



Physical activity and quality of life among college students without comorbidities for cardiometabolic diseases: systematic review and meta-analysis

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Accepted: 3 November 2021 / Published online: 20 November 2021
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Abstract

Purpose To systematically review studies on the relationship between physical activity (PA) and quality of life (QOL) in university students without comorbidities for cardiometabolic diseases from around the world.

Methods We included observational studies with university students of both sexes, from public or private institutions, and that investigated the association or correlation between physical activity and quality of life among these students, without delimitation of date, language, or location. Reviews, letters to the editors, studies with qualitative methodologies, case studies, book chapters, articles with college students who had some specific disease or condition, such as obesity, diabetes, and others; studies with children of parents with chronic diseases, and those that were institutions aimed only at very specific populations, were excluded. Meta-analysis was calculated.

Results Thirty studies, consisting of 19,731 students, were included. The most commonly used instruments to assess the quality of life of the university population were the Quality of Life Questionnaire—short version (WHOQOL-BREF), and the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). The International Physical Activity Questionnaire (IPAQ) was the most commonly used instrument to assess PA. For the meta-analysis, 22 studies were included. Weak but positive correlations were found between PA and the QOL domains: physical health (0.16, 95% CI 0.11–0.22; $I^2 = 99.96\%$); mental health (0.14; 95% CI 0.07–0.20; $I^2 = 99.97\%$); social relations (0.24, 95% CI 0.08–0.38; $I^2 = 99.99\%$); environment (0.23, 95% CI 0.14–0.32; $I^2 = 99.90\%$); vitality (0.17, 95% CI 0.15–0.20; $I^2 = 99.49\%$); pain (0.02, 95% CI –0.02 to 0.12; $I^2 = 99.96\%$); QOL and PA (0.21, 95% CI 0.08–0.34; $I^2 = 99.99\%$). An association of $R = 0.60$ (95% CI 0.25–0.95; $I^2 = 85.61\%$) was found between QOL and PA in total.

Conclusion The results of our study showed a weak but positive relationship between physical activity and overall quality of life in college students, and also between PA and the domains of QL: physical health, social relationships, mental health, environment, and vitality, in this same population. It is important to study this population, since risk behaviors in this phase tend to perpetuate in the other phases of life.

Keywords Physical activity · University students · Higher education · Quality of life · Systematic review · Meta-analysis

Introduction

Physical inactivity is a public health problem worldwide. It is estimated that in 2017, 31.1% of the world adult population was below the American College of Sports Medicine

recommendations (150 min of moderate physical activity (PA)/week or 75 min of vigorous PA/week) for PA practice [1–3]. According to the World Health Organization, sedentary lifestyles favor the onset of non-communicable diseases and injuries (NCDs) and are one of the factors responsible for most deaths caused by these diseases [4]. In addition, the literature shows that PA practice is related to improved health, well-being, an improved biochemical profile, as well as positively influencing mood and anxiety.

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PA contributes to reducing the risk of NCDs and improving quality of life (QoL) [1, 5–7].

A longitudinal study conducted from 1997 to 2014 with a representative sample of US adults showed that individuals who engaged in at least 150 min of moderate-intensity aerobic PA, 75 min of vigorous-intensity aerobic PA per week, or a combination of the two, with moderate muscle strengthening activities twice a week or more, had a lower risk of all-cause mortality compared to those who did not exercise regularly [8]. Kallio et al. (2020) [9] observed that during two years of follow-up at school, students showed a reduction in daily PA time, with a consequent increase in sedentary time. These results demonstrate that with an increase in time spent studying as individuals age, there is a reduction in time allocated to PA.

It is important to consider that academic life brings great challenges and difficulties. It is a period when most students move to another city or even state, often leaving their parents' home for the first time and becoming responsible for themselves. Still, with the increased time spent on studies and extracurricular activities at university, leisure time is restricted, which leads to the interruption or reduction of PA practice upon entering higher education [10, 11]. Corroborating this information, a survey conducted in 23 countries showed that the prevalence of physically inactive university students ranged from 21.9 to 80.6% [12–14].

It is noteworthy that increased physical inactivity coincides with higher rates of obesity, increasing the risk of health problems, and reducing the QoL of individuals [15]. QoL can be assessed by different domains: physical; mental; environmental; social relationships; access to food, health and education; pain; housing; commuting; in addition to financial issues [16]. It can be affected by various factors, such as the individual's routine and the stages they are in. Therefore, higher education and all the changes arising from it can influence the QoL of college students [17–19]. Encouraging PA should be one of the world's public policy priorities, especially in middle-income countries. Its practice is beneficial at any age, but it is important to pay attention to some population groups, such as these students, due to the challenges they face during this period of life. Moreover, the behaviors adopted and consolidated during this period tend to remain in during the other stages of life, influencing future health [15, 20].

Given the above, it is important to better understand PA as a factor influencing the QoL of college students around the world. After searching the literature, no studies were found to provide a comprehensive overview of this relationship, thus a systematic review with meta-analysis on this subject may help fill this gap. Given this context, our aim was to systematically review studies on the relationship between physical activity (PA) and quality of life (QOL) in

university students without comorbidities for cardiometabolic diseases from around the world.

Methodology

Protocol and registration

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) checklist [21]. This review was registered in the International Prospective Registry of Systematic Reviews (PROSPERO): Number CRD42020197289.

Eligibility criteria

Studies with university students of both sexes were included; of any educational institution, whether public or private. Studies that investigated the correlation or association between levels of physical activity and quality of life in general or between domains of it, published on any dates, languages, or locations.

Review articles, letters to the editors, studies with qualitative methodologies, case studies, book chapters, articles with university students who had some specific disease or condition, such as obesity, diabetes, among others; studies with children of parents with chronic diseases, and those directed only to very specific populations were excluded.

Information sources and search strategy

The search strategy was developed based on the list of recommendations from the Peer Review of Electronic Search Strategies (PRESS) [22] and later sent for review to two researchers with experience in Systematic Reviews.

To search for the studies, the following databases were used: MEDLINE, LILACS, Embase, Scopus, Web of Science, Google Scholar and ProQuest Dissertation & Theses Global.

The search strategy used for MEDLINE was as follows: ("College Student"[Title/Abstract] OR "University student"[Title/Abstract] OR Student[Title/Abstract] OR Undergraduate[Title/Abstract] OR "Bachelor's degree"[Title/Abstract] OR University[Title/Abstract] OR Universities[Title/Abstract] OR Faculty[Title/Abstract] OR Academy[Title/Abstract]) AND ("Physical activity level"[Title/Abstract] OR "Physical activity"[Title/Abstract] OR "Sedentary behavior"[Title/Abstract] OR "Sedentary lifestyle"[Title/Abstract]) AND ("Quality of life"[Title/Abstract] OR Lifestyle[Title/Abstract] OR "Life quality"[Title/Abstract] OR "Health-related quality of Life"[Title/Abstract] OR "Health related quality of life"[Title/Abstract] OR HRQOL[Title/Abstract]) AND

(Observational OR "Observational Study" OR Survey OR "Cross-sectional" OR Cohort OR "Case–control" OR Intervention OR "Intervention study" OR "Clinical Trial" OR "Clinical study" OR "Randomized controlled trial" OR RCT OR Association OR Relationship OR Correlation). For the other six databases, the search strategy was adapted according to their peculiarities (Appendix 1).

The searches started and ended in August 2020. In addition, the references of the included articles were inspected in order to identify qualified articles for review.

Selection of studies and data extraction

The selection of studies was performed in two stages, by two researchers independently (LCSA and NSM). In the first stage, articles were selected by title and abstract. Always following the eligibility criteria. In the second, the selected ones were read in full and selected. Then, the two researchers met to resolve any disagreements about the selection. In addition, a search was performed in the reference lists of selected articles. The participation of a third researcher was not necessary, as all discrepancies between the two main ones were resolved. When there was an absence of information in the articles, the authors were contacted at least twice in order to obtain this data.

Subsequently, the characteristics of the studies were organized into three tables containing information as follows: Author and year; study country; sample (n sample, sex and age); study design, aim of the study; instruments for assessing physical activity and quality of life and their respective final or domain scores; statistical test used, adjustment variables, main results, and finally the following question: "Is physical activity related to quality of life?".

Risk of bias within individual studies

The critical tool recommended by the Joanna Briggs Institute for adapted cross-sectional studies was used to assess the risk of bias [23].

The tool consists of eight questions: "Inclusion criteria clearly defined in the sample"; "Subjects of study and environment described in detail"; "Exposure measured in a valid and reliable way"; "Clearly defined objectives and inclusion and exclusion criteria"; "Confounding factors identified"; "Strategies for dealing with confounding factors"; "Results measured in a valid and reliable way"; "Adequate statistical analysis" [23].

The questions were answered as "yes", "no", "unclear", or "not applicable". If all answers are "yes", in all items, the risk of bias will be low and if any item is classified as "no", a high risk of bias will be expected [23]. The evaluation of risk of bias was not used as eligibility criteria for inclusion of articles.

Summary measures and data analysis

When quantitative data were available, meta-analyses were performed to: (1) verify the correlation between the scores of the instruments for assessing QOL (and its components) and the practice of PA (Always having analyzed the highest level of physical activity practice, when this data was available in the original articles); and (2) estimate the magnitude of the association between the scores of the instruments for assessing QOL and the practice of PA.

Random models were used for meta-analysis, with effect estimation using the Maximum Likelihood method (Maximum-likelihood). The meta-analysis random effects assumes that different studies estimate different intervention effects, although related [24, 25], which agrees with our data.

In the case of studies where the measure of effect was the correlation, the authors did not present the error estimates (Standard Error, Standard Deviation, Confidence Interval, or Variance) necessary for their performance. Thus, we proceeded to obtain the correlation coefficient (r) transformed to the z -value [26], where:

$$Z = 0.5 * \ln ((1 + r) / (1 - r)).$$

(ln: natural log; r : correlation coefficient).

The z -value was used because it presents a normal approximate distribution and its variance can be estimated by the formula (ref):

Variance = $1 / (n - 3)$ (n = number of participants for each article).

After summarizing the results and calculating the respective Confidence Intervals (95% CI), the measurements were again transformed into a correlation coefficient for better interpretation of the results and presented using Forest Graphics.

For studies that investigated the association between exposures and outcomes of interest through regression analysis, the summary measure was presented using the β coefficient, accompanied by the respective 95% CI.

The heterogeneity of treatment effects between studies was tested using the Chi-square method ($p < 0.10$) [27] and its magnitude using I^2 . Due to the reduced number of studies included in the meta-analysis, it was not possible to perform meta-regression and analysis of publication bias, according to the recommendation of protocols by Cochrane [25]. All tests were performed using the Stata Software, version 16, serial number 301606311865, using the "meta" command.

Results

Selection of studies

Figure 1 shows the steps for selecting articles and those included in the review. Appendix 2 shows the excluded articles and the reason for the exclusion of each one [3, 5, 28–69].

Study characteristics

There was no response from the contacted authors to obtain missing data. Table 1 shows the general characteristics of the studies. After the analysis, 30 articles were included, all

with cross-sectional design. With individuals of both sexes and published in the years 2011 to 2020.

The studies were developed in several countries around the world: Brazil [7, 70, 71]; the USA [14, 72–77]; Turkey [78–81]; Korea [82, 83]; China [13, 84]; Croatia [85, 86]; Taiwan [12]; Pakistan [87]; South Africa [88]; Colombia [89]; Italy [90]; Venezuela [91]; Poland [92]; Serbia [93]; Iran [94]; and Vietnam [95]. The total sample was 19,731 individuals. The general objective of each study and other characteristics are shown in Table 1.

Risk of bias within individual studies

The risk of bias assessment was carried out by two researchers (LCSA e NSM), independently and at the end of it, both

Fig. 1 Flow diagram of the literature search and selection criteria (Adapted from PRISMA)

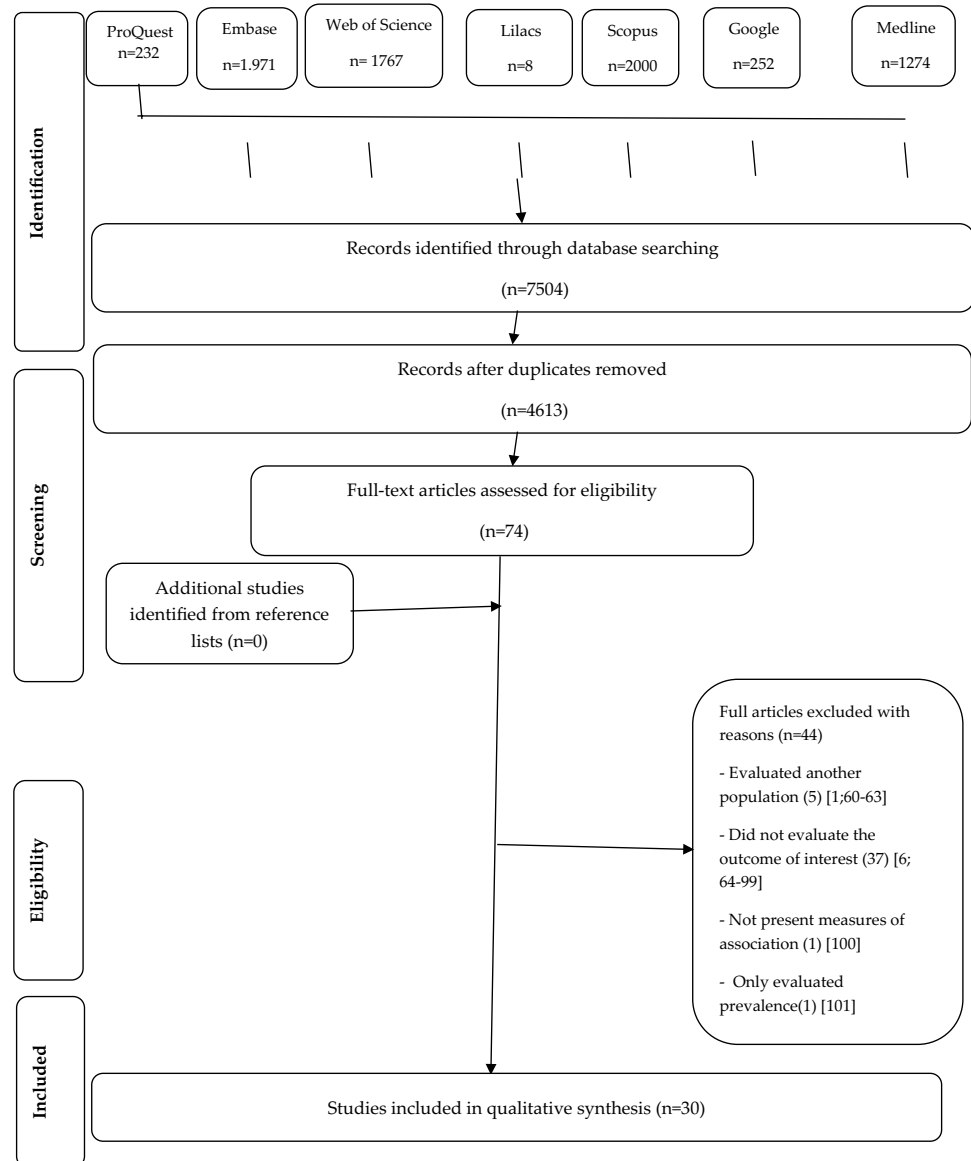


Table 1 Description of included studies

Author/year	Country	Sample (n. sex. age)	Study design	Aim of the study
Chang et al. [16]	Taiwan	1230. Both sexes. 18–25 years	Cross-sectional	To investigate associations between current exercise participation, sleep quality, and QoL among university students in Taiwan
Çiçek [17]	Turkey	150. Both sexes. 20.67 ± 1.65 years	Cross-sectional	To investigate Physical Activity (PA) and QoL of students in the SDS and ODS who attend the university
Dunn (2011)	EUA	243. F. 18–27 (21.0 ± 1.70) years	Cross-sectional	To investigate the relationships among individual (self-efficacy and enjoyment), social environmental factors (family and friend support), physical environmental factors (residential density, pedestrian infrastructure, proximity of recreational facilities, street connectivity, aesthetic quality, land use mix, traffic safety, and crime safety), PA and HRQoL in female college students
Ge et al. [13]	China	926. Both sexes. 17–23 years. (Mean ± 19,78)	Cross-sectional	To evaluate the association between physical activity, sedentary time, and sleep duration in the HRQoL of university students in Northeast China
Goldsby [72]	EUA	998. Both sexes. 18–29 years	Cross-sectional	To evaluate the relationship between HRQoL variables, MVPA, and BMI
Park and Kim [81]	Korea	183. NR. NR	Cross-sectional	To identify the relationships between PA, health status, and QoL of university students
Joo [82]	Korea	337. Both sexes. 21.92 ± 1.14; 21.80 ± 1.16; 21.84 ± 1.17. years	Cross-sectional	To analyze the associations between PA and stress, interpersonal relationships, and the QoL in university students
Joseph et al. [73]	USA	590. Both sexes. 20.4 ± 1.7 years	Cross-sectional	To add to the limited body of research examining the relationship between PA and QoL in young adults
Khan and Hassansdra [86]	Pakistan	378. Both sexes. 18–48 years	Cross-sectional	To explore the associations between PA, QoL, and psychological health related among university students in Pakistan
Kılınc et al. [78]	Turkey	150. Female. 17–28 years	Cross-sectional	To determine the relationship between the QoL of female students studying at Yüzüncü Yıl University and their levels of PA
Kocaaga et al. [79]	Turkey	30. F. 18–26 years	Cross-sectional	To investigate the relationship between PA, FC, QoL, and sleep quality in healthy adults
Kokic et al. [84]	Croatia	517. Both sexes. 20 ± 2 years	Cross-sectional	To determine and compare PA levels, health-HRQoL, and the prevalence of musculoskeletal pain symptoms (MPS) among the students of Physiotherapy and Social Sciences
Kruger and Sonono [87]	South Africa	703. Both sexes. 19.6 ± 1.26 years	Cross-sectional	To investigate the role of psychosomatic problems in the relationship between PA and HRQoL
Legey et al. [7]	Brazil	140. Both sexes. 23.6 ± 3.7 years	Cross-sectional	Investigate the relationship of PA level and their domains with HRQL, mood state (MS), and anxiety

Table 1 (continued)

Author/year	Country	Sample (n. sex. age)	Study design	Aim of the study
Lemos et al. [84]	Colo mbia	237. Both sexes. 20.6 ± 2.2 years	Cross-sectional	To determine the level of QoL in college students' health areas and evaluate associated factors
Maciel et al. [69]	Brazil	1966. Both sexes. 30.4 ± 12.4 years	Cross-sectional	To check for any significant differences in perceived QoL, specifically aspects of a physical nature, among volunteers who are more physically active and those less physically active in a university community
Mak et al. [83]	China	538. Both sexes. 18–31 years	Cross-sectional	To examine the relationships between socio-economic status, health promoting lifestyles, and QoL among Chinese Nursing students
Massidda et al. [89]	Italy	155. Both sexes. 18–30 years	Cross-sectional	To investigate the relationships between different levels of PA (walking, moderate-intensity activity, vigorous-intensity activity) and HRQoL in a population of male and female University students
Mendoza et al. [90]	Venezuela	64. Both sexes. 17–43 years	Cross-sectional	To examine the associations of PA and sedentary behavior with perceived QoL in college students in Venezuela
Nieves (2017)	EUA	597. Both sexes. 18–25 years	Cross-sectional	To assess the relationship between the PA level and HRQoL of college students
Nowak et al. [91]	Poland	595. Both sexes. 18–30 years	Cross-sectional	To explore the relation between PA, sedentary behavior, and the subjective and objective indicators of QoL as well as life satisfaction among university students, whose education is related to different dimensions on health
Pedišić et al. [85]	Croatia	1163. Both sexes. 21.5 ± 1.8 years	Cross-sectional	To determine the relationship between PA in work, transport, domestic and leisure-time domains and HRQoL among university students
Pekmezovic et al. [92]	Serbia	1624. Both sexes. 20.8 ± 1.8 years	Cross-sectional	To estimate HRQoL among students of University of Belgrade (Serbia) and its associations with socio-demographic factors, habits of life, and depression status
Peleias et al. [70]	Brazil	1350. Both sexes. 17–40 years (Mean: 22.8 ± 1.3)	Cross-sectional	To evaluate the association between leisure-time PA and QoL in medical students
Pourranjbar and Zeytoonli [93]	Iran	374. Both sexes. Mean: 22.4 years	Cross-sectional	To investigate the lifestyle, QoL, and PA barriers among female students of Kerman University of Medical Sciences, Iran
Snedden et al. [14]	EUA	2164. Both sexes. Mean: 19,7 years	Cross-sectional	To examine and compare the role of self-assessed sport and PA involvement on HRQoL among undergraduate student-athletes and general undergraduate college students
Vo et al. [94]	Vietnam	712. Both sexes. 19–35 years	Cross-sectional	To obtain an in-depth understanding of the QoL of medical students in southern Vietnam

Table 1 (continued)

Author/year	Country	Sample (n. sex. age)	Study design	Aim of the study
Yildirim and Bayrak [80]	Turkey	1057. Both sexes. 19–27 years	Cross-sectional	To evaluate the participation of university students in PA based on sport and the effects of QoL on the students' academic achievement and socialization
Zhang et al. [75]	EUA	325. Both sexes. Mean: 21.4 years	Cross-sectional	To examine the relationships among 2 X 2 achievement goal orientations, PA, and HRQo L in college students
Zhang et al. [76]	EUA	235. F. Mean: 21.0 years	Cross-sectional	To examine the influences of individual (e.g., self-efficacy, enjoyment), social (e.g., family and friend support), and physical environmental factors (e.g., crime safety) on college women's PA and HRQoL

NR not reported. *F* female, *QoL* quality of life; *PA* physical activity; *SDS* sports department; *ODS* others departments; *HRQoL* health related quality of life; *MVPA* moderate/vigorous physical activity; *BMI* body max index; *FC* functional capacity

met to agree to resolve the differences, without the need for the participation of a third researcher (Appendix 3).

Of the 8 parameters evaluated in the 30 selected studies, four had only "yes" answers: Exposure measured in a valid and reliable way; Objective criteria and standard for measurement; Results measured in a valid and reliable way; Appropriate statistical analysis. Among the studies, seven [13, 14, 74, 75, 77, 81, 85] met all the parameters evaluated (Fig. 2).

Results of individual studies

Tables 2 and 3 show the results of the relationship between physical activity and quality of life in university students, showing the various instruments used to evaluate the variables of interest, types of statistical tests used; the adjustment variables and the main outcomes found.

Among the selected studies, the most used instruments to assess the quality of life of the university population were the Quality of Life Questionnaire—short version (WHOQOL-BREF), used by nine studies [70, 71, 78, 79, 81–84, 95] and the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), also used by nine articles [12, 75, 80, 85, 87, 90, 91, 93].

The International Physical Activity Questionnaire (IPAQ) was the most used instrument to assess physical activity among university students. It was used by 14 of the 30 studies evaluated [13, 70, 73, 76, 78–80, 83, 85–87, 89, 90, 92]. The other instruments used to assess quality of life (QOL) and physical activity (PA) and the score obtained in each one are presented in more detail in Table 2.

Table 3 shows the type of statistical test used (association or correlation), in addition to the adjustment variables. As

Fig. 2 Risk of bias in the included studies (The Joanna Briggs Institute Critical Appraisal Checklist for Case Series)

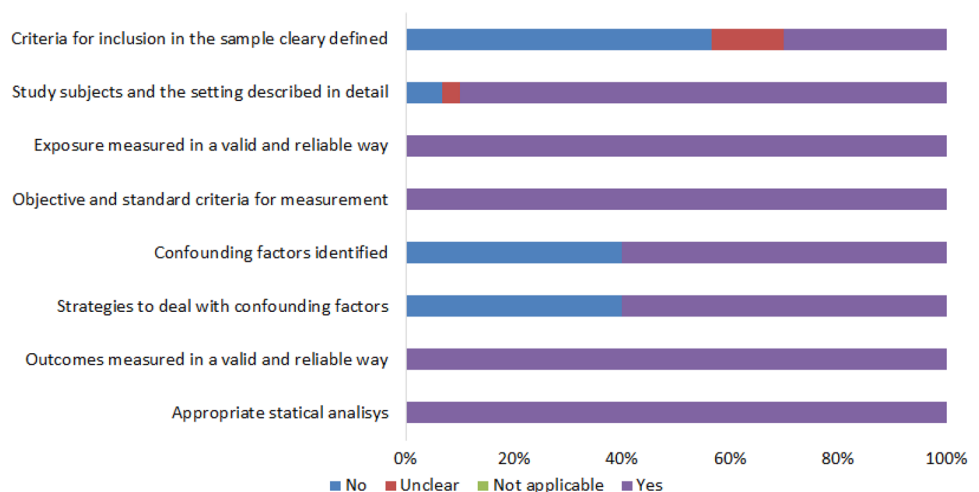


Table 2 Instruments used to assess QOL and PA

Author/year	QOL instrument	QOL result-score	PA instrument	PA result-score
Chang et al. [16]	Taiwan version of SF-36	PCS F: 51.66 ± 6.60 PCS M: 52.68 ± 6.19 MCS F: 43.84 ± 9.36 MCS M: 44.33 ± 9.06	Questionnaire developed by the Ministry of Education	Exercise frequency F: 2.00 ± 1.41 Exercise frequency M: 2.63 ± 1.71
Çiçek [17]	WHOQo L-BREF	F: Phys. H: 25.80 ± 4.20; Psy. H: 22.40 ± 5.25; SR: 15.50 ± 6.46; E: 28.06 ± 4.58, M: Phys. H: 26.26 ± 4.54; Psy. H: 22.66 ± 3.81; SR: 18.28 ± 7.08; E: 28.60 ± 5.11	IPAQ Short	SA F: 894.84 ± 1406.46; MA F: 432.13 ± 735.34; LA F: 1281.77 ± 927.65; TA F: 2592.44 ± 2276.82 ST F: 366.19 ± 177.14, SA M: 2500.07 ± 2743.46; MA M: 432.13 ± 735.34; LA M: 1702.41 ± 1450.68; TA M: 4938.86 ± 3919.33; ST M: 368.28 ± 178.41
Dunn (2011)	The Young Adult Quality of Life Inventory	NR	Six items (2–7) from the 2001 BRFSS	NR
Ge et al. [13]	SF-12 Chinese version	PCS: LA: 47.98 ± 8.82 MA: 49.76 ± 7.69 HA: 50.76 ± 8.16 MCS: LA: 49.23 ± 9.15 MA: 49.98 ± 9.61 HA: 50.23 ± 9.58 PCS: ST: < 6 h/day: 49.47 ± 8.91; 6–< 8 h/day: 49.66 ± 8.27; 8–< 10 h/day: 50.65 ± 7.42; ≥ 10 h/day: 50.47 ± 7.47 MCS: ST: < 6 h/day: 50.32 ± 8.92; 6–< 8 h/day: 50.30 ± 9.42; 8–< 10 h/day: 48.74 ± 10.40; ≥ 10 h/day: 50.64 ± 9.36	IPAQ – Long Form	F: LA: 36 (11.7%); MA: 105 (34.1%); HA: 167 (54.2%) M: LA: 84 (13.6%); MA: 264 (42.7%) HA: 270 (43.7%)
Goldsby [72]	QoL Questionnaire	NR	IPAQ	NR
Joo [82]	The Korean version of WHOQOL-BREF	QoL (total score): 92.14 ± 14.83 (LA); 93.54 ± 14.27 (MA); 93.95 ± 12.58 (HA); Phys D.: 26.30 ± 4.46 (LA); 27.23 ± 4.60 (MA); 27.58 ± 4.43 (HA); Psy. D: 23.39 ± 3.25 (LA); 23.04 ± 4.38(MA); 23.04 ± 3.78(HA); SD: 11.75 ± 1.47 (LA); 11.94 ± 1.98(MA); 11.97 ± 1.66 (HA); ED: 30.69 ± 3.55(LA); 31.32 ± 4.91 (MA); 31.35 ± 4.31 9(HA)	The Korean version of IPAQ	IA: 3 (0.9) (LA); 2 (0.6) (MA); 8 (2.4) (HA); MA: 18 (5.3) (LA); 18 (5.3) (MA); 58 (17.2) (HA); Li. A: 46 (13.6) (LA); 63 (18.7) (MA); 44 (13.1) (HA); SED: 38 (11.3) (LA); 17 (5.0) (MA); 10 (3.0) (HA)
Joseph et al. [73]	SWLS	SWLS: M: 25.5 ± 5.2; F: 25.8 ± 5.5	PSWS	PSWS: M: 18.4 ± 3.7; F: 16.9 ± 3.7
Khan and Hassansdra [86]	SF-36	NR	IPAQ	NR
Kilinc et al. [78]	WHOQOL-BREF	NR	IPAQ	NR
Kocaaga et al. [79]	SF-36	NR	IPAQ	NR

Table 2 (continued)

Author/year	QOL instrument	QOL result-score	PA instrument	PA result-score
Kokic et al. [84]	SF-36	PF: 90 ± 50; RFP: 100 ± 37.5; BP: 70.5 ± 29; GH: 70 ± 25; V: 62.5 ± 28.1; SF: 75 ± 42; RPE: 100 ± 33.3; MH: 50 ± 25; PCS: 55.7 ± 11; MCS: 48.3 ± 8.9	IPAQ Short Form	Total PA: 3,759 ± 4,341; VIPA: 960 ± 2880; MIPA: 720 ± 1330; Walking: 1,188 ± 2,326.5; LA: 57 ± 11; MA: 1,41 ± 27.3; HA: 3,19 ± 61.7
Kruger and Sonono [87]	Questionnaire developed by Haskell et al., 2007	PA: M: 4.11 ± 1.84; F: 3.32 ± 1.59	Questionnaire developed by SASAS, 2012	SWLS: M: 4.85 ± 1.21; 4.88 ± 1.24
Legay et al. [7]	SF-36	NR	The instrument proposed by Baecke et al., 1982	NR
Lemos et al. [88]	Q-LES-Q	QoL: 51 ± 6.8	IPAQ	NR
Maciel et al. [69]	WHOQOL-BREF	NR	IPAQ	NR
Mak et al. (2017)	WHOQOL-BREF	Social relationships: 13.74 ± 2.30; Environmental: 13.52 ± 2.04; Psychological health: 13.10 ± 1.76; Physical health: 12.15 ± 1.86	HPLP-II	PA Total Score: 128.23 ± 17.37
Massidda et al. [89]	SF-36	NR	IPAQ	NR
Mendoza et al. [90]	SF-36	NR	SF-36; EQ-5D; EQ-VAS	NR
Nieves (2017)	SF-36	NR	PA-R	NR
Nowak [91]	COMQOL-A5	QoL: productivity: 8.05 ± 6.64; intimacy: 12.51 ± 7.23; safety: 10.66 ± 6.75; Community: 5.65 ± 7.07; Emotional: 9.63 ± 8.38; SWLS: 21.34 ± 4.89	IPAQ	Leisure time: 1668.00 (0.0–32,100.00); Domestic and gardening: 1200.00 (0.00–18,660.00); Work-related: 5436.00 (33.00–49,560.00); Transport-related: 1485.00 (49.50–20,790.00); Sedentary weekly: 300.00 (30.00–900.00); Sedentary weekend: 300.00 (30.00 – 900.00)
Park and Kim [81]	WHOQOL-BREF	QoL: 3,429 ± 0,379 (2,50–4,35)	Self-reported physical activity questionnaire, about the last 7 days	Total PA: 2529.40 ± 5057.896 (0–59,640); Walking activity: 1172.33 ± 2768.614 (0–35,640); MA: 360.66 ± 908.884 (0–7200); VA: 996.42 ± 2630.122 (0–17,280);
Pedišić et al. [85]	SF-12v2	NR	IPAQ	NR

Table 2 (continued)

Author/year	QOL instrument	QOL result-score	PA instrument	PA result-score
Pekmezovic et al. [92]	SF-36	SF-36: Total Score: 76.7 ± 15.1 ; Physical functioning: 93.7 ± 12.5 ; Physical role: 83.3 ± 27.6 ; Pain: 83.1 ± 19.5 ; General health: 74.3 ± 17.4 ; Vitality: 64.1 ± 21.1 ; Social functioning: 77.8 ± 22.3 ; Emotional role: 67.1 ± 40.5 ; Mental health: 69.9 ± 20.5 ; Physical com- posite score: 79.7 ± 13.7 ; Mental composite score: 70.6 ± 18.8	Questions about moderate activities that increase breathing or heart rate, moderated for at least 10 min	Never PA: 71.6 ± 18.3 (Total SF-36 score \pm SD); Occasionally PA: 74.3 ± 14.9 (Total SF-36 score \pm SD); Weekly: 78.4 ± 14.3 (Total SF-36 score \pm SD); Everyday: 80.0 ± 14.4 (Total SF-36 score \pm SD)
Peleias et al. [70]	WHOQOL-BREF	QoL self-assessment—general: 7.9 ± 1.27 ; WHOQOL-BREF: Physical health: 65.2 ± 14.70 ; Psychological: 61.7 ± 15.69 ; Social relations: 63.6 ± 19.89 ; Environ- ment: 63.8 ± 14.08 ;	Questions for both global leisure-time PA	No PA: F: 329 (46.0%); M: 206 (32.3%). Low PA: F: 88 (12.3%); M: 56 (8.8%). Moderate PA: F: 147 (20.5%); M: 156 (24.5%). High PA: F: 150 (21.0%); 218 (34.2%)
Pourranjbar and Zeytoonli [93]	The brief version of the quality of life questionnaire including 26 items	Awareness of the benefits of PA: 4.43 ± 0.63 ($n = 374$); Weight and Nutrition: 2.70 ± 0.66 ($n = 371$); Participation in PA: 2.17 ± 0.75 ($n = 372$); Psychological aspects and attitude: 2.63 ± 0.67 ($n = 368$); interpersonal and social relation- ships: 3.34 ± 0.63 ($n = 370$); Using the Internet and social networks: 2.43 ± 0.66 ($n = 372$); Sleep and rest: 2.61 ± 0.68 ($n = 374$); Disease prevention and individual health: 3.63 ± 0.53 ($n = 370$); Social health: 3.24 ± 0.74 ($n = 373$); smoking, alcohol, and drugs consumption: 3.78 ± 0.71 ($n = 366$)	IPAQ	Participated in PA just one session/ week: 35.9%; two sessions/week: 30.5%; three sessions/week: 16.3%
Snedden et al. [14]	VR-12, composed of PCS and MCS	Division I Athlete: PCS Score: 55.02 ± 3.9 ; MCS Score: 55.58 ± 7.0 General Undergraduate: PCS Score: 55.49 ± 5.3 ; MCS Score: 43.26 ± 11.4	Self-assessed sport and PA level cat- egorized as Division I athlete, club athlete, intramural player, student who works out regularly, or student who is physically inactive	Club athlete: 122 (9.2%); Intramural player: 193 (23.2%); Works out regularly: 705 (53.3%); Physically Inactive: 302 (22.8%)
Vo et al. [94]	WHOQOL-BREF	Physical: F: 52.62 ± 13.09 ; M: 57.06 ± 13.02 . Psychological: F: 50.34 ± 14.85 ; M: 52.08 ± 15.84 . Social: F: 59.61 ± 15.45 ; M: 57.47 ± 17.57 . Environmental: F: 53.59 ± 14.49 ; M: 55.48 ± 15.82	Sociodemographic questionnaire	Frequency of physical activity (times per week): Never: 267 (37.5%)

Table 2 (continued)

Author/year	QOL instrument	QOL result-score	PA instrument	PA result-score
Yildirim and Bayrak [80]	WHOQOL-BREF	Life quality: 98.2875 ± 12.48586; perceived quality of life: 3.5848 ± 0.75296; perceived quality of health: 3.7251 ± 0.80152; physical health dimension: 15.0426 ± 2.24911; Mental Health Dimension: 14.7122 ± 2.22713; Social Relations Dimension: 14.5289 ± 2.87120; Environmental Health Dimension (TR): 14.0953 ± 2.06584; Socializing with S DFA: 3.7021 ± 0.58256; Personal and Social Integration: 4.0062 ± 0.74515; Leadership: 3.2963 ± 0.90637; Belonging: 3.7917 ± 0.80557; Self-confidence: 3.4669 ± 0.89327	Cooper physical activity scale	Sedentary: 295 (28,8%); Low Active: 218 (21,2%); moderately active: 183 (17,8%); highly active: 330 (32,2%)
Zhang et al. [75]	23-item Quality of Life Inventory	NR	IPAQ	NR
Zhang et al. [76]	The Young Adult Quality of Life Inventory	Self-efficacy: 3.43 ± 0.83; Enjoyment: 5.74 ± 0.96; Family support: 2.24 ± 1.02; Friend support: 2.79 ± 1.08; Crime safety: 3.15 ± 0.95; Physical functioning: 81.25 ± 14.61; Psychosocial functioning: 76.75 ± 13.18	Six items from the 2001 Behavioral Risk Factor Surveillance System physical activity module	MVPA (min/week): 460.54 ± 619.62;

NR not reported. *QoL* quality of life; *PA* physical activity; *WHOQOL-BREF* quality of life questionnaire-short form; *SF-36* medical outcomes study 36-item short-form health survey; *IPAQ* international physical activity questionnaire; *PCS* physical component summary; *MCS* mental component summary; *F* female; *M* male; *Phys. H* psychological health; *SR* social relationships; *E* environment; *SA* severe activity; *MA* moderate activity; *LA* low activity; *TA* total activity; *BRFSS* behavioral risk factor surveillance system; *ST* sitting time; *HA* high activity; *Phys D* physical domain; *Psy. D* psychological domain; *SD* social domain; *ED* environment domain; *IA* intense activity; *Li. A* light activity; *SED* sedentary; *GLT* godin leisure time; *PSWS* physical self-worth scale; *SWLS* satisfaction with life scale; *VIPA* vigorous-intensity PA; *MIPA* moderate-intensity PA; *PF* physical functioning; *RFP* role functioning/physical; *BP* bodily pain; *GH* general health; *V* vitality; *SF* social functioning; *RFE* role functioning/emotional; *MH* mental health; *Socializing with S DFA* socializing with the physical activities based on sports; *MVPA* moderate-to-vigorous physical activity

Table 3 Outcomes of included studies

Article	Statistical tests used	Adjustment variables	Outcomes	
			Main results	Is pa practice related to better qol?
Chang et al. [12]	Correlation and association	BMI; self-perceived health; satisfaction with exercise participation; gender; effect of exercise	Exercise frequency was significantly correlated with higher mental QOL (MCS) scores; Higher scores on most of the domains of QOL, except for bodily pain ($r = -0.111$, $P = .013$) in males	YES (MCS)
Çiçek [17]	Correlation	NR	Correlation between PA and WHOQoL: Relationship between high levels of PA and total PA with physical, psychological, social relationships and the environment ($p < 0.005$ and $p < 0.001$). Low levels of PA with physical and social relationships, and also, moderate PA and sitting time had a significant difference in social relationships ($p < 0.005$ and $p < 0.001$)	YES (Physical, Psychological, social relationships; environmental)
Dunn (2011)	Correlation	NR	Positive correlations: social support from family and friends and PA and HRQoL. PA was significantly correlated with physical HRQoL ($r = 0.19$, $p < 0.01$) but not with psychosocial HRQoL ($r = 0.02$)	YES (Social support from family and friends HRQoL)
Ge et al. [13]	Association	Gender; age; grade; specialty; BMI; home location; monthly living expenses; PA and ST (for sleep duration); PA and sleep duration (for ST) or ST and sleep duration (for PA);	Positive impact of PA on the HRQoL. A higher score for PCS and MCS: better HRQoL. The effect of PA on the HRQoL of college students was independent of the effect of ST on the HRQoL	YES (PCS; MCS)
Goldsby [72]	Association	QVRS, Sex, MVPA, Sleep duration	No statistical evidence found supporting a mediating effect of MVPA on the relation between HRQoL	NO
Joo [82]	Association	Age; sex; grade; smoking; alcohol drinking; number of breakfasts per week and activity of daily living	The high and moderate PA groups obtained significantly lower scores for PWI than the low group ($P < 0.05$) and the high group obtained significantly higher scores for interpersonal relationships than the low group ($P < 0.05$)	YES. (Lower scores for PWI and interpersonal relationship)

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qoL?
Joseph et al. [73]	Association	BMI; gender, race; physical self-esteem; exercise self-efficacy; positive affect; negative affect	<p>Main results</p> <p>The PA model (RMSEA = .03, CFI = .99) accounted for 25% of the variance in QoL. PA had positive direct effects on exercise self-efficacy ($b = .28, P \wedge .001$) and physical self-esteem ($b = .10, P \wedge .001$). Physical self-esteem was found to be the most powerful mediating variable on QOL ($b = .30, P \wedge .001$)</p>	YES (exercise self-efficacy, physical self-esteem)
Khan e Hassansdra (2016)	Correlation	NR	<p>Psychological suffering showed a negative correlation with all IPAQ scores ($r = -0.12, p < 0.05$) and a significant negative relationship with vigorous PA ($r = -0.10, p < 0.05$) and walking ($r = -0.113, p < 0.05$). The summary of the physical component of the SF-36 showed a significant positive association with the summary of the mental health component of the SF-36 ($r = 0.72, p < 0.01$), general quality of life score ($r = 0.91, p < 0.01$), and vigorous physical activity ($r = 0.10, p < 0.05$). The summary of the SF-36 mental component had a positive relationship with overall quality of life ($r = 0.91, p < 0.01$), vigorous physical activity ($r = 0.12, p < 0.05$), and general physical activity ($r = 0.12, p < 0.05$). General quality of life was significantly correlated with vigorous PA ($r = 0.10, p < 0.05$) and walking ($r = 0.86, p < 0.01$)</p>	YES; (PCS; MCS, General QoL)

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qol?
			Main results	
Kılınç et al. (2016)	Correlation	NR	The relationship between QoL and PA: the relationship between OFA and EFA a significant relationship was found between OFA and EFA ($r=0.463$; $p<0.05$), between walking and OFA (0.302), between MET and EFA (0.819), between MET and OFA (0.756), MET and walking (0.506). As for walking and AFA ($r=0.097$) and physical area and OFA (0.055), no relationship was found	YES (OFA, EFA)
Kocaaga et al. [79]	Correlation	NR	Positive correlation between physical 6-min-long walk test and IPAQ walking score ($r=0.194$, $p<0.05$), IPAQ moderate and SF36 emotional status ($r=0.253$, $p<0.05$)	YES (SF- Emotional Status)
Kokic et al. [84]	Correlation AND Association	Age; Gender; BMI; Course of Study	The mental health domain was negatively associated with vigorous-intensity PA ($p<0.05$; $rs=-0.101$), moderate-intensity PA ($p<0.05$; $rs=-0.103$), and total PA ($p<0.05$; $rs=-0.125$). Overall health was in a positive relationship with vigorous-intensity PA ($p<0.05$; $rs=0.121$), moderate-intensity BP ($p<0.05$; $rs=0.103$), total PA ($p<0.05$; $rs=0.115$), and in a negative relation as time spent sitting ($p<0.05$; $rs=-0.120$)	YES. (Mental Health Domain, overall Health)
Kruger e Sonono (2016)	Correlation	NR	Positive relationship between AF and QoL ($\beta=0.11$). Those who practice PA were satisfied with their QoL. AF had a negative relationship with psychosomatic health related to problems ($\beta=-0.23$). Likewise, psychosomatic health related to problems had a negative relationship with QoL ($\beta=-0.39$)	YES. (General Qol, psychosomatic health related to problems)

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes
Legey et al. [7]	Association	NR	<p>Main results</p> <p>Is pa practice related to better qol?</p> <p>Negative correlation was found between LTPA and total mood disorder (TMD) ($p=0.004$). Positive correlations between the vigor subscale and both LTPA ($p=0.001$) and total PAL ($p=0.019$). LTPA and total PAL demonstrated positive coefficients with the PCS ($p=0.000$; $p=0.005$), MCS ($p=0.000$; $p=0.006$), and total HRQL ($p=0.000$; $p=0.003$)</p> <p>YES. (TMD; vigor subscale; PCS, MCS, and Total HRQoL)</p>
Lemos et al. [88]	Association	Sex; Age; Children; Socioeconomic Stratium; Weekly hours of classroom academic hours; Acute Pain; Chronic pain; Vigorous physical activity	<p>The levels of physical activity were AFB 85.2%, AFM 6.4%, AFV 8.4% and regular assets 11.4%. Factors negatively associated with quality of life: weekly hours of academic presence and the presence of acute as chronic pain. The practice of VFA was positively associated</p> <p>YES (weekly hours of academic presence and the presence of acute as chronic pain)</p>
Maciel et al. [69]	Association	NR	<p>The data association between the practice of PA and positive perception of QoL in aspects of physical therapy that are related to a capacity for work, energy for daily activities, and locomotion</p> <p>YES. (capacity for work; energy for daily activities, locomotion)</p>
Mak et al. (2017)	Association	Interpersonal relationship; Spiritual growth; Nutrition; Stress management; Health responsibility; Physical activity	<p>The social domain obtained the highest classification (mean = 13.7), followed by environmental (mean = 13.5), psychological (mean = 13.1), and physical (mean = 12.2). Significant associations were observed between QoL and four HPL variables after control for socioeconomic variables: responsibility for health (estimate coefficient = - 0.265, SE = 0.083, $P=0.002$), physical activity (estimate coefficient = 0.169, SE = 0.071, $P=0.018$), spiritual growth (estimate coefficient = 0.428, SE = 0.097, $P<0.0001$), and stress management (estimate coefficient = 0.277, SE = 0.092, $P=0.0003$)</p> <p>YES. (Responsibility for health; spiritual growth; stress management)</p>

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qol?
Massidda et al. [89]	Association	Types and frequencies of PA; Age; BMI; total weekly Energy Expenditure	<p>Main results</p> <p>Women had significantly lower scores for GH ($F = 5.057$; $gl = 1$; $p = 0.02$), MH ($F = 5.240$; $gl = 1$; $p = 0.02$) and summary of the mental component (MCS) ($F = 4.745$; $df = 1$; $= 0.03$) domains than men. Vigorous activity ($F = 16.230$; $gl = 1$; $p = 0.01$) and EE (kcal) during the week ($F = 6.377$; $gl = 1$; $p = 0.01$) were higher in men. As for the PA categories, 7.40% of women (age = 23.1 ± 2.3 years; BMI = 21.8 ± 2.2); 20.8% of men (age = 23.2 ± 3.9 years; BMI = 22.5 ± 2.2) were classified as moderate; 79.1% (age = 21.7 ± 2.9 years; BMI = 22.4 ± 1.9) in the high PA categories. There were no significant differences ($p > 0.05$) between the PA categories and HRQoL scores for men, there was a tendency for higher scores with the increase in PA levels in both sexes. The differences in scores between women who practice low and high PA physical exercises were at least five points in MH, MCS and PCS, and approximately more than ten points in GH and SF. The most influenced variable was the PR in both sexes, while the regular frequency of PA during the week was the most important positive predictor for the highest scores in most HRQoL domains in both sexes</p>	YES (MH, MCS, PCS, GH, SF)
Mendoza et al. [90]	Correlation	NR	Subjects reported engaging in vigorous PA for an average of 2.05 days during the previous week. The subjects reported walking for an average of 93.49 min during the previous week. Neither PA nor sedentary behavior was associated with QoL in this population	NO

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qol?
			Main results	
Nieves (2017)	Correlation	NR	A positive correlation was found between PA level and PF, which was statistically significant ($r = .124$, $p = .019$). A positive correlation was also found between PA-R and role limits due to emotional health problems, ($r = .221$, $p = .003$). The relationship between PA level and role limits due to physical health was not significant ($r = -.032$, $p = .429$)	YES (Emotional health problems)
Nowak et al. [91]	Correlation	NR	Domestic activity positively relates to the importance score ($p < 0.001$), satisfaction score ($p = 0.017$), and productivity ($p = 0.001$) and intimacy ($p = 0.004$) domains of the QoL. Work-related activities negatively relate to material QoL ($p = 0.025$) and positively to communicative QoL ($p = 0.033$). Transport activities seem to positively relate to importance score of QoL ($p = 0.001$). Sedentary weekly activities are positively related to satisfaction score ($p = 0.047$) and intimacy domain of the QoL ($p = 0.030$). In contrast, sedentary weekend activities negatively relate to importance score ($p = 0.011$), satisfaction score ($p = 0.004$), intimacy ($p = 0.023$), safety ($p = 0.018$), and communication ($p = 0.014$) domains of QoL	YES. (Satisfaction score; productivity; intimacy, safety, and communication)
Park and Kim [81]	Correlation	NR	A positive relationship between moderate and vigorous activity and health status. The QoL positively correlated with physical health (under health status). However, PA was not related with both a QoL	YES. (Health status, physical health)

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qol?
			Main results	
Pedišić et al. [85]	Correlation	NR	In females, leisure-time PA was positively related to General Health, Vitality, and HRQoL-total score. In males, transport-related PA yielded no statistically significant relationship with any of the HRQoL measures. The results indicate a significant but low relationship between PA and different HRQoL domains in the population of university students after adjustment for age, size of community, personal monthly budget, body mass index, smoking habits, and alcohol intake	YES. (General Health, vitality, HRQoL Total Score)
Pekmezovic et al. [92]	Correlation	NR	The highest values of the SF-36 scales were obtained for Physical Functioning (93.7). The highest proportion of students (36.5%) reported weekly practice of physical activity. Based on the comparison across the physical activity categories, there is a clear pattern of differences in the total SF-36 scores ($P=0.001$)	YES. (Physical Functioning)
Peleias et al. [70]	Association	Age, Sex, Year of medical course;	Men had higher scores in the physical health ($p < 0.001$) and psychological ($p < 0.001$) domains. In the group that did not report PA at leisure, there was a significant association between moderate and high levels of PA at leisure and better QoL for all measures. For low volume of PA, this association was also significant for most QoL measures, with the exception of the domains of physical health ($p = 0.08$) and social relationships ($p = 0.26$), in which only a non-significant trend for a positive association was observed. There was a significant interaction between high volume of PA at leisure and general QoL ($p = 0.04$), an ambivalent domain of WHOQoL ($p < 0.001$)	YES. (Physical Health, psychological domain, General QoL, environment domain)

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qol?
			Main results	
Pourranjbar and Zeytoonli [93]	Correlation	NR	All students were aware of the positive benefits of PA. Both severe and moderate activities had significant relationships with physical and psychological health, social relationships and the environment ($p < 0.005$ and $p < 0.001$, respectively), while low activity had a significant relationship only with social relationships ($p < 0.005$)	YES. (physical and psychological health, social relationships, and the environment domains)
Snedden et al. [14]	Association	Sex, Year in school;	Significant differences in the MCS were observed between the levels of sport and PA; but not on the PCS. After controlling for the sex variable, a positive relationship was found between the increase in sport and the level of PA and higher MCS	YES. (Level of sports, MCS)
Vo et al. [94]	Association	Gender; Relatives work at healthcare sector; BMI; Frequency of physical activity; Sleep duration; Use of sleeping medication; Frequency of social activities	Higher scores were observed in all four domains assessed in students who participated in physical activities 3–4 and 4 or more times a week, when compared to those without physical activity (except for third year students), who had lower scores in all four domains (physical, $p = 0.000$; psychological, $p = 0.000$; social, $p = 0.133$; and environmental, $p = 0.001$)	YES. (Physical; psychological, social, and environmental domains)
Yildirim and Bayrak [80]	Correlation	NR	A significant relationship ($p < 0.01$) in a positive way has been determined between physical activities based on sports and quality of life (0.57), between joining in physical activities based on sports and academic standing (0.43), between joining in physical	YES. (General QoL)

Table 3 (continued)

Article	Statistical tests used	Adjustment variables	Outcomes	Is pa practice related to better qol?
Zhang et al. [75]	Correlation	NR	<p>Main results</p> <p>Participants reported relatively high levels of the achievement goal orientations, physical activity, and HRQoL. Mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance goal orientations were all positively related to one another with no to moderate correlation coefficients. PA had low positive correlations with the mastery approach and performance-approach goal orientations but no correlations with the mastery-avoidance and performance-avoidance goal orientations. HRQoL had low negative correlations with the mastery-avoidance and performance avoidance goal orientations but had a low positive relation with the mastery approach goal orientation and physical activity</p>	YES. (General QoL; mastery approach; performance-approach goal orientations.)
Zhang et al. [76]	Association	Enjoyment; barrier self-efficacy; family support; friend support; crime safety	<p>The pleasure of physical activity was positively related to barrier self-efficacy, social support from family and friends, physical activity, physical and psychosocial functioning of HRQoL (r's ranging from 0.28 to 0.54, all $p < 0.01$). Positive correlations were observed between social support from family and friends, physical activity, and HRQoL. Physical activity was correlated with HRQoL-physical functioning ($r = 0.19$, $p < .01$), but not with HRQoL-psychosocial functioning ($r = 0.02$)</p>	YES. (Barrier self-efficacy, social support from family and friends, physical activity, HRQoL-physical functioning, and HRQoL psycho-social functioning, general QoL)

NR not reported; QoL quality of life; PA physical activity; SF – 36 medical outcomes study 36-item short-form health survey; WHOQoL-BREF quality of life questionnaire-short form; IPAQ international physical activity questionnaire; BRFS behavioral risk factor surveillance system; HRQoL health-related quality of life; SF-12 12-item short-form health survey; ST sedentary time; PCS physical component summary; MCS mental component summary; MVPA moderate/vigorous physical activity; YQoLR youth quality of life instrument research version; YRBS youth risk behavior survey; PWI Korea socio-psychosocial well-being index; SWLS the 5-item satisfaction with life scale; PSWS physical self-esteem was measured by the 6-item physical self-worth scale; OFA moderate physical activity; EFA heavy physical activities; MET metabolic threshold; LTPA leisure-time physical activity; MS mood state; PAL physical activity level; Q-LES-Q quality of life enjoyment and satisfaction questionnaire; AFB low physical activity; AFM moderate physical activity; AFV vigorous physical activity; HPLP II the health-promoting lifestyle profile II; HPL health promoting lifestyles; GH general health; MH mental health; EE energy spending; BMI body mass index; SF social functioning; EQ-5D EuroQol health states descriptive system; EQ-VAS visual analogue scale; PA-R NASA/JSC physical activity rating scale; PF physical functioning; COMQoL-A5 comprehensive quality of life scale—adult; SQLS life satisfaction was measured using the satisfaction with life scale; PARCY physical activity rating for children and youth; PQoL physical QoL; MQoL mental QoL.; VR-12 veterans RAND 12 item health survey

well as the main results, and the answers to the question "IS PA PRACTICE RELATED TO THE BEST QOL?".

In all studies, the practice of physical activity by university students was related to the improvement of their quality of life, in at least one assessed domain. Chang and collaborators (2016) [12] found in their results that a higher frequency of physical exercises correlated with higher Mental Component Summary (MCS) scores.

GE and collaborators (2019) [13] and SNEDDEN and collaborators (2019) [14], also found positive results between physical activity and Physical Component Summary (PCS) and Mental Component Summary (MCS). Their results found that a higher score for PCS and MCS indicated a better Health Related Quality of Life (HRQOL) and a positive relationship between increased sport and PA level and greater MCS, respectively. The other results are presented in more detail in Table 2.

Summary measures and meta-analysis

The analyzed data were divided into subgroups, according to the common outcomes of the selected articles. They were separated into seven subgroups according to quality of life: Physical Health; Mental health; Social relationships; Environment; Vitality; Pain; General (AF vs QV).

A meta-analysis was performed for each item of quality of life mentioned above. Due to the lack of data in the

articles, 22 were included. Weak but significant correlations were found.

The correlation between physical activity and the physical health domain was 0.16 (95% CI: 0.11–0.22; $I^2 = 99.96%$) (Fig. 3); between physical activity and mental health was 0.14 (95% CI: 0.07–0.20; $I^2 = 99.97%$) (Fig. 4); physical activity and social relations: 0.24 (95% CI 0.08–0.38; $I^2 = 99.99%$) (Fig. 5); physical activity and the environmental domain: 0.23 (95% CI 0.14–0.32; $I^2 = 99.90%$) (Fig. 6); physical activity and vitality: 0.17 (95% CI 0.15–0.20; $I^2 = 99.49%$) (Fig. 7) physical activity and pain: 0.02 (95% CI – 0.02 to 0.12; $I^2 = 99.96%$) (Fig. 8) and correlation between physical activity and overall quality of life: 0.21 (95% CI 0.08–0.34; $I^2 = 99.99%$) (Fig. 9). An association of $\beta = 0.60$ (95% CI 0.25–0.95; $I^2 = 85.61%$) was found between physical activity and general quality of life (Fig. 10).

Discussion

This review assessed the relationship between physical activity and quality of life in college students. Our overall results showed weak but positive relationships and associations between PA practice on QoL of these students in several countries around the world. These results underline the importance of encouraging physical activity through policies and actions targeting this audience, and also encouraging the use of universities/faculties themselves, as many of these

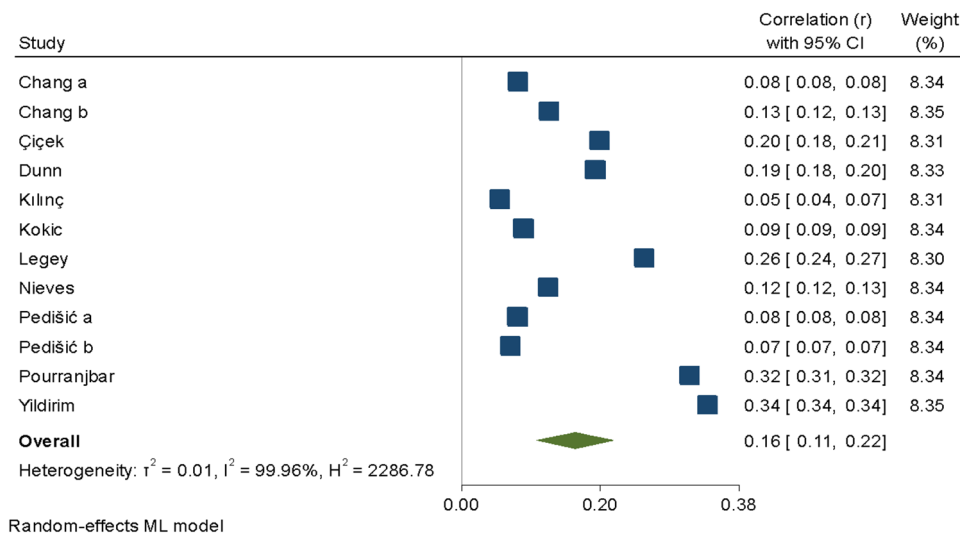


Fig. 3 Correlation between physical activity (PA) and physical domain. **Chang a:** Exercise Frequency X Physical Component Summary (PCS) in male; **Chang b:** Exercise Frequency X PCS in female; **Çiçek:** Total Activity X Physical Health; **Dunn:** PA X Physical health-related quality of life; **Kılınc:** Moderate Physical Activity (OFA) X Physical area; **Kokic:** "My level of PA is adequate" X

PCS; **Legey:** Physical Activity Level (PAL) X Physical Capacity; **Nieves:** PAL X Physical Functioning; **Pedišić a:** Total PA X Physical functioning in female; **Pedišić b:** Total PA X Physical functioning in male; **Pourranjbar:** High PA Level X Physical Health; **Yildirim:** Sports-based physical activity and socialization X QOL (Physical Health)

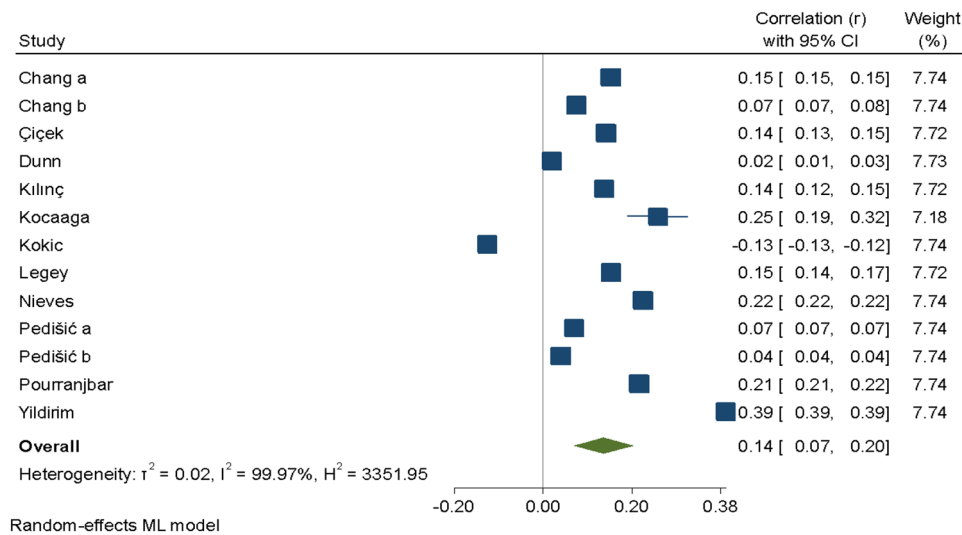
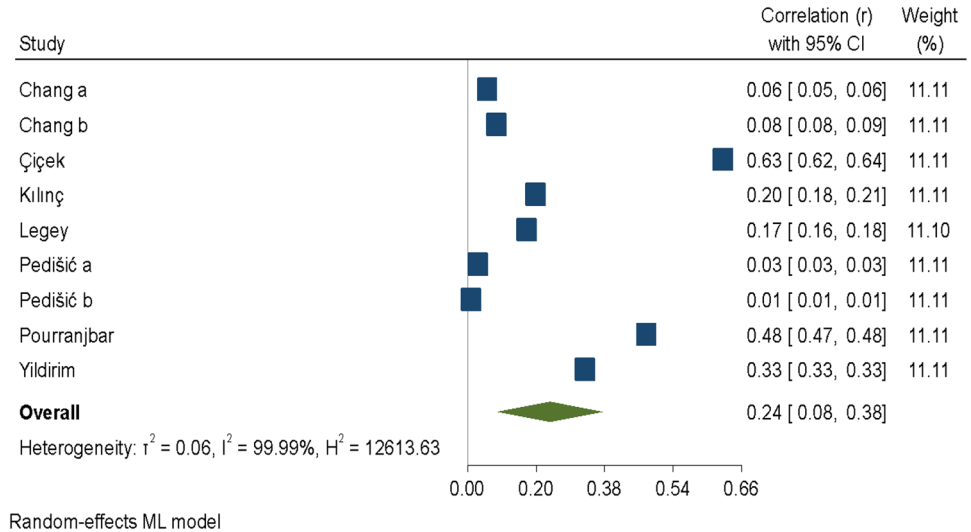


Fig. 4 Correlation between physical activity and mental domain. **Chang a:** Exercise Frequency X Mental Component Summary (MCS) in male; **Chang b:** Exercise Frequency X Mental Health in female; **Çiçek:** Severe Activity X Psychological Health; **Dunn:** PA X Psychosocial health-related quality of life; **Kılınç:** Heavy physical activities(EFA) X Psychological Area; **Kocaaga:** IPAQ moderate X SF36 Emotional Status; **Kokic:** Total PA X Mental health; **Legey:**

PAL X Emotional Aspect; **Nieves:** Physical Activity Rating Scal (PA-R) X Role limits due to emotional problems; **Pedišić a:** Total PA X Mental Health in female; **Pedišić b:** Total PA X Mental Health in male; **Pourranjbar:** Moderate PA Level X Psychological Health **Yildirim:** Sports-based physical activity and socialization X QoL (Mental Health)

Fig. 5 Correlation between physical activity and social relationships domain. **Chang a:** Exercise Frequency X Social functioning (SF) in male; **Chang b:** Exercise Frequency X Social functioning (SF) in female; **Çiçek:** Total Activity X Social Relationships; **Kılınç:** EFA X Social Domain; **Legey:** PAL X Social Aspect; **Pedišić a:** Total PA X Social functioning in female; **Pedišić b:** Total PA X Social functioning in male; **Pourranjbar:** High PA Level X Social Relationships; **Yildirim:** Sports-based physical activity and socialization X QoL (Social Relationships)



institutions have adequate physical space and trained professionals or academics for this type of activity [96–98].

The results of the individual studies showed that students with better levels of PA had better HRQoL scores. The benefits of PA are well known and can directly affect QoL: it helps in the prevention and treatment of chronic diseases; it positively influences sleep quality, physical and mental health, stress and anxiety; it favors social relationships; it helps motor balance; among many others [10, 99]. These findings are in agreement with other previous systematic

reviews that have also evaluated the relationship between PA and QL in adults in general [100, 101]; children and adolescents [102] and the elderly [103], showing the positive influence of this relationship and other populations.

Our meta-analysis revealed significant associations between PA and global QoL. And significant correlations between PA and global QoL, and PA and the domains: physical, mental, social relations, environment, vitality in higher education students. High heterogeneity was found in all analyses, which may be due to methodological causes, since the

Fig. 6 Correlation between physical activity (PA and environment domain. **Çiçek:** Total Activity X Environment; **Kilinc:** EFA X Environmental area; **Pourranjbar:** High PA Level X Environment; **Yildirim:** Sports-based physical activity and socialization X Environmental Health

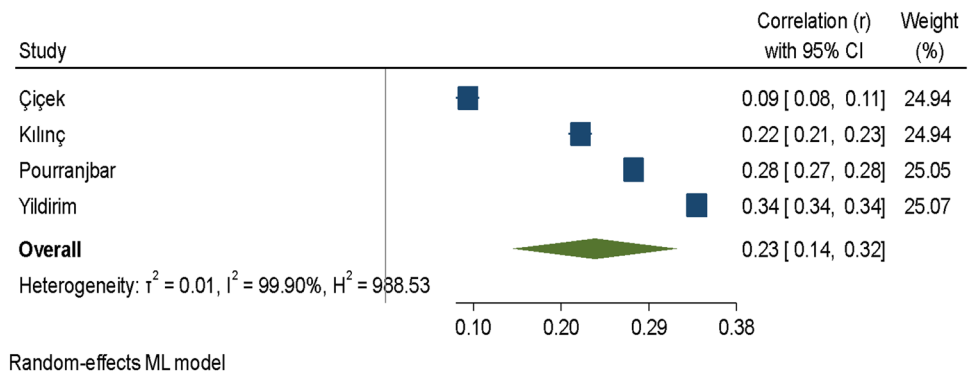


Fig. 7 Correlation between the vitality domain (VT) and physical activity (PA). **Chang a:** Exercise Frequency X VT in male; **Chang b:** Exercise Frequency X VT in female; **Kokic:** Total PA X VT; **Legey:** Physical Activity Level X VT; **Pedišić a:** PA total X VT in female; **Pedišić b:** PA total X VT in male

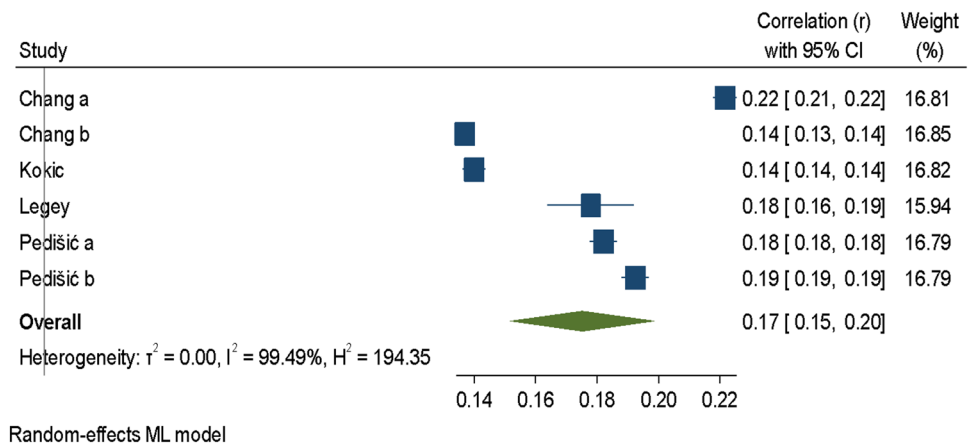
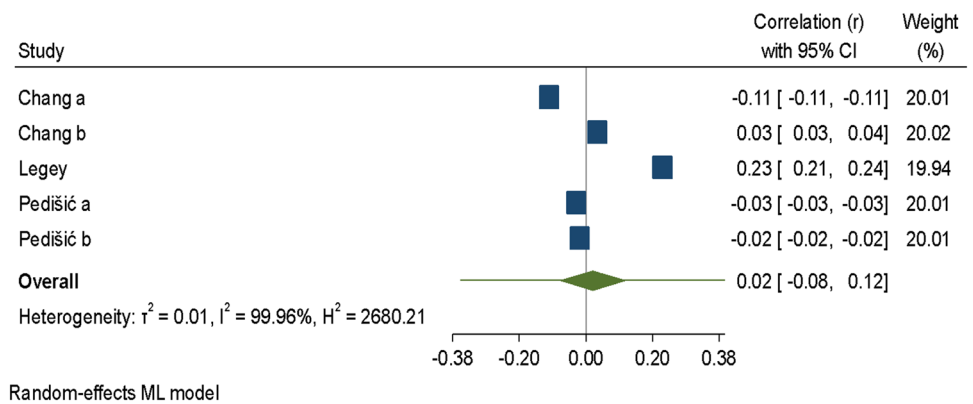


Fig. 8 Correlation between physical activity and pain domain. **Chang a:** Exercise Frequency X Bodily pain (BP) in male; **Chang b:** Exercise Frequency X Bodily pain (BP) in female; **Legey:** PAL X Pain; **Pedišić a:** Total PA X Bodily pain in female; **Pedišić b:** Total PA X Bodily pain in male



analyses were composed entirely of cross-sectional studies, where these methodological differences are expected, since the study includes articles developed in several countries around the world, since each population has its own characteristics and peculiarities [104, 105].

We found positive correlations between PA and mental health: 0.24 (95% CI 0.08–0.38; $I^2 = 99.99\%$). In this sense, Román-Mata et al. [99] evaluated 1095 university students from Andalusia and Melilla. In this study, the authors observed that the total resilience score was lower in those who reported being physically inactive ($x^- = 3.58 \pm 0.752$)

compared to those who practiced physical activity ($x^- = 3.92 \pm 0.706$) ($p < 0.05$). Still, when considering psychological distress, the authors found that, similarly, the lowest values of psychological distress were presented by those who practice physical activity ($x^- = 2.14 \pm 0.672$), compared to those who did not perform any activity ($x^- = 2.53 \pm 0.702$).

In this perspective, Chow and Choi [106] carried out a study with 416 university students from Hong Kong and found that there was a positive correlation between physical activity and mental health ($r = 0.258$; $p < 0.01$). Furthermore, the results showed that the physical activity score was one of

Fig. 9 Correlation between physical activity and general quality of life. **Ji- Yeon (Park):** Total physical activity X Quality of Life (QoL); **Khan:** Overall Physical Activity X QoL; **Kilinc:** Physical Activity X QoL; **Kruger:** PA X QoL; **Legey:** Physical Activity Level (PAL)X HRQoL Total; **Yildirim:** Physical activity based on sports and socializing X QoL; **Zhang:** PA X Mastery-approach goal orientation

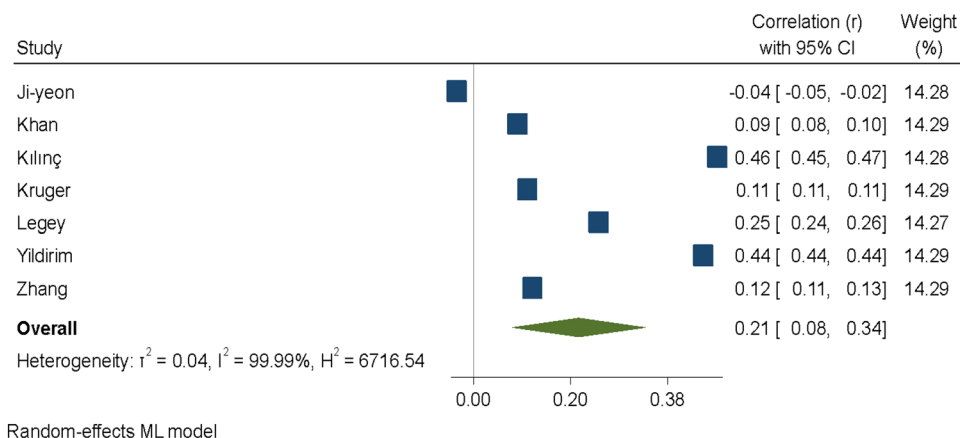
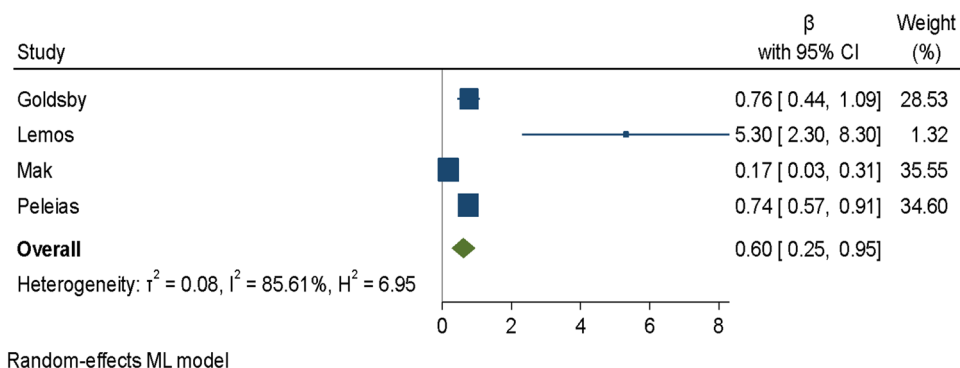


Fig. 10 Association between physical activity and general quality of life. **Goldsby:** Moderate-vigorous physical activity (MVPA) X Health Related Quality of Life; **Lemos:** Vigorous physical activity X QoL; **Mak:** PA (HPL) X QoL; **Peleias:** High PA X QoL self-assessment—general total



the predictors of a positive mental health status ($\beta = 0.032$; 95% CI 0.016–0.048; $p < 0.001$). These findings emphasize the importance of an active life during all stages, but especially, during higher education, where these individuals undergo significant changes in their lives. Evidence points out that regular physical activity brings benefits for functioning and physical fitness, is able to reduce stress, positively influence self-esteem and cognitive functioning, which are essential elements for good mental health [107, 108].

Wu et al. (2015) [109] found that, among 4747 Chinese university students, high screen time (> 2 h/day) was positively correlated with anxiety, depression, psychopathological symptoms, and poor sleep quality. In addition, there were progressive increases in protective effects against depression, psychopathological symptoms, and poor sleep quality with increasing levels of physical activity. In addition, the authors found that participants with high PA and low screen time had the lowest risk of psychopathological symptoms (OR = 0.46, 95% CI 0.32–0.67) and poor sleep quality compared to the other groups (OR = 0.50, 95% CI 0.30–0.82).

Similarly, another study conducted with 617 Indian university students showed that the participants' physical activity levels (moderate and high) were inversely associated with anxiety scores (OR = 0.16 and 0.96; $p = 0.001$) and of depression (OR = 0.11 and 0.96; $p = 0.001$). Also, poor sleep

quality was positively associated with anxiety (OR = 1.38) and depression OR = 1.58 ($p = 0.001$) [110]. These results suggest that greater sedentary behavior, represented by screen time, and lower PA level are related to the development of anxiety, depression, psychopathological symptoms, and poorer sleep quality. These are factors that can influence the quality of life of individuals.

In our results, positive correlations were also found between PA and vitality (0.17, 95% CI 0.15–0.20; $I^2 = 99.49\%$). Vitality is one of the domains of QL, it is used in determining Mental Component Summary (MCS) and Physical Component Summary (PCS) scores [111]. Corroborating our results, even though with another population, Puetz (2006) [112], conducted a literature review, where he searched for epidemiological studies that examined the association between PA and feelings of energy and fatigue in individuals with a mean age of 49.4 ± 10 years; and in his results he found that higher risks of low vitality were associated with less active lifestyles.

It is important to consider that with the COVID-19 pandemic, caused by (SARS)-CoV-2, it caused negative effects in the general population worldwide. Recent studies show that physical activity can help improve and maintain the mental health of individuals, even in periods of social isolation. Ozdemir et al. (2020) [113] carried out a study eight

weeks after the announcement of the first case in Turkey in which they evaluated 2301 adults aged 20 to 75. The authors found that only 6.9% of the sample were physically active, there was a positive relationship between physical activity levels and quality of life, while there was a negative relationship between levels of physical activity, depression, and anxiety ($p < 0.05$). Also, when physically active and inactive participants were compared, a difference was observed for the variables of general health status and physical and psychological health status ($p < 0.05$).

Another study carried out with 645 Chinese adults showed that there was a reduction in the practice of PA during the pandemic, whereas before, 49.3% performed some PA from 2 to 4 times a week and 26.1% more than five times a week. However, 64.8% of participants engaged in little physical activity (i.e., less than 600 MET-min/week) during the COVID-19 pandemic. Only 18.0% and 17.2%, respectively, of the participants practiced moderate and high levels of physical activity. Furthermore, the results indicated that there was an increase in the average time of sedentary lifestyle from the pre-COVID-19 period ($M = 5.4$, $SD = 2.9$) to the COVID-19 pandemic period ($M = 5.8$, $SD = 4.6$), ($t(644) = -2.6$, $p < 0.05$). In addition, there was a reduction in the scores for the physical and mental components related to quality of life (75.3; $SD = 16.6$ and 66.6; $SD = 19.3$, respectively). Finally, more than half of participants (53.6%) reported moderate levels of perceived stress during the COVID-19 pandemic [114].

Considering the university population, the suspension of in-person classes, the longer time at home and the need to adapt to a new model of remote classes may have contributed to the worsening of these individuals' mental health. In addition, social isolation and the closing of gyms may have influenced this population to reduce or discontinue physical activity. In this sense, Gallo et al. (2020) [114] compared the practice of physical activity among university students in Australia and found that there was a reduction in the time spent walking between men and women from 2018/2019 to 2020 ($p < 0.05$). Also, fewer participants reached "sufficient" levels of activity in 2020, compared to 2018/2019 ($p < 0.05$). These results may highlight the importance of public health strategies designed to encourage the adoption of healthy lifestyle habits in order to improve and maintain health and quality of life at the population level.

It should also be noted that systematic reviews are high quality sources of information; they provide a relevant synthesis of results, covering as many articles as possible to answer the research question. Their sample includes a significant number of people; in a diverse way; bringing representativeness to the population studied. In addition, the cost of its development is low; most often it requires as work the authors' research and writing time, without any additional cost, as with original articles. It is a very useful tool for

evidence-based clinical practice, and can be used as a source of research for the development and evaluation of policies, actions and programs in the management of municipalities, states or countries [113, 114].

Study limitations

One of the limitations of this study was the heterogeneity of the methodologies used in the articles, which were all cross-sectional, making it difficult to carry out other complementary statistical analysis. In addition, many times they were not taken by the authors as being marked as an error (Standard Error, Standard Deviation, Confidence Interval or Variance), and it was also required to perform meta-analyses. As these are only cross-sectional studies, it is not possible to state that physical activity improves quality of life, and further studies are needed, especially of the longitudinal type that allow this monitoring.

Another limitation is due to the fact that studies may have been included or excluded due to the way the instrument was described by the authors of the original articles and, therefore, they were selected according to the terms used in the search strategy of this review. Some examples are original articles that used instruments such as "Satisfaction with Life Scale" or similar and were included even though satisfaction with life was not a search term. As occurred with others who used the SF-36, and do not refer to it as "Quality of life", but rather as health status or similar expressions.

Strengths of the study

This systematic review was carried out using the most current recommended methods for this type of study. It followed PRISMA [21], and was registered with PROSPERO. In addition, the PRESS [22] checklist was also used. The selection of the studies took place independently and several databases were used in order to achieve a large number of studies. Grey literature was also consulted. When necessary, the authors were contacted in order to obtain answers regarding the articles. There were no studies similar to this one, of systematic review and meta-analysis found in the literature.

Conclusion

The results of our study showed weak but positive relationships between physical activity and overall quality of life of college students and also between PA and the domains of QoL: physical health, social relationships, mental health, environment and vitality, in this same population. These may alert to the need to increasingly study this population, as they undergo intense changes and behaviors that tend to perpetuate into other life stages, and may also highlight the

importance of bringing more data to support the development of policies, actions, and programs that benefit these students.

Funding To the Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, Brazil), for granting the scholarship. To the Coordenação de Aperfeiçoamento de Pessoal de Ensino Superior (CAPES, Brazil) and to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil) for financial support. To the Programa de Pós-Graduação em Ciência da Nutrição (PPGCN/UFV) e to the Universidade Federal de Viçosa.

Declarations

Conflict of interest There is no conflict of interest regarding the research, authorship, or publication of this article.

Availability of Data and Material Not applicable.

Code Availability Stata Software, version 16, serial number 301606311865.

Ethical Approval Not applicable.

Informed Consent Not applicable.

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