

Health Conditions, Substance Use, Physical Activity, and Quality of Life in Current and Former Baseball Players

Garrett S. Bullock,^{*†‡} PT, DPT, DPhil, Kristen F. Nicholson,[†] PhD, Brian R. Waterman,[†] MD, Eric Niesen,[§], Paul Salanh,^{||} PT, DPT, PhD, Charles A. Thigpen,[¶] PT, PhD, Ellen Shanley,[¶] PT, PhD, OCS, Laurie Devaney,[#] PT, ATC, OC, SFAAOMPT, PhD, Gary S. Collins,^{**††} BSc(Hons), PhD, Nigel K. Arden,[†] MD, FRCP, and Stephanie R. Filbay,^{‡ ‡‡} BPhy(Hons), PhD

Investigation performed at Wake Forest School of Medicine, Winston-Salem, North Carolina, USA

Background: A comprehensive understanding of lifestyle (health conditions and substance use), health-related quality of life (HRQoL), flourishing (holistic representation of health), and physical activity can inform stakeholders (players, coaches, and clinicians) and help improve long-term health across the life span.

Purpose: To describe health conditions (comorbidities or diagnoses), substance use, physical activity, HRQoL, and flourishing in current and former collegiate and professional baseball players and to assess the relationship between playing position and HRQoL/flourishing in former baseball players.

Study Design: Descriptive epidemiology study.

Methods: Eligible participants were those ≥ 18 years old with ≥ 1 season of collegiate or professional baseball experience. Participants completed a survey on health conditions (asthma, diabetes, hypertension, hypercholesterolemia, and depression), substance use (tobacco, alcohol, and energy drinks), physical activity (International Physical Activity Questionnaire–Short Form), HRQoL (Veterans Rand 12-Item Health Survey [VR-12] physical and mental component scores), and flourishing (Flourishing Scale). Adjusted multivariable regressions were performed for HRQoL and flourishing.

Results: Overall, 260 baseball players opened the survey, and 214 (current players, 97; former players, 117) participated for an 82% response rate. Of the former players, 32% had hypertension or hypercholesterolemia. In addition, 26% of current players had used smokeless tobacco (median, 3 years; interquartile range [IQR], 1-5 years) as compared with 34% of former players (median, 15 years; IQR, 5-25 years). In addition, 14% of current players had used electronic cigarettes (median, 2 years; IQR, 0-4 years) as opposed to 3% of former (median, 3 years; IQR, 2-4 years). Energy drinks were consumed by 31% and 14%, respectively, of current and former players on at least a weekly basis. Current baseball players performed 8667 metabolic equivalents per week of physical activity as opposed to 3931 in former players. Pitching was associated with worse VR-12 Mental Component Scores (-5.0 ; 95% confidence interval, -9.0 to -1.0). Playing position was not related to VR-12 Physical Component Scores or flourishing in former baseball players.

Conclusion: The similar smokeless tobacco prevalence between current and former baseball players suggests that they may start using tobacco products during baseball participation and continue after retirement. Similar reported HRQoL as compared with the general US population and high flourishing and physical activity levels suggest that baseball players may present with good musculoskeletal and psychological health.

Keywords: physical activity; smokeless tobacco; electronic cigarette; energy drinks; retired athletes

Baseball is a bat-and-ball sport with 160 member countries in the World Baseball Softball Confederation.³⁹ It is played at all competition levels and ages, with $>36,000$ and >8000 players participating at the collegiate and professional

levels in the United States, respectively.^{14,54} Participating in baseball has many health benefits, including enhanced cardiovascular health and physical fitness.^{10,48,59} However, baseball players have greater body mass index (BMI) as compared with the general population,¹³ which is associated with an increased risk of comorbidities such as diabetes and hypercholesterolemia.⁵² Playing baseball and other sports also potentially increases the risk of stress and

The Orthopaedic Journal of Sports Medicine, 9(11), 23259671211056645
DOI: 10.1177/23259671211056645
© The Author(s) 2021

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

anxiety,³ and baseball has a history of excess use of alcohol⁸⁵ and smokeless tobacco,⁸⁴ which can contribute to poor health outcomes.^{42,64} A systematic scoping review determined that there is currently a paucity of long-term general health research in baseball.¹⁰

One construct that assesses the multidimensions of health is health-related quality of life (HRQoL),⁸³ which encompasses several interconnected concepts, such as physical function, social function, general health, energy, and mental health.⁸³ HRQoL assesses baseline health and influences orthopaedic surgical outcomes.²⁸ While HRQoL is multifaceted,⁸³ it does not assess psychological constructs, such as life purpose and meaning, which limits the full evaluation of health.⁷⁸ One psychological health construct that evaluates such topics is *flourishing*.^{17,78} In addition to physical, psychological, and social health, flourishing incorporates life purpose and meaning, which are not evaluated via HRQoL.⁷⁸ Flourishing is the highest level of health and is defined as a holistic representation of physical, psychological, and social health.^{17,78} People with high flourishing have been shown to have positive individual and societal influences and overall life satisfaction.^{34,35,40,73}

Few studies have investigated flourishing in athletes; professional current and former cricketers have reported high flourishing as compared with lower playing standards,⁹ demonstrating potential disparities between different playing standards. Within baseball, 1 investigation of HRQoL and flourishing in retired professional baseball players found that 51% indicated moderate life satisfaction and 15% indicated low life satisfaction.⁴¹ This is opposed to 5.6% of the general US population reporting low or very low life satisfaction.⁷⁶ No studies have compared HRQoL or flourishing between current and former baseball players.¹⁰ While there is a paucity of HRQoL or flourishing research in baseball players, existing data have suggested the potential for worse life satisfaction than that in the general population. This highlights the need to investigate HRQoL and flourishing in current and former baseball players at all competition levels.

The *2011 Compendium of Physical Activities* categorized baseball as a moderate-intensity physical activity endeavor[†]; however, baseball requires players to sit for

prolonged periods while their team bats and to stand for prolonged periods while fielding. Furthermore, the positions have different physical requirements, which potentially affect physical activity levels.⁶⁶ There is a dearth of scientific data exploring the relationship between playing baseball and physical activity. This research gap is significant because former athletes may not maintain high physical activity levels after retirement from sport,^{63,89} which may lead to greater risk of inactivity-related chronic diseases.⁸⁶ Understanding baseball players' physical activity habits could help to inform interventions that aim to foster a sustainable, physically active lifestyle for retired baseball players.

Currently, there is a gap in our understanding of the long-term health effects of baseball participation.¹⁰ Furthermore, each baseball position has unique physical attributes with distinctive selective criteria,⁶⁶ potentially resulting in various long-term health needs.

Current and former baseball players may also demonstrate different health outcomes, attributed to age, playing exposure, and physical function. A comprehensive understanding of general health, HRQoL, flourishing, and physical activity will inform stakeholders of possible interventions for current and former baseball players to improve long-term health and HRQoL across the life span.

The purpose of this study was (1) to describe health conditions (comorbidities or diagnoses), substance use (tobacco use, electronic cigarette use, energy drink use), physical activity, HRQoL, and flourishing in current and former baseball players at the collegiate and professional levels and (2) to assess the relationship between playing position and HRQoL and flourishing in former baseball players. It was hypothesized that current baseball players would report greater physical activity, HRQoL, and flourishing as compared with former baseball players.

METHODS

Study Design

The study protocol received institutional review board approval. We employed a cross-sectional questionnaire that was designed to evaluate 5 aspects of health and well-being:

*Address correspondence to Garrett S. Bullock, PT, DPT, DPhil, Department of Orthopaedic Surgery, Wake Forest School of Medicine, 475 Vine St, Winston-Salem, NC 27101, USA (email: garrettbullock@gmail.com).

[†]Department of Orthopaedic Surgery, Wake Forest School of Medicine, Winston-Salem, North Carolina, USA.

[‡]Centre for Sport, Exercise and Osteoarthritis Research Versus Arthritis, University of Oxford, Oxford, UK.

[§]Houston Astros Baseball Club, Houston, Texas, USA.

^{||}Krannert School of Physical Therapy, University of Indianapolis, Indianapolis, Indiana, USA.

[¶]ATI Physical Therapy, Greenville, South Carolina, USA.

^{¶¶}Department of Kinesiology, College of Agriculture, Health, and Natural Resources, University of Connecticut, Storrs, Connecticut, USA.

^{**}Centre for Statistics in Medicine, Nuffield Department of Orthopaedics, Rheumatology, and Musculoskeletal Sciences, University of Oxford, Oxford, UK.

^{††}Oxford University Hospitals NHS Foundation Trust, Oxford, UK.

^{‡‡}Centre for Health, Exercise and Sports Medicine, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, Melbourne, Australia.

Final revision submitted June 2, 2021; accepted August 24, 2021.

One or more of the authors has declared the following potential conflict of interest or source of funding: S.R.F. and N.K.A. were funded by the Centre for Sport, Exercise and Osteoarthritis Research Versus Arthritis (grant No. 21595). G.S.C. was supported by the NIHR Biomedical Research Centre. B.R.W. has received research support from Arthrex and Encore Medical; education payments from Arthrex, Medwest, and Smith & Nephew; nonconsulting fees from Arthrex; honoraria from Vericel; and hospitality payments from Wright Medical. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was obtained from Wake Forest School of Medicine (IRB00059828).

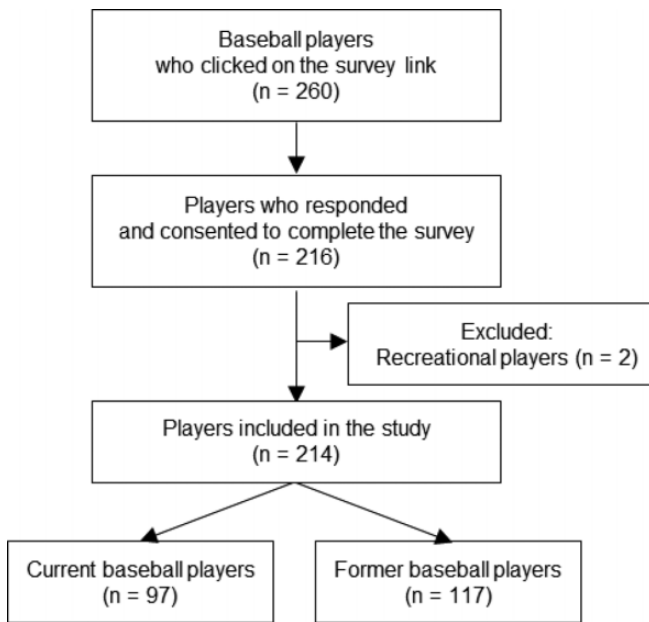


Figure 1. Study participant flowchart.

(1) baseball-related injury; (2) joint pain and osteoarthritis; (3) general health and disease prevalence; (4) physical activity; and (5) resilience, quality of life, and flourishing.^{7-9,11,21,72}

Participants and Recruitment

Participants were recruited from collegiate baseball teams, collegiate baseball team alumni networks, professional baseball organizations, and social media. The research team contacted the head coach or front office for each team and network, as well as sports medicine baseball experts with large social media followings. The head coach, front office member, or baseball expert disseminated the survey to the team and network via social media. Recruitment was performed between September 2019 and April 2020. A total of 260 participants opened the survey, and 214 consented to participate and commenced the survey (Figure 1). Eligible players were aged ≥ 18 years with ≥ 1 season of collegiate or professional baseball experience. We excluded players who participated at the recreational level (lower than the collegiate level, such as Little League, middle school, or high school).

Questionnaire Design

The study questionnaire was adapted from a health and well-being study on former elite and recreational cricketers.^{7-9,11,21,72} The questionnaire was modified for use in North America and within baseball participants via a survey pilot. The pilot group consisted of current and former baseball players ($n = 4$), collegiate and professional baseball coaches ($n = 5$), and medical professionals who specialized in treating baseball players (sports physician, physical therapists, and athletic trainer; $n = 4$). Participant data

were entered into an encrypted database. RedCap software (Research Electronic Data Capture; Vanderbilt University)⁴⁴ was used, and participants could save their progress and return to complete the questionnaire at a later time.

The questionnaire collected the following data: age, sex, BMI, other sports played, number of baseball seasons played, years since retirement from baseball (if applicable), number of joints injured, number of orthopaedic surgical procedures, persistent joint pain, physician-diagnosed osteoarthritis, health conditions, health behaviors, physical activity, HRQoL, and flourishing. For the full questionnaire, see the Appendix.

Outcomes

Health Conditions. Health conditions were assessed using the following question, developed from the cricket health and well-being study: “Have you ever been told you have any of the following by a doctor?”^{9,11} Participants were also asked, “Do you currently have any of the following, diagnosed by a doctor?” The assessed health conditions included asthma, depression, diabetes, hypertension, and hypercholesterolemia.

Substance Use

Tobacco Use. Participants were asked about their history of smoking and consuming smokeless tobacco (chewing tobacco, snuff), as developed from the cricket health and well-being study.^{9,11} Participants were assessed for electronic cigarette use via the question “Do you use electronic cigarettes (e-cigarettes, vaping, Juul, etc)?” Response options were *yes*, *no*, and *ex-electronic cigarette user*.

Alcohol Use. Participants were assessed for alcohol use via the following question, developed from the Health Services in England study⁵³: “Over a typical week, how many units of alcohol do you consume (1 unit of alcohol is equal to: 1 small glass of wine (125 mL; 4 ounces), OR 1 pub measure of spirits, OR 8 ounces of normal strength beer/lager).”

Energy Drink Use. Participants were assessed for energy drink use via the question “Do you drink energy drinks (Red Bull, Monster, All Star, etc)?” If participants answered *yes*, they were asked how many units they consumed per day, in which 1 unit was 8 oz (1 can of Red Bull or 1/2 can of Monster Energy).

Health-Related Quality of Life

HRQoL was assessed using the Veterans Rand 12-Item Health Survey (VR-12), a nonproprietary version of the 12-Item Short Form Survey (Short Form-12).⁷¹ The VR-12 utilizes a 5-point scoring system per question, allowing for decreased floor and ceiling effects as compared with the Short Form-12.⁷¹ HRQoL is assessed on a scale from 0 to 100, with 0 representing full disability and 100 representing no disability.⁸¹ The VR-12 is composed of the physical component score (PCS) and mental component score (MCS), which have high reliability in general population samples.²⁴ The PCS and MCS are calculated via a normative-based algorithm using general population data from the

2000-2002 US Medical Expenditure Panel Survey.⁷¹ The VR-12 has demonstrated a minimum detectable change of 5.08 for the PCS and 11.15 for the MCS in spinal orthopaedic cases.²⁴ The VR-12 has also shown high responsiveness in knee arthroscopy cases.⁵⁸

Flourishing

Flourishing was assessed using the Flourishing Scale,¹⁷ an 8-item survey that measures perceived success in interpersonal relationships, self-esteem, purpose, competence, and optimism.^{17,73} Each question is scored on a scale from 1 (strong disagreement) to 7 (strong agreement), with scores ranging from 8 (strong disagreement on all items) to 56 (strong agreement on all items). A higher score is considered greater flourishing. The Flourishing Scale has high reliability (intraclass correlation coefficient, 0.83-0.87)^{17,73} and criterion and convergent validity in university students^{17,73} and in adults from a variety of socioeconomic backgrounds, cultural origins, and age ranges.³⁰

Physical Activity

The International Physical Activity Questionnaire–Short Form (IPAQ-SF) was utilized to assess activity.³⁶ The IPAQ-SF has been used as a population surveillance and evaluation physical activity tool^{33,65} and has had fair agreement with accelerometer data (intraclass correlation coefficient, 0.30-0.39)^{19,46} and good validity versus other questionnaires and logs for physical activity ($r > 0.50$).^{45,46} Participants were asked to recall a typical week as time spent in vigorous-intensity activity, moderate-intensity activity, and walking.³⁶ To reduce variability, we used a standardized approach outlined in the IPAQ-SF manual to clean and code the IPAQ-SF data.³⁶ In line with recommendations, we recorded bouts of weekly activity <10 minutes as zero minutes.³⁶ Time spent in vigorous activity, moderate activity, and walking was converted to metabolic equivalents (METs), in which 1 MET is 1 kcal/kg/h, or the resting metabolic rate, during quiet sitting.³⁶ Vigorous activity was calculated as 8 METs/min, moderate activity as 4 METs/min, and walking as 3.3 METs/min.³⁶ The METs were truncated at 3 hours (180 minutes) per day per vigorous activity, moderate activity, and walking to reduce participant overestimation effect.³⁶ METs for all 3 forms of activity were combined and reported as total weekly METs.

Explanatory Variables

Playing Status and Playing Position. Participants were categorized as currently playing baseball, no longer playing baseball, or planning to return to baseball.^{9,11} Only 1 participant planned to return to baseball, with the last game age noted as 23 years and current age as >30 years. The participant was categorized as no longer playing baseball for analyses.

Playing position was assessed using the question “What is/was your main position of play?” Responses were

categorized as pitcher, position player, or 2-way player (pitcher and position player).

Confounders

Confounders were identified via clinical reasoning and literature search. In relation to HRQoL and flourishing, confounders included BMI,²³ competition level,⁸ baseball seasons played,⁷⁴ injury history,⁹ and education level.⁸⁷

Competition Level and Seasons Played. Competition level was assessed using the following question: “What was the highest level of baseball that you played for at least one season?” Participants were stratified into professional (Olympic or World Baseball Classic, Major League Baseball, Minor League Baseball, independent baseball) and college (4-year and junior college). Participants who reported their highest standard of play as high school, recreational, or *don't know* were excluded from all analyses.

Baseball experience was assessed using the question “For approximately how many seasons have you played baseball?”

Injury History. Injury history was assessed using the question “Have you ever had any baseball-related injuries leading to more than 4 weeks of reduced participation in exercise, training or sport?” Participants who responded *yes* were then instructed “Please write the number of injuries for each joint and side for [left/right] hip/groin, knee, ankle, foot, shoulder, elbow, hand/finger, spine/back, other joint.”

Education Level. Education was assessed using the following question: “What is the highest level of education you have successfully completed?” Participants were stratified into high school (high school diploma, did not finish college) and university degree (associate's degree or vocational certificate, bachelor's degree, graduate degree, doctorate degree). For a full cross-tabulate analysis of education level, see Supplemental Table S1.

Statistical Analyses

All data were assessed for missingness before analyses. Missing data were calculated as total and percentage of total data (Supplemental Table S2 and Figure S1). Missing data varied (playing status, 0%; age, 6%; handedness, 0%; BMI, 6%; comorbidities, 6%; flourishing, 17%; physical activity, 10%; joint injury, 7%). Data were assumed to be missing at random owing to survey fatigue. Multiple imputation using chained equations with 30 iterations (120 data sets) was performed. Outcomes, explanatory variables, and confounders in all statistical analyses were imputed. Each imputed data set was analyzed separately and pooled using Rubin's rules.⁸⁸ Imputed data converged and were observed to have similar descriptive summary statistics and variances when compared with the original data (Supplemental Figure S2 and Table S3). Sensitivity analyses were performed comparing complete case and imputed analyses, demonstrating similar results (Supplemental Table S4). Responses of *don't know* were excluded from all analyses.

Before data analysis, data were assessed for normality. Data were reported as mean (standard deviation), median (interquartile range), or count (percentage). Data were

calculated for all baseball players and for subgroups of current and former players. Chi-square and Mann-Whitney *U* tests were performed to compare health conditions and substance use between current and former baseball players. Multivariable linear regressions were used to determine the relationships between (1) baseball playing positions (pitcher, 2-way, position player) and (2) HRQoL and flourishing in former baseball players. Unadjusted and adjusted coefficients and 95% confidence intervals (CIs) were calculated. Sensitivity analyses were performed to assess potential relationships between pitchers and nonpitchers for HRQoL and flourishing. Models were adjusted for competition level (professional vs college), number of baseball seasons played, BMI, education level, and injury history. All assumptions for regressions were evaluated and satisfied.⁶⁷ All analyses were performed using R 4.02 (R Core Team) using the *dplyr* package²⁶ for cleaning and coding, the *nanian* package for missingness assessment,⁵⁷ the *mice* package for multiple imputation,⁸⁸ and *ggplot2* package for data visualization.

RESULTS

A total of 214 baseball players participated in this study (Table 1), with 76 identifying as pitchers, 81 identifying as position players, and 57 identifying as 2-way players. Former baseball players demonstrated an increased prevalence of hypertension (current, 1%; former, 14%; $P < .001$) and hypercholesterolemia (current, 2%; former, 18%; $P < .001$) and a decreased prevalence of electronic cigarette use (current, 14%; former, 3%; $P = .003$). Current and former baseball players showed no difference in prevalence for smokeless tobacco use (current, 26%; former, 34%; $P = .237$) or alcohol consumption (current, 2 units; former, 4 units; $P = .247$).

HRQoL in Former Baseball Players

No relationships were observed between playing position and PCSs: unadjusted (pitchers, 0.1 [95% CI, -3.1 to 3.2], $P = .989$; 2-way, -1.8 [95% CI, -5.5 to 2.0]) and adjusted (pitchers, -0.6 [95% CI, -3.1 to 3.2]; 2-way, -1.2 [95% CI, -4.7 to 2.3]). When compared with position players, pitching was related to decreased MCSs: unadjusted (-4.9 [95% CI, -8.6 to -1.1]) and adjusted (-5.0 [95% CI, -9.0 to -1.0]) (Table 2). Sensitivity analyses assessing potential relationships between pitchers and nonpitchers demonstrated similar results for the PCS and MCS (Supplemental Table S5).

Flourishing in Former Baseball Players

No differences were observed between playing position and flourishing: unadjusted (pitchers, -2.6 [95% CI, -7.9 to 2.7]; 2-way, -2.0 [95% CI, -8.5 to 4.5]) and adjusted (pitchers, -3.3 [95% CI, -9.2 to 2.6]; 2-way, -1.8 [95% CI, -8.4 to 4.7]) (Table 2). Sensitivity analyses assessing potential relationships between pitchers and nonpitchers demonstrated similar results for flourishing (see Supplemental Table S5).

DISCUSSION

Our study revealed that 26% of current and 34% of former baseball players have used smokeless tobacco, which is greater than the rate in the general population, and that 14% of current baseball players have used electronic cigarettes, which is a larger prevalence than that of former baseball players. A greater prevalence of current baseball players (31%) than former baseball players (14%) consumed energy drinks. Current and former baseball players who used energy drinks consumed similar quantities, at 6 units per week. Current and former baseball players reported HRQoL similar to that of the general US population, as well as high flourishing and high levels of physical activity. Former pitchers reported worse mental components of HRQoL than did position players.

Substance Use

Current and former baseball players reported smokeless tobacco use comparable to that reported in past literature and of similar prevalence.⁷⁵ These findings suggest that baseball players may begin smokeless tobacco use while playing baseball and continue after cessation of play. Tobacco use has been related to poorer orthopaedic surgery outcomes,²⁷ signifying continued emphasis on tobacco cessation. Tobacco cessation programs have demonstrated high efficacy,^{75,79,80} and the National Collegiate Athletic Association and Major League Baseball have established a greater commitment to tobacco cessation programs in the last decade.^{54,55} Over 1 in 10 current baseball players indicated using electronic cigarettes. While there is little research on this topic, this use is greater than that in the general US adult population, at 1.4% to 6.8%.^{4,12} In contrast, former baseball players reported electronic cigarette use similar to that in the general population.^{4,12} Currently, there is sparse literature on the long-term health effects of electronic cigarette use. However, electronic cigarettes contain toxins and nicotine, which can adversely affect health.⁵ Further research is required to understand the age discrepancies in baseball regarding tobacco and electronic cigarette use.

Current and former baseball players' energy drink consumption is similar to that in a meta-analysis of young adults.⁷⁰ Since 2004, there has been an increasing trend of energy drink consumption, with a proportional increase in adverse events, particularly in young adult males.²⁵ Energy drinks are not regulated for caffeine quantity and have been associated with adverse cardiac events.⁷⁰ Energy drink consumption has also been linked to increased risk-taking behavior and substance abuse, highlighting the potential harmful effects.² Within baseball, no league-wide policies have been enacted toward energy drink consumption. Therefore, there is a need to understand seasonal and career trends of energy drink consumption in baseball and to decipher the potential short- and long-term health effects.

Physical Activity

Current and former baseball players reported greater weekly physical activity habits than those of sedentary⁵⁰

TABLE 1
Characteristics of Current and Former Baseball Players^a

Variable	All Players (N = 214)	Current Players (n = 97)	Former Players (n = 117)
Age, y	29.8 ± 13.3	20.9 ± 4.8	36.8 ± 13.7
Body mass index	27.2 ± 3.2	26.3 ± 2.7	28.0 ± 3.4
Hand dominance			
Left	36 (17)	13 (13)	23 (20)
Right	178 (83)	84 (87)	94 (80)
Baseball seasons played	16.4 ± 5.7	14.9 ± 4.7	17.8 ± 6.1
Position			
Pitcher	76 (36)	30 (31)	46 (39)
Position player	81 (38)	37 (38)	44 (38)
2-way	57 (26)	30 (31)	27 (23)
Highest level of play			
Collegiate	175 (82)	92 (95)	83 (71)
Professional	38 (18)	5 (5)	33 (39)
Education			
High school diploma	77 (38)	64 (74)	12 (10)
Associate degree	12 (6)	12 (14)	0 (0)
University degree	67 (33)	7 (8)	60 (51)
Graduate degree	48 (24)	3 (3)	45 (38)
Asthma	9 (4)	5 (5)	4 (3)
Diabetes	3 (1)	1 (1)	2 (2)
Hypertension	17 (8)	1 (1)	16 (14)
Hypercholesterolemia	23 (11)	2 (2)	21 (18)
History of depression	17 (8)	11 (11)	6 (5)
Smokeless tobacco			
Current user	44 (21)	22 (23)	22 (19)
Former user	21 (10)	3 (3)	18 (15)
Duration of smokeless tobacco use, y	11 [3-19]	3 [1-5]	15 [5-25]
Electronic cigarette use			
Current user	11 (5)	9 (9)	2 (2)
Former user	6 (3)	5 (5)	1 (1)
Duration of electronic cigarette use, y	2 [0-4]	2 [0-4]	3 [2-4]
Alcohol consumption, units per week ^b	3 [0-7]	2 [0-5]	4 [1-8]
Current energy drink use	46 (21)	30 (31)	16 (14)
Energy drink consumption, units per week ^c	6 [4.5-7.5]	6 [4.5-7.5]	6 [4.6-7.3]
Physical activity per week, METs	5880 [2272-9488]	8667 [5069-12,272]	3931 [1662-6200]
Flourishing Scale score ^d	51.3 ± 5.8	51.5 ± 5.7	51.1 ± 6.0
VR-12 ^e			
PCS	48.96 ± 6.10	49.90 ± 4.78	48.07 ± 7.02
MCS	49.85 ± 9.13	48.80 ± 9.69	50.75 ± 8.63
History			
Orthopaedic surgery	95 (44)	35 (36)	60 (51)
≥4-wk time-loss injury	114 (53)	41 (42)	73 (62)

^aData are reported as mean ± SD, No. (%), or median [interquartile range]. MCS, mental component score; MET, metabolic equivalent; PCS, physical component score; VR-12, Veterans Rand 12-Item Health Survey.

^bOne alcohol unit is equivalent to 1 shot, 4 oz of wine, or a half pint of beer.

^cOne energy drink unit is equivalent to 8 oz.

^dFlourishing is scored from 8 (strong disagreement on all items) to 56 (strong agreement on all items). A higher score is considered greater flourishing.

^ePCS and MCS were calculated using norm-based scoring (population norm, 50 ± 10). A higher score indicates better health-related quality of life.

and recreationally active³² male college students and the general population of men in the United States.⁵⁶ While the weekly physical activity level of current baseball players is not surprising, given their high-level practice and play, interestingly, former baseball players indicated higher weekly physical activity than did a comparable general population.⁵⁶ High physical activity has been associated with a decreased prevalence of osteoarthritis and joint

arthroplasty.⁴⁷ High-level athletes perform greater levels of training and play a larger volume of games than do those at lower competition levels.⁴³ Furthermore, higher-level athletes demonstrate greater resilience and psychological hardiness, which may be due to the increased levels of training and competition.^{15,68,69} Within a qualitative study, elite cricketers maintained physical activity after retirement by utilizing psychological strengths and

TABLE 2
Relationship Between Playing Position and HRQoL and Flourishing in Former Baseball Players^a

Variable	VR-12 PCS ^b		VR-12 MCS ^b		Flourishing ^c	
	β (95% CI)	P Value	β (95% CI)	P Value	β (95% CI)	P Value
Pitcher ^d	-0.6 (-3.1 to 3.2)	.699	-5.0 (-9.0 to -1.0)	.002	-3.3 (-9.2 to 2.6)	.264
2-way ^d	-1.8 (-5.5 to 2.0)	.496	1.7 (-2.7 to 6.2)	.445	-1.8 (-8.4 to 4.7)	.576
Professional player ^e	1.9 (-1.4 to 5.2)	.253	-1.3 (-5.6 to 2.9)	.534	-0.1 (-5.9 to 6.0)	.572
Baseball seasons	-0.2 (-0.4 to 0.1)	.101	0.2 (-0.1 to 0.4)	.211	0.1 (-0.3 to 0.5)	.572
Body mass index	-0.9 (-1.2 to -0.4)	<.001	0.1 (-0.5 to 0.7)	.718	-0.4 (-1.3 to 0.4)	.282
High school diploma ^f	-0.4 (-6.0 to 5.2)	.896	-0.1 (-6.3 to 6.2)	.995	1.1 (-7.6 to 9.7)	.809
Joint injury history	-0.2 (-3.2 to 2.8)	.902	-0.8 (-4.5 to 3.0)	.454	-0.5 (-5.8 to 4.8)	.854

^aBold *P* values indicate statistical significance ($P < .05$). HRQoL, health-related quality of life; MCS, mental component score; PCS, physical component score; VR-12, Veterans Rand 12-Item Health Survey.

^bPCS and MCS were calculated using norm-based scoring (population norm, 50 ± 10). A higher score indicates better health-related quality of life.

^cFlourishing is scored from 8 (strong disagreement on all items) to 56 (strong agreement on all items). A higher score is considered greater flourishing.

^dPosition players were used as the reference category in the multivariable analyses.

^eCollegiate baseball players were used as the reference category in the multivariable analyses.

^fPlayers with a university degree were used as the reference category in the multivariable analyses.

implementing alternative strategies despite persistent joint pain.²⁰ In this sample, former baseball players may have increased physical activity attributed to inherent learned habits and psychological strengths. Further research is required to understand the motivations and maintenance of physical activity in athletes at all competition levels after cessation of play to create more effective physical activity interventions.

Health-Related Quality of Life

Current and former baseball players had HRQoL similar to that in the US general population. In contrast to our findings, a recent meta-analysis found that former collision sport athletes demonstrated poorer physical components of HRQoL than the general population.²² Baseball is a non-collision sport, which might explain why the prevalence of injuries was similar to that in cricket^{31,60,61} and why HRQoL in current and former baseball players was comparable to that in current and former recreational and elite cricketers.^{9,11}

After controlling for confounders, we observed former pitchers to have a clinically meaningful decrease in mental components of HRQoL as compared with former position players.²⁹ Furthermore, the similarities in physical components of HRQoL between pitchers and position players, after controlling for previous injury, suggest that these mental components of HRQoL disparities are not explained by impaired physical function. The potential differences in MCS may be due to time commitments or greater levels of social and psychological stress that pitchers can face as compared with other position players. Perfectionist and neurotic tendencies may also play a role in these findings. Another potential explanation is the increased depression prevalence of left- versus right-handed people.¹⁶ Laterality has been associated with increased risk of depression and anxiety.¹⁶ For descriptive analysis, see Supplemental Table S6.

However, these explanations are hypothetical and beyond the scope of this study. Investigating a prospective cohort of former professional baseball players to better understand the relationship between baseball exposure (seasons, games, and innings played) and HRQoL is required.

Flourishing

Current and former baseball players reported high flourishing scores, and there were no differences between playing positions and flourishing. Baseball players demonstrated higher flourishing scores as compared with a general population sample of Portuguese aged 25 to 60 years,⁷³ college students from Singapore and the United States,¹⁷ and a sample of New Zealanders aged 50 to 59 years.³⁰ The Flourishing Scale scores for these baseball players were similar to those of a sample of former cricketers in the United Kingdom.⁹ As there is no minimal detectable difference established for the Flourishing Scale, it was not possible to determine if differences in flourishing scores are clinically meaningful. However, the similarities in flourishing between baseball and cricket players may be due to sports participation. Sports participation can improve social and community relations^{18,38,49} and increase physical activity,^{6,18} which can assist in improving psychological health and flourishing.^{6,18,38}

Strengths and Potential Limitations

This study had strengths and potential limitations. It utilized reliable and valid outcome measures to assess HRQoL,⁷¹ flourishing,¹⁷ and physical activity,³⁶ increasing the ability to compare these results with the general population. Baseball stakeholders were used to develop and modify this survey, which increased the pertinence and applicability of this study. Given the use of email lists and social media for recruitment, it was not possible to

determine a true response rate, which limited our understanding of the influence of selection bias on the results. Additionally, the use of only an online platform, via email and social media, for data collection incorporated single-method bias, which decreased the precision of these results. The cross-sectional nature of this study required participants to recall past events; thus, recall bias may have decreased the precision of these results. Self-reported physical activity data can be over- or underestimated.⁶³ Direct measures such as accelerometers provide increased physical activity measurement accuracy.⁶² However, to increase the response and utility of this survey, self-reported physical activity measures³⁶ were used, which are widely used to measure population-level physical activity.

All health outcomes and HRQoL explored in this study are multidimensional and complex. While all participants played at a high level (collegiate or professional ranks) with a prolonged baseball exposure, former baseball players have other competing interests and stresses, such as socioeconomic status, family and work responsibilities, travel, and recreational and leisure activities, which may explain variance in these outcomes and HRQoL.^{37,51,77,82} Furthermore, concerning baseball exposure, it was not possible to obtain precise data on games played or innings pitched, which may have resulted in residual confounding. The competition-level question has not been validated, as the competition level was based on self-report and not on baseball records, which may have reduced the precision in these results.

As an a priori sample size calculation was not performed, post hoc power analyses were completed to improve interpretation. With a sample of 214 participants, an effect size of 0.27 could be detected at an alpha of .05 and a power of 0.80. For multivariable regression, with a sample of 117 former baseball players, an R^2 of 0.11 could be detected with 5 degrees of freedom and at a power of 0.80. As the effect size difference between current and former players' MCS was 0.21, there may have been a chance for a type 2 error.

CONCLUSION

All participants reported high smokeless tobacco use, which suggests that baseball players may begin tobacco product use during baseball participation and continue after retirement. Current baseball players indicated higher electronic cigarette and energy drink use as compared with former baseball players; however, given the relatively new inception of these substances, similar conclusions concerning baseball exposure and electronic cigarette and drink use cannot be made at this time. All participants had HRQoL similar to that of the general US population, as well as high flourishing and physical activity levels. Former pitchers reported decreased mental components of HRQoL as compared with position baseball players. These results can be used to inform baseball stakeholders on the potential risks and benefits of high-level baseball participation and encourage the implementation of health interventions for current and former players.

Supplemental material for this article is available at <http://journals.sagepub.com/doi/suppl/10.1177/23259671211056645>.

REFERENCES

1. Ainsworth BE, Haskell WL, Herrmann SD, et al. 2011 Compendium of physical activities: a second update of codes and MET values. *Med Sci Sports Exerc.* 2011;43(8):1575-1581.
2. Ali F, Rehman H, Babayan Z, Stapleton D, Joshi DD. Energy drinks and their adverse health effects: a systematic review of the current evidence. *Postgrad Med.* 2015;127(3):308-322.
3. Arimond G, Petrick JF. Organized baseball's effect on eight-year-old boys' perceived locus of control. *J Appl Rec Res.* 1998;23(3):203-223.
4. Bao W, Xu G, Lu J, Snetselaar LG, Wallace RB. Changes in electronic cigarette use among adults in the United States, 2014-2016. *JAMA.* 2018;319(19):2039-2041.
5. Breland A, Soule E, Lopez A, et al. Electronic cigarettes: what are they and what do they do? *Ann N Y Acad Sci.* 2017;1394(1):5-30.
6. Brunet J, Sabiston CM, Chaiton M, et al. The association between past and current physical activity and depressive symptoms in young adults: a 10-year prospective study. *Ann Epidemiol.* 2013;23(1):25-30.
7. Bullock GS, Collins G, Peirce N, Arden NK, Filbay SR. Physical activity and health-related quality of life in former elite and recreational cricketers from the UK with upper extremity or lower extremity persistent joint pain: a cross-sectional study. *BMJ Open.* 2019;9(11):e032606.
8. Bullock GS, Collins GS, Peirce N, Arden NK, Filbay SR. Health-related quality of life and flourishing in current and former recreational and elite cricketers. *Health Qual Life Outcomes.* 2020;18(1):1-12.
9. Bullock GS, Collins GS, Peirce N, Arden NK, Filbay SR. Playing sport injured is associated with osteoarthritis, joint pain and worse health-related quality of life: a cross-sectional study. *BMC Musculoskelet Disord.* 2020;21(1):1-11.
10. Bullock GS, Uhan J, Harriss EK, Arden NK, Filbay SR. The relationship between baseball participation and health: a systematic scoping review. *J Orthop Sport Phys Ther.* 2020;50(2):55-66.
11. Cai H, Bullock GS, Sanchez-Santos MT, et al. Joint pain and osteoarthritis in former recreational and elite cricketers. *BMC Musculoskelet Disord.* 2019;20(1):596.
12. Coleman BN, Rostron B, Johnson SE, et al. Electronic cigarette use among US adults in the Population Assessment of Tobacco and Health (PATH) Study, 2013-2014. *Tob Control.* 2017;26(e2):e117-e126.
13. Conroy DE, Wolin KY, Carnethon MR. Overweight and obesity among Major League Baseball players: 1871-2015. *Obes Res Clin Pract.* 2016;10(5):610-612.
14. Cooper JJ. How many baseball players are in each organization? Published August 21, 2018. Accessed July 30, 2020. <https://www.baseballamerica.com/stories/ask-ba-how-many-players-are-in-each-organization/>
15. Cowden RG, Fuller DK, Anshel MH. Psychological predictors of mental toughness in elite tennis: an exploratory study in learned resourcefulness and competitive trait anxiety. *Percept Motor Skills.* 2014;119(3):661-678.
16. Denny K. Handedness and depression: evidence from a large population survey. *Laterality.* 2009;14(3):246-255.
17. Diener E, Wirtz D, Tov W, et al. New well-being measures: short scales to assess flourishing and positive and negative feelings. *Soc Indicator Res.* 2010;97(2):143-156.
18. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act.* 2013;10:98.

19. Ekelund U, Sepp H, Brage S, et al. Criterion-related validity of the last 7-day, short form of the International Physical Activity Questionnaire in Swedish adults. *Public Health Nutr*. 2006;9(2):258-265.
20. Filbay SR, Bishop FL, Peirce N, Jones ME, Arden NK. Physical activity in former elite cricketers and strategies for promoting physical activity after retirement from cricket: a qualitative study. *BMJ Open*. 2017; 7(11):e017785.
21. Filbay SR, Bullock GS, Sanchez-Santos MT, Arden NK, Peirce N. A higher playing standard, bowling, and intermittent helmet use are related to a greater odds of injury or concussion in cricket. *Clin J Sport Med*. Published online April 29, 2021. doi:10.1097/JSM.0000000000000933
22. Filbay SR, Thomas B, McKay C, Adams J, Arden NK. Quality of life and life satisfaction in former athletes: a systematic review and meta-analysis. *Sports Med*. 2019;49(11):1723-1738.
23. Ford ES, Moriarty DG, Zack MM, Mokdad AH, Chapman DP. Self-reported body mass index and health-related quality of life: findings from the Behavioral Risk Factor Surveillance System. *Obesity Res*. 2001;9(1):21-31.
24. Gornet MF, Copay AG, Sorensen KM, Schranck FW. Assessment of health-related quality of life in spine treatment: conversion from SF-36 to VR-12. *Spine J*. 2018;18(7):1292-1297.
25. Gunja N, Brown JA. Energy drinks: health risks and toxicity. *Med J Aus*. 2012;196(1):46-49.
26. Hadley Wickham RF, Lionel H, Kirill M. dplyr: a grammar of data manipulation. R Project. Published June 18, 2021. Accessed July 30, 2020. <https://CRAN.R-project.org/package=dplyr>
27. Halawi MJ, Allen DA, Baron S, et al. Tobacco smoking independently predicts lower patient-reported outcomes: new insights on a forgotten epidemic. *J Arthroplasty*. 2019;34(7):S144-S147.
28. Hawkins RJ, Thigpen CA. Selection, implementation, and interpretation of patient-centered shoulder and elbow outcomes. *J Shoulder Elbow Surg*. 2018;27(2):357-362.
29. Hays RD, Morales LS. The RAND-36 measure of health-related quality of life. *Ann Med*. 2001;33(5):350-357.
30. Hone L, Jarden A, Schofield G. Psychometric properties of the Flourishing Scale in a New Zealand sample. *Soc Indicator Res*. 2014; 119(2):1031-1045.
31. Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *J Athl Train*. 2007;42(2):311-319.
32. Hubbs A, Doyle EI, Bowden RG, Doyle RD. Relationships among self-esteem, stress, and physical activity in college students. *Psych Rep*. 2012;110(2):469-474.
33. Hultenheim Klintberg I, Karlsson J, Svantesson U. Health-related quality of life, patient satisfaction, and physical activity 8-11 years after arthroscopic subacromial decompression. *J Shoulder Elbow Surg*. 2011;20(4):598-608.
34. Huppert FA. Psychological well-being: evidence regarding its causes and consequences. *Appl Psych*. 2009;1(2):137-164.
35. Huppert FA, So TT. Flourishing across Europe: application of a new conceptual framework for defining well-being. *Soc Indicator Res*. 2013;110(3):837-861.
36. IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)—short and long forms. Published November 2005. Accessed July 30, 2020. <http://www.ipaq.ki.se/scoring.pdf>
37. Iwasaki Y. Leisure and quality of life in an international and multicultural context: what are major pathways linking leisure to quality of life? *Soc Indicator Res*. 2007;82(2):233-264.
38. Jewett R, Sabiston CM, Brunet J, et al. School sport participation during adolescence and mental health in early adulthood. *J Adolesc Health*. 2014;55(5):640-644.
39. Kelly WW. Is baseball a global sport? America's "national pastime" as global field and international sport. *Global Networks*. 2007;7(2): 187-201.
40. Keyes CL. The mental health continuum: from languishing to flourishing in life. *J Health Soc Behav*. 2002;43(2):207-222.
41. Lerch S. Life satisfaction of retired ballplayers. *Baseball Res J*. 1982; 11:39-43.
42. Levine MA. Effect of smokeless tobacco on cardiovascular risk factors in professional baseball players. *Clin J Sport Med*. 1993;3(1):62.
43. Low J, Williams AM, McRobert AP, Ford PR. The microstructure of practice activities engaged in by elite and recreational youth cricket players. *J Sport Sci*. 2013;31(11):1242-1250.
44. Lyon JA, Garcia-Milian R, Norton HF, Tennant MR. The use of Research Electronic Data Capture (REDCap) software to create a database of librarian-mediated literature searches. *Med Ref Serv Q*. 2014;33(3):241-252.
45. Macfarlane DJ, Lee CC, Ho EY, Chan KL, Chan D. Convergent validity of six methods to assess physical activity in daily life. *J Appl Phys*. 2006;101(5):1328-1334.
46. Mader U, Martin BW, Schutz Y, Marti B. Validity of four short physical activity questionnaires in middle-aged persons. *Med Sci Sports Exerc*. 2006;38(7):1255-1266.
47. Manninen P, Riihimaki H, Heliövaara M, Suomalainen O. Physical exercise and risk of severe knee osteoarthritis requiring arthroplasty. *Rheumatology*. 2001;40(4):432-437.
48. Marini M, Sarchielli E, Portas MF, et al. Can baseball improve balance in blind subjects? *J Sports Med Phys Fit*. 2011;51(2):227-232.
49. Marlier M, Van Dyck D, Cardon G, et al. Interrelation of sport participation, physical activity, social capital and mental health in disadvantaged communities: a SEM-analysis. *PLoS One*. 2015;10(10): e0140196.
50. McArthur LH, Raedeke TD. Race and sex differences in college student physical activity correlates. *Am J Health Behav*. 2009;33(1): 80-90.
51. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev*. 2007; 29(1):29-48.
52. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA*. 2003; 289(1):76-79.
53. National Audit Office. *Reducing Alcohol Harm: Health Services in England for Alcohol Misuse*. The Stationery Office; 2008.
54. National Collegiate Athletic Association. Estimated probability of competing in college athletics. Published April 8, 2020. Accessed July 30, 2020. <http://www.ncaa.org/about/resources/research/estimated-probability-competing-college-athletics>
55. National Collegiate Athletic Association. NCAA drug testing program and bylaws. Accessed July 30, 2020. <http://www.ncaa.org/sport-science-institute/ncaa-drug-testing-program>
56. Ng SW, Popkin BM. Time use and physical activity: a shift away from movement across the globe. *Obesity Rev*. 2012;13(8):659-680.
57. Nicholas T, Di C, Miles M, et al. naniar: data structures, summaries, and visualisations for missing data. R Project. Published May 14, 2021. Accessed July 20, 2020. <https://cran.r-project.org/web/packages/naniar/index.html>
58. Oak SR, Strnad GJ, Bena J, et al. Responsiveness comparison of the EQ-5D, PROMIS global health, and VR-12 questionnaires in knee arthroscopy. *Orthop J Sports Med*. 2016;4(12):2325967116674714.
59. Oja P, Titz S, Kokko S, et al. Health benefits of different sport disciplines for adults: systematic review of observational and intervention studies with meta-analysis. *Br J Sports Med*. 2015;49(7): 434-440.
60. Orchard J, James T, Alcott E, Carter S, Farhart P. Injuries in Australian cricket at first class level 1995/1996 to 2000/2001. *Br J Sports Med*. 2002;36(4):270-274.
61. Posner M, Cameron KL, Wolf JM, Belmont PJ Jr, Owens BD. Epidemiology of Major League Baseball injuries. *Am J Sport Med*. 2011; 39(8):1675-1691.
62. Prince SA, Adamo KB, Hamel ME, et al. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *Int J Behav Nutr Phys Act*. 2008;5(1):56.
63. Reifsteck EJ, Gill DL, Brooks D. The relationship between athletic identity and physical activity among former college athletes. *Athl Insight*. 2013;5(3):271-284.

64. Robertson PB, Walsh MM, Greene JC. Oral effects of smokeless tobacco use by professional baseball players. *Adv Dent Res*. 1997; 11(3):307-312.
65. Rosemann T, Kuehlein T, Laux G, Szecsenyi J. Osteoarthritis of the knee and hip: a comparison of factors associated with physical activity. *Clin Rheumatol*. 2007;26(11):1811-1817.
66. Roth TS, Garrett CH, Osbahr DC. Baseball. In: Krutsch W, Mayr HO, Musah V, et al. *Injury and Health Risk Management in Sports*. Springer; 2020:471-477.
67. Royston P, Altman DG. Regression using fractional polynomials of continuous covariates: parsimonious parametric modelling. *J Royal Stat Soc*. 1994;43(3):429-453.
68. Sarkar M, Fletcher D. Psychological resilience in sport performers: a review of stressors and protective factors. *J Sport Sci*. 2014;32(15): 1419-1434.
69. Secades XG, Molinero O, Salguero A, et al. Relationship between resilience and coping strategies in competitive sport. *Percept Mot Skills*. 2016;122(1):336-349.
70. Seifert SM, Schaechter JL, Hershorin ER, Lipshultz SE. Health effects of energy drinks on children, adolescents, and young adults. *Pediatrics*. 2011;127(3):511-528.
71. Selim AJ, Rogers W, Fleishman JA, et al. Updated US population standard for the Veterans RAND 12-Item Health Survey (VR-12). *Qual Life Res*. 2009;18(1):43-52.
72. Shah K, Furniss D, Collins GS, et al. Cricket related hand injury is associated with increased odds of hand pain and osteoarthritis. *Sci Rep*. 2020;10(1):1-9.
73. Silva AJ, Caetano A. Validation of the flourishing scale and scale of positive and negative experience in Portugal. *Social Indicators Res*. 2013;110(2):469-478.
74. Simon JE, Docherty CL. Current health-related quality of life is lower in former Division I collegiate athletes than in non-collegiate athletes. *Am J Sport Med*. 2014;42(2):423-429.
75. Sinusas K, Coroso JG. A 10-yr study of smokeless tobacco use in a professional baseball organization. *Med Sci Sports Exerc*. 2006;38(7): 1204-1207.
76. Strine TW, Chapman DP, Balluz LS, Moriarty DG, Mokdad AH. The associations between life satisfaction and health-related quality of life, chronic illness, and health behaviors among US community-dwelling adults. *J Comm Health*. 2008;33(1):40-50.
77. Thoits PA. Stress and health: major findings and policy implications. *J Soc Health*. 2010;51(1):S41-S53.
78. VanderWeele TJ, McNeely E, Koh HK. Reimagining health—flourishing. *JAMA*. 2019;321(17):1667-1668.
79. Walsh MM, Hilton JF, Ellison JA, et al. Spit (smokeless) tobacco intervention for high school athletes: results after 1 year. *Addict Behav*. 2003;28(6):1095-1113.
80. Walsh MM, Hilton JF, Masouredis CM, et al. Smokeless tobacco cessation intervention for college athletes: results after 1 year. *Am J Public Health*. 1999;89(2):228-234.
81. Ware JE Jr, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36), I: conceptual framework and item selection. *Med Care*. 1992;30(6):473-483.
82. Wilkins K, Beaudet MP. Work stress and health. Article in English and French. *Health Rep*. 1998;10(3):47-62 (ENG), 49-66 (FRE).
83. Wilson IB, Cleary PD. Linking clinical variables with health-related quality of life: a conceptual model of patient outcomes. *JAMA*. 1995;273(1):59-65.
84. Wisniewski JF, Bartolucci AA, Beisel JG, Mann KR. Characteristics of the professional baseball smokeless tobacco user. *J Dent Res*. 1990; 69:259-259.
85. Wisniewski JF, Curcio BF, Bartolucci AA, Fox LM, Lovell J. Patterns of nicotine and alcohol usage in professional baseball players. *J Dent Res*. 1996;75:517-517.
86. Witkowski S, Spangenburg EE. Reduced physical activity and the retired athlete: a dangerous combination? *Br J Sports Med*. 2008; 42(12):952-953.
87. Zahran HS, Zack MM, Vernon-Smiley ME, Hertz MF. Health-related quality of life and behaviors risky to health among adults aged 18-24 years in secondary or higher education—United States, 2003-2005. *J Adolesc Health*. 2007;41(4):389-397.
88. Zhang Z. Multiple imputation with multivariate imputation by chained equation (MICE) package. *Ann Trans Med*. 2016;4(2):30.
89. Zielinski J, Krol-Zielinska M, Kusy K. Changes in physical activity of elite track and field athletes in selected age categories. *Stud Phys Cult Tourism*. 2006;13:185-187.