 BRFSS was used to develop questions, as it was the most recently released. Researchers used specific questions from the following sections: health status, healthy days (health-related quality of life), chronic health conditions, and demography. Optional modules used included diabetes, childhood asthma prevalence, emotional support and life satisfaction. The participants' responses were then compared to the 2011 BRFSS results, as they were the most recently published results available at the time of analysis (16). Some of the results from the 2011 BRFSS looked at adults aged 45 and older. As a result, the current study examined both the health outcomes of all participants, and then took a closer look at the participants age 45 and older to see if their results differed. The 2011 BRFSS sample was those who answered the national U.S. telephone survey.

The Satisfaction with Life Scale (SWLS) consists of five statements such as "In most ways, my life is close to my ideal" and "The conditions of my life are excellent" which are scored on a six-point Likert scale (1=strongly disagree, 7=strongly agree). The purpose of this survey is to measure ones satisfaction with life as a whole (8). This scale has been used to examine overall satisfaction with life in a variety of age groups, cultures, and varying health statuses (3, 21, 22). In younger and older adults, researchers have found optimism is associated with greater life satisfaction (5). Leading to the thought Subsequently, SWLS may provide a glance at an individual's physiological resilience.

Seven questions, developed by the ITF, were used to determine overall involvement in tennis. Questions inquired about racquet hand dominance, frequency and consistency of regular tennis participation, preferred court surface, and highest ranking. To determine frequency, participants were asked "How frequent in a week do they play tennis". In an effort to determine consistency, participants were asked, "In the past 10 years how many times a week did you play tennis, and "How many years have you played tennis". Participants responded by choosing answers from categorical scales relevant to each question. The International Tennis Number Conversion Chart from July 2005 was used to standardize rankings to the ITF metric (27).

Statistical Analysis

Descriptive characteristics were calculated for all variables. A Chi-squared test for independence was used in cross tabulation analysis of past and current tennis participation. Chi-squared goodness of fit analyses were used to examine the differences in the relationships between participant responses and BRFSS data, as well as other relevant norms. Data was later stratified by sample age (45 years of age or older) in order to understand how answers could change with age.

RESULTS

Demographic information for total sample and sub-sample are presented in Table 1. The majority of our total sample and sub-sample were male (66.2% and 67.4% respectively). More than 75 percent of study participants reported regular tennis participation (2 or more times/week) for the last ten years. Likewise, most participants (77.2%) reporting regular tennis participation for the previous ten years, reported similar levels of current participation ($X^2 = 26.1, \mathrm{df} = 1, p = 0.0001$). The sub-category of individuals who are 45 years or older demonstrated similar results, with 80.2% of participants reporting regular tennis participation (2 or more times/week) for the last ten years. 61 percent of those who responded reported playing the majority of tennis on a standard hard court. Over half of the study participants did not play at a collegiate level, but played at a USTA NTRP ranking of 3-6, which indicates a diverse sample of recreational players in terms of skill level.

Table 1. Demographics

	Total Sample (n = 142)	Sub-Sample (n = 89)
Age	47.60 ± 13.53 years	56.67 ± 6.67 years
Height	1.75 ± 0.10 m	1.75 ± .10 m
Weight	77.03 ± 15.73 kg	79.47 ± 17.17 kg
BMI	25.06 ± 3.64 kg ·m^{-2}	25.82 ± 3.96 kg ·m^{-2}

Initial comparison of the total sample of participants compared to BRFSS, general population data, showed several indicators of better health. A significantly lower proportion of people reported being obese (χ^2 = 19.92, p = 0.0001; Figure 1). The majority of the participants in this study reported having good or better overall health (χ^2 = 17.191, p = 0.0001), likewise, many stated being full of energy and health in the 30 days prior to completing this study (22.71 days out of the past 30). When compared to the BRFSS results, the sample indicated meeting the U.S. Physical Activity Guidelines (χ^2 = 63.5, p = 0.0001; Figure 2).

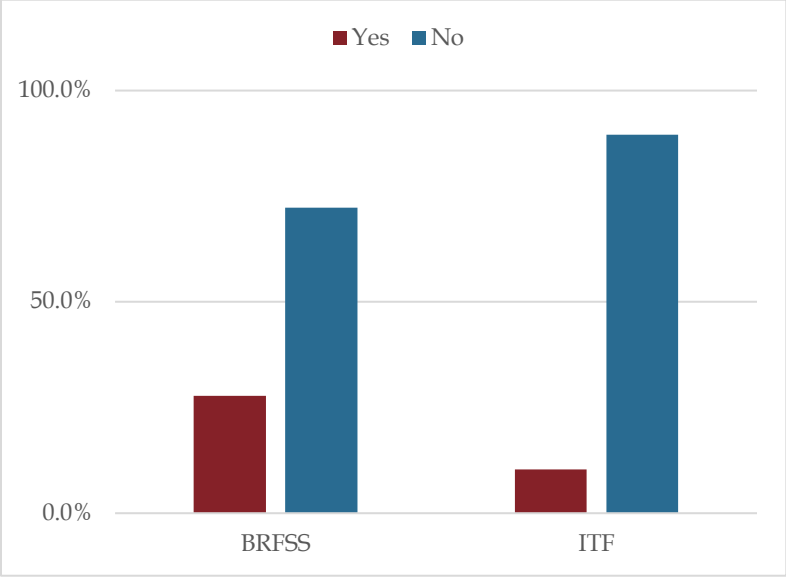

Figure 1. Adults aged 18 years and older who were obese in the current sample and the 2011 BRFSS.

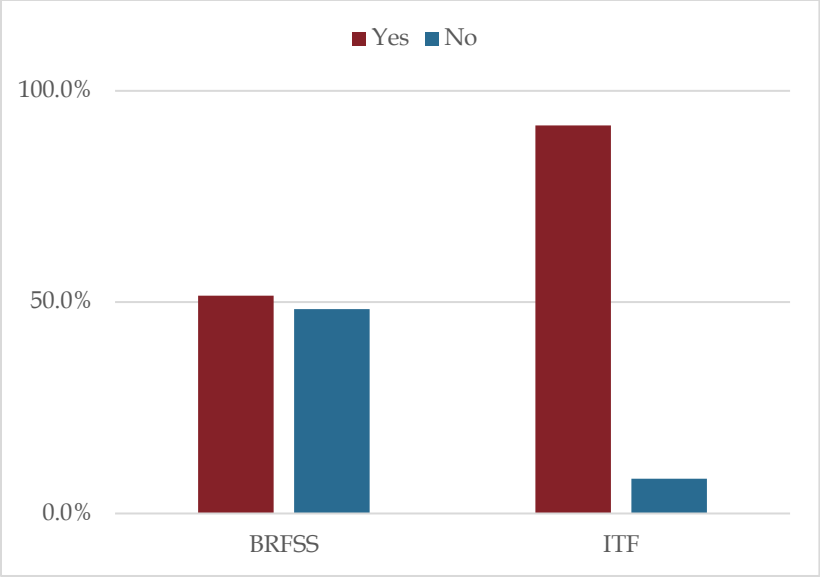

Figure 2. Adults who meet the U.S. physical activity guidelines in the current sample and the 2011 BRFSS.

When study participants 45 and older were compared to the BRFSS sub-sample of 45 years and older, the current study indicated a significantly lower number of adults 45 years or older who have had coronary heart disease ($\chi^2 = 8.759$, $p = 0.003$; Figure 3) and stroke ($\chi^2 = 22.5$, $p = 0.0001$). When compared to the BRFSS a statistically significant portion of this sub-sample reported meeting the U.S. physical activity guidelines ($\chi^2 = 39.02$, $p = 0.0001$; Figure 4), similarly to the study sample, many of the participants aged 45 and older stated being full of energy and health in the 30 days prior to completing this study (22.54 days out of the past). This sample also indicated a significantly lower number of adults with diabetes ($\chi^2 = 3.889$, $p = 0.049$; Figure 5), and obesity ($\chi^2 = 6.990$, $p = 0.008$). A greater proportion of this sub-category did indicate they currently had asthma when compared to the BRFSS ($\chi^2 = 32.875$, $p = 0.0001$; Figure 6).

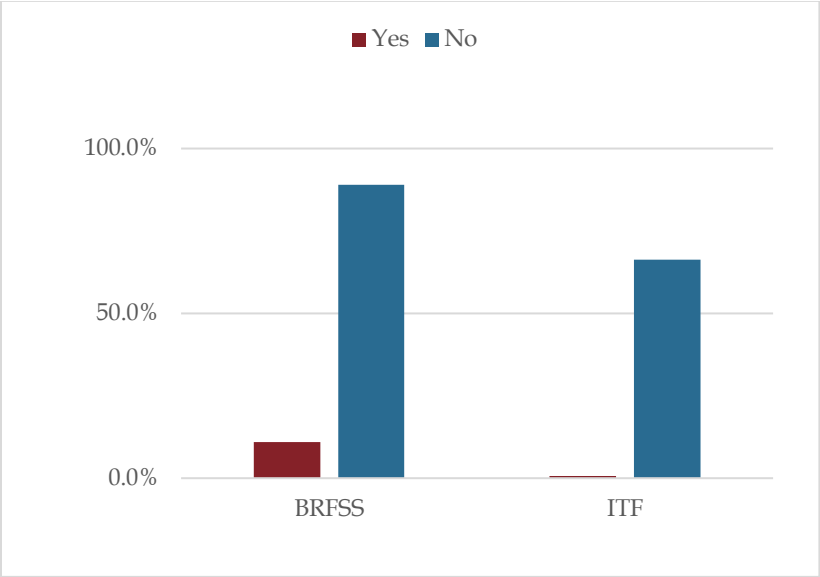

Figure 3. Adults aged 45 years old or older who have had coronary heart disease in the current sample and 2011 BRFSS.

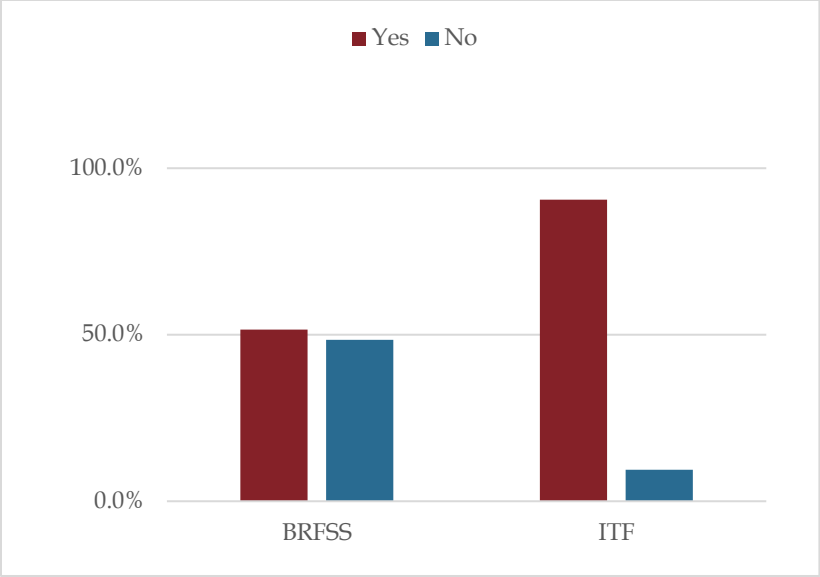

Figure 4. Adults 45 years and older who meet the U.S. minimum physical activity guidelines in the current sample and the 2011 BRFSS.

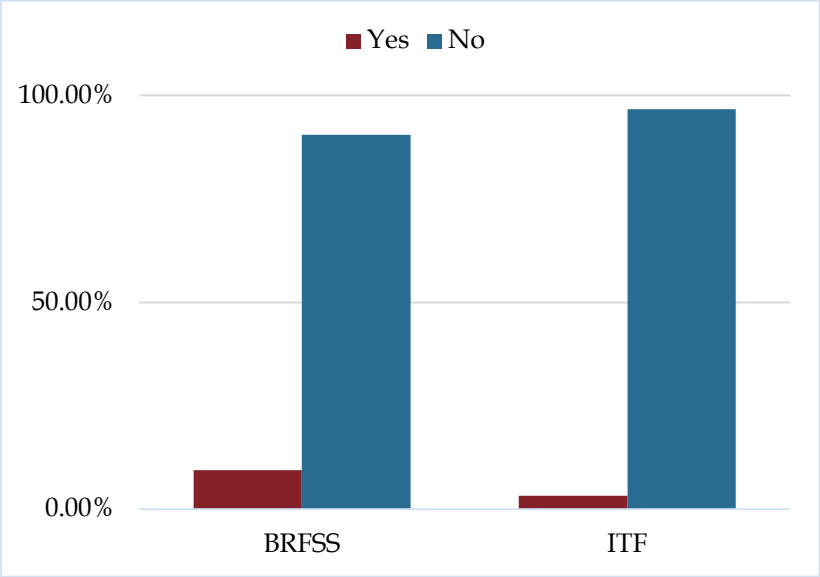

Figure 5. Adults 45 years and older diagnosed with diabetes in the current sample and the 2011 BRFSS.

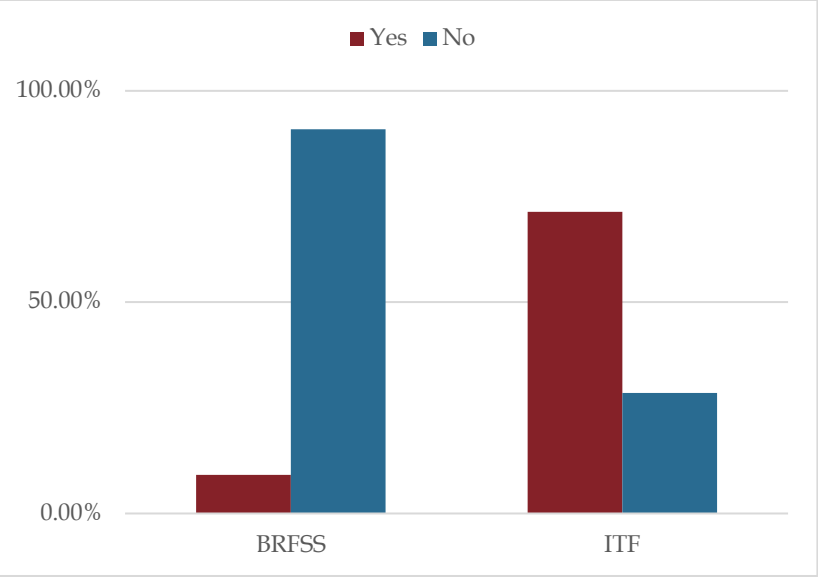

Figure 6. Adults aged 45 years and older who currently with asthma in the current sample and the 2011 BRFSS.

The BRFSS question "Has a doctor, nurse, or other health professional for ever told you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?", was used along with the SWLS to examine mental health parameters. Compared to BRFSS data, most of the total sample and sub-sample of individuals 45 and older did not significantly differ in depressive disorder diagnosis (χ^2 = 0.396, p = 0.529; χ^2 = 0.014, p = 0.906, respectively). Responses to the SWLS indicated the total, and the sub-sample exhibited an average level of satisfaction with their life (7).

DISCUSSION

Cardiovascular disease (CVD) has been the leading cause of death among developed nations since cause of death became a recorded statistic (15). Thus, finding pathways to reduce risk factors for CVD and other chronic diseases is vital for improving public health. Furthermore, researchers have found a negative relationship between obesity and quality of life especially in elderly (28). The relationship does not seem to impact the individual's satisfaction with life, but is important when considering the overall wellness of the individual (28).

A recent study examining the Copenhagen City Heart Study found that individuals who played tennis had a predicted life expectancy gain of 9.7 years (25). A possible explanation for these previous findings, was social support having a strong effect on long-term survival. Belonging to a group which meets on a regular basis promotes an environment of support and community. The current investigation supports this notion that lifetime sports, specifically tennis, may be a viable means to achieve physical activity in many age groups and promote a healthier life. Physical inactivity is a well-acknowledged risk factor for CVD and other chronic diseases (1, 29). The majority of participants in the study stated participating in leisure-time tennis play, in addition to meeting the United States Guidelines for physical activity, as determined via the IPAQ. Affiliation with the sport of tennis may provide sample opportunities for physical activity. Further, analysis of the sub-category sample 45 years or older indicated meeting the

physical activity guidelines, however when compared to the BRFSS there was no significant difference in leisure-time play. This finding suggests that tennis participation may provide a pathway for encouraging older adults to participate in physical activity.

When compared to the current body of literature regarding physical activity and mental health, findings of the current study regarding mental health are surprising. Fluetsch and colleagues utilized the 2015 BRFSS results to explore the relationship of physical activity to mental health, they found that individuals who participated in higher physical activity levels were associated with fewer self-reported days of poor mental health (11). One systematic review found that exercise had a significant but small effect on mental health in older adults (31). Another meta-analysis found high intensity interval training programs are associated with several health benefits, including anxiety and depression, across the lifespan (19). While an improvement in mental health parameters were not found in the current study when compared to the general populations, the fact that our findings are not showing a significant decrease in mental health parameters in the older population (45 years and older) is promising.

Strengths and limitations: The major limitations of this study are those associated with self-reported data. The inherent bias of self-reported data is often a limitation in epidemiological studies; however, the measures used in this study, with the exception of the tennis questions, have been validated previously. The seven questions developed by the ITF do allow some confidence in the accuracy of the responses because the participants were consistently involved in the tennis community.

Although retrospective methodologies are often criticized for reliability and validity, retrospective recall is one of the primary methods to determine performance levels. Work by Hayman et al. found an inclination of elite adolescent golfers to underreport sports participation when recalling time periods from a more distant past (14). The majority of questions used in the present investigation were extracted from the BRFSS standard interview tool. A recent review of reliability and validity of the BRFSS found high levels of validity and reliability (23).Likewise, the International Physical Activity Questionnaire has provided measurements that are comparable to other established self-report surveys (6). This study neglected to include queries of singles and doubles participation, which may have provided some indication of regular intensity of play. Another limitation to the study is that tennis participation and health parameters were examined within a unique group of participants, which may limit the generalizability of the findings outside of groups participating in similar lifetime sports.

Similarly, the current study results may have limited generalizability due to use of the 2014 BRFSS for questions and the 2011 BRFSS for analysis. Researchers were limited in what was available at the time this study was conducted. However, in comparing the questions asked to a more recent BRFSS, very little differences were found. It is important to note that each year the survey is unique and there is inherent error in making broad, generalizing comparisons to other survey years.

The present study indicated that regular tennis participation may provide beneficial health outcomes throughout the life course. The communal mores surrounding the sport of tennis may encourage chronic physical activity participation and attenuation of subsequent co-morbidities.

Persistent sports participation and lower attrition are more common in sports, such as tennis, where social approval is readily available by coaches, parents, teammates, and fan bases (12). This cultural milieu may be what fosters opportunities for tennis participation, and increased levels of physical activity across the lifespan. Future research should consider the sociological influences contributing to long-term activity participation and how those insights might be leveraged to improve intervention efficacy on a large scale. Likewise, future research would benefit from the inclusion of comparison samples who are physically active, non-tennis players and sedentary individuals to better delineate the direct influence of tennis participation.

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REFERENCES

1. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol 2(2): 1143-1211, 2012.

2. Booth M. Assessment of physical activity: An international perspective. Res Q Exerc Sport 71(2 Suppl): S114-120, 2000.

3. Buczak-Stec EW, Konig HH, Hajek A. Impact of incident parkinson's disease on satisfaction with life. Front Neurol 9: 589, 2018.

4. Bulter L. *Teaching lifetime sports*. Bergin & Garvey; 2002.

5. Chang EC, Sanna LJ. Optimism, pessimism, and positive and negative affectivity in middle-aged adults: A test of a cognitive-affective model of psychological adjustment. Psychol Aging 16(3): 524-531, 2001.

6. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 35(8): 1381-1395, 2003.

7. Diener E. Understanding scores on the satisfaction with life scale. Retrieved from : http://labs.psychology.illinois.edu/~ediener/Documents/Understanding%20SWLS%20Scores.pdf; 2006.

8. Diener E, Emmons RA, Larsen RJ, Griffin S. The satisfaction with life scale. J Pers Assess 49(1): 71-75, 1985.

9. Farooq MA, Parkinson KN, Adamson AJ, Pearce MS, Reilly JK, Hughes AR, Janssen X, Basterfield L, Reilly JJ. Timing of the decline in physical activity in childhood and adolescence: Gateshead millennium cohort study. Br J Sports Med 52(15): 1002-1006, 2018.

10. Flegal KM, Graubard BI. Estimates of excess deaths associated with body mass index and other anthropometric variables. Am J Clin Nutr 89(4): 1213-1219, 2009.

11. Fluetsch N, Levy C, Tallon L. The relationship of physical activity to mental health: A 2015 behavioral risk factor surveillance system data analysis. J Affect Disorders 253: 96-101, 2019.

12. Gould D, Weiss MR. Advances in pediatric sport sciences. Champaign, IL: Human Kinetics; 1987.

13. Groppel J, DiNubile N. Tennis: For the health of it! Phys Sportsmed 37(2): 40-50, 2009.

14. Hayman R, Polman R, Taylor J. The validity of retrospective recall in assessing prctice regimes in golf. Int J Sport Exerc Psychol 10(4): 329-337, 2012.

15. Heron M, Anderson RN. Changes in the leading cause of death: Recent patterns in heart disease and cancer mortality. NCHS Data Brief (254): 1-8, 2016.

16. Li C, Balluz LS, Okoro CA, Strine TW, Lin JM, Town M, Garvin W, Murphy W, Bartoli W, Valluru B, Centers for Disease Control and Prevention. Surveillance of certain health behaviors and conditions among states and selected local areas --- behavioral risk factor surveillance system, United States, 2009. MMWR Surveill Summ 60(9): 1-250, 2011.

17. Malina RM. Tracking of physical activity and physical fitness across the lifespan. Res Q Exerc Sport 67(3 Suppl): S48-57, 1996.

18. Malina RM. Physical activity and fitness: Pathways from childhood to adulthood. Am J Hum Biol 13(2): 162-172, 2001.

19. Martland R, Mondelli V, Gaughran F, Stubbs B. Can high intensity interval training improve health outcomes among people with mental illness? A systematic review and preliminary meta-analysis of intervention studies across a range of mental illnesses. J Affect Disorders 263: 629-660, 2020.

20. National Center of Chronic Disease Prevention and Health Promotion: Centers for Disease Control and Prevention. Behavior risk factor surveillance system. Retrieved from: https://www.cdc.gov/brfss/index.html; 2014.

21. Pavot W, Diener E. Review of the satisfation with life scale. Psychol Assess 5(2):164-172, 1993.

22. Pavot W, Diener E. The satisfaction with life sclase and the emerging construct of life satisfaction. J Posit Psychol 3(2): 137-152, 2008.

23. Pierannunzi C, Hu SS, Balluz L. A systematic review of publications assessing reliability and validity of the behavioral risk factor surveillance system (brfss), 2004-2011. BMC Med Res Methodol 13: 49, 2013.

24. Pluim BM, Staal JB, Marks BL, Miller S, Miley D. Health benefits of tennis. Br J Sports Med 41(11): 760-768, 2007.

25. Schnohr P, O'Keefe JH, Holtermann A, Lavie CJ, Lange P, Jensen GB, Marott JL. Various leisure-time physical activities associated with widely divergent life expectancies: The Copenhagen city heart study. Mayo Clin Proc 93(12): 1775-1785, 2018.

26. Swank AM, Condra S, Yates JW. Effects of long term tennis participation on aerobic power body composition, muscular strength, flexibility and serum lipids. Sports Med Train Rehabil 8(2): 99-112, 1998.

27. Tennis Development Department: International Tennis Federation. International Tennis Number Manual. London, England: International Tennis Federation; 2004.

28. Wang L, Crawford JD, Reppermund S, Trollor J, Campbell L, Baune BT, Sachdev P, Brodaty H, Samaras K, Smith E. Body mass index and waist circumference predict health-related quality of life, but not satisfaction with life, in the elderly. Qual Life Res 27(10): 2653-2665, 2018.

29. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: The evidence. CMAJ 174(6): 801-809, 2006.

30. Willett K, Jiang R, Lenart E, Spiegelman D, Willett W. Comparison of bioelectrical impedance and bmi in predicting obesity-related medical conditions. Obesity (Silver Spring) 14(3): 480-490, 2006.

31. Windle G, Hughes D, Linck P, Russell I, Woods B. Is exercise effective in promoting mental well-being in older age? A systematic review. Aging Ment Health 14(6): 652-669, 2010.