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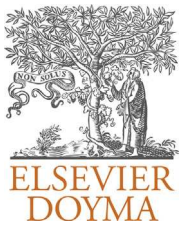

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REVIEW

Association between injury and quality of life in athletes: A systematic review, 1980–2013

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Abstract Despite the benefits of participation in sports, it also entails a risk situation for the occurrence of injuries at any level of performance. These injuries can affect both physical and psychological aspects, and consequently, generate a significant decline in performance and/or lack of participation, which may affect their quality of life. The present study aims to systematically review information regarding the association of injury with domains of quality of life (QoL) in adult athletes and to identify the most commonly used instruments for the measurement of injury and QoL in adult athletes published between 1980 and 2013. Searches were performed using five databases (MEDLINE/PubMed, Web of Science, SPORTDiscus, PsycINFO and LILACS) and the references cited in retrieved articles. From the search, only 12 articles met the inclusion criteria and were retrieved and examined. Different questionnaires without standardization are used to assess the injury of athletes. For the assessment of QoL, most studies used the SF-36. The evaluation of the direction of the association between injury and domains of QoL demonstrated that most studies included in this review showed high percentages of negative association in the *life satisfaction* domain (100%), followed by *bodily pain* (71.4%), *physical component score* (75%), *physical functioning*, *physical*, *vitality*, *social functioning* (66.7% each), *mental health* (62.5%), and *general health* domains (57.1%). In conclusion, in adult athletes, most studies demonstrated a negative association between injury and QoL domains, especially in the physical and social aspects. However, the association between injury and QoL domains needs further investigation.

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PALABRAS CLAVE
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Asociación entre lesión y calidad de vida en los atletas: Una revisión sistemática, 1980-2013

Resumen A pesar de los beneficios de participar en la vida deportiva, ello entraña una situación de riesgo debido a la ocurrencia de lesiones a cualquier nivel de desempeño. Dichas lesiones pueden afectar tanto a los aspectos físicos como psicológicos, y generar por tanto un descenso significativo del desempeño y/o una falta de participación, lo que puede afectar a su vez a la calidad de vida. El presente estudio trata de revisar sistemáticamente la información relativa a la asociación entre las lesiones y los ámbitos de la calidad de vida en atletas adultos, así como identificar los instrumentos más comúnmente utilizados en la medición de las lesiones y la calidad de vida en dichos atletas, en artículos publicados entre 1980 y 2013. Las búsquedas se realizaron utilizando cinco bases de datos (MEDLINE/PubMed, Web of Science, SPORTDiscus, PsycINFO y LILACS) y las referencias citadas en artículos recuperados. De entre la búsqueda realizada, sólo 12 artículos cumplieron los criterios de inclusión, y fueron recuperados y examinados. Se han utilizado diferentes cuestionarios no estandarizados para evaluar las lesiones de los atletas. Para evaluar la calidad de vida, muchos estudios utilizaron el SF-36. La evaluación de la dirección de la asociación entre lesión y ámbitos de la calidad de vida demostró que muchos estudios incluidos en esta revisión reflejaron elevados porcentajes de asociación negativa en el ámbito de la satisfacción de vida (100%), seguido de los ámbitos de dolor corporal (71,4%), puntuación de componentes físicos (75%), funcionamiento físico, vitalidad física, funcionamiento social (66,7% cada uno), salud mental (62,5%), y salud general (57,1%). En conclusión, en atletas adultos, muchos estudios demostraron una asociación negativa entre lesiones y ámbitos de la calidad de vida, especialmente en los aspectos físicos y sociales. Sin embargo, la asociación entre lesión y ámbitos de la calidad de vida precisa una investigación adicional.

Introduction

Sports practice is widespread all over the world,[1] demonstrating a strong positive influence in health for practitioners related to physical aspects; e.g., cardiorespiratory improvements[2–6] and psychological aspects, e.g., stress and anxiety reduction.[7,8] Despite these benefits, participation in sports also entails a risk situation for the occurrence of injuries at any level of performance.[6,9,10] This framework has been shown to be more exacerbated in athletes, as well as those who exhaustively exercise,[9] as there is greater exposure to extrinsic and intrinsic factors. Among the extrinsic factors, the training characteristics and the type of the activity are highlighted; the intrinsic factors are associated with the biological (e.g. sex, age), biomechanical (e.g. flexibility and muscle strength) and psychosocial characteristics (e.g. motivation and experience).[11,12]

Participation in sports between athletes involves an elevated physical requirement that can provoke an organic adjustment process that can have a negative effect on body with a high potential for imbalance in muscle and bone structures resulting in injuries.[13] These injuries can affect both physical and psychological aspects, and consequently, generate a significant decline in performance and/or lack of participation which may affect their quality of life.

Quality of life (QoL) is defined as an individual's perception of his or her position in life in the sociocultural context and in relation to his or her goals, expectations, standards and concerns.[14] This concept is multidimensional that allows for the analysis of several dimensions[15,16] which in turn, can also be referred to as general QoL or health related quality of life (HRQoL). The QoL concept is based on the definition that encompasses a sense of well-being and happiness, without reference to health problems or disorders. On the other hand, HRQoL is part of a multidimensional approach that considers physical, mental and social-related symptoms, as well as limitations that are caused by illness.[17]

Evidence supports the association between injury and QoL in athletes, however this relation is not fully established yet.[1,18] Other studies have been done specifically with QoL in older adults,[19,20] or in non-athletes[21,22] and without evaluating the relation to injuries. Furthermore, other studies investigated only the instruments used to evaluate the injury and QoL, which is their validity and reliability without evaluating the association between the variables.[23–25]

Such evidence will provide an overview of the influence of the injury in the different domains of QoL in athletes, and will also identify gaps in the literature for the development of new research, as well direction and planning for injury prevention and rehabilitation allowing for a faster return with major quality and minor residual injury effects for this population, prioritizing a healthy return to sports. With these facts in mind, the present study aims to systematically review information regarding the association of injury with domains of QoL in adult athletes and to identify the most commonly used instruments for the measurement of injury and QoL in adult athletes published between 1980 and 2013.

Methods

The literature search was performed in April 2013 on the MEDLINE/PubMed, Web of Science, SPORTDiscus, PsycINFO and LILACS electronic databases. The search was limited to articles that were published between January 1980 and April 2013, and articles that were published in Portuguese, English and Spanish were considered. A combination of Medical Subject Headings (MeSH), ''*Descritores de Ciências da Saúde*'' (DeCS; for terms in Portuguese) and text words were used to generate the list of citations. The search process was constructed specifically for each database and no limits were used in these searches. The key terms were used to search in MEDLINE/PubMed and LILACS and by topic in the Web of Science, SPORTDiscus and PsycINFO.

Our search strategy was based on a combination of four search parameters: injury, quality of life, population and age group. The keywords for injury (wounds and injuries OR injur* OR athletic injur*), quality of life (quality of life OR personal satisfaction OR health status OR well being OR health related quality of life), population (athlet* OR athletic* OR sport* OR sports medicine) and age group (adult* OR aged OR elderly OR young adult* OR middle aged) were used in combination to locate potentially relevant studies. The Boolean operator ''AND'' was used to combine the four groups in the search. The truncation symbols for each specific database (e.g., * or #) were used to capture all suffix variations of a root word.

Articles were selected in accordance with a systematic method. All of the selection processes and article evaluations were conducted in pairs (N.B.M; G.C.V.), and if there was disagreement between reviewers on the inclusion and exclusion criteria, the article in question was specifically discussed until a final consensus was reached. An initial analysis was performed based on the titles of the manuscripts, and a second evaluation was carried out based on the abstracts of all articles that met the inclusion criteria or could not be clearly ruled out. After examining the abstracts, all of the selected articles were retrieved and subsequently examined using the established inclusion criteria. A manual search of the bibliographies of selected articles was also performed, and the principal authors of the manuscripts were contacted to identify other publications that met the inclusion criteria.

Inclusion and exclusion criteria

The following inclusion criteria were considered: (i) original articles published in *peer-reviewed* journals that aimed to test for an association between injury and domains of QoL, (ii) studies published between January 1980 and April 2013; (iii) samples with athletes aged 17 years or older or samples with a mean age in this age group; (iv) cross-sectional and follow-up studies; and (v) team or individual sports.

The injury assessment included: Self-assessment of injury and the evaluation by the team orthopedist and internist. For the QoL assessment, we decided that the search for studies should not be limited to those that used a generic instrument to assess QoL (e.g., WHOQoL-100 or SF-36) because it could exclude important studies that examine the association between PA and domains of QoL. Therefore, we included studies that utilized self-reported QoL questionnaires, inventories and wellbeing scales which contained the QoL or HRQoL domains (well-being, life satisfaction, self-rated health), and the domains that comprise QoL or HRQoL (*physical*, *psychological*, *social*, *cultural*, *mental* and *spiritual* domains).[14,26–28]

Articles were excluded if they assessed athletes in adapted sport activities, for example wheelchair sports, because this category has different conditions of training and game when compared to unadjusted sports.

Quality assessment of the studies

Two independent reviewers (N.B.M; G.C.V.) evaluated the quality of the studies using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist.[29] The checklist contains 22 items and contains recommendations about what should be included for a more accurate and complete description of observational studies. All of the questions were coded as zero (representing poor quality) or one (representing adequate quality). Study quality scores could range from zero to 22 points meaning that the higher the score, the better the methodological quality of the study. In the event of differences in article evaluations between the two reviewers, the article was reassessed until they reached an agreement. The studies were classified in three groups according to their methodological quality. For this purpose, each study's methodological score was compared to the maximum score in STROBE (22 points): this strategy derived high quality ($\geq$70% total score), moderate quality (50–69% total score), and low quality (<50% total score) studies[30] (see Table 1).

Direction of the association between injury and QoL

An evaluation was performed to determine the direction of the association between injury and domains of QoL in the reviewed studies. For this evaluation, significant results of association between injury and QoL domains were used. The percentages of the studies according to the direction of the association were calculated. In order to provide a better understanding, percentages were grouped into three categories: (a) negative (−): studies with negative association between injury and QoL; (b) zero (0): studies without a significant association between injury and QoL; and (c) positive (+): studies with a positive association between injury and QoL (see Table 2).

Table 2 ''*Summary of the association of injury and different aspects of QoL*'' had the purpose of identifying a common QoL domain, independently of the instrument used to assess the QoL. The QoL domains were grouped into the same class, as follows: *Mental Health*: Stress,[31] Anxiety and Depression[32]; *General Health*: Perceived Health[32]; *Physical component score*: Health Index[32] and Knee Specific Quality of Life[33]; *Physical Functioning*: Usual activities and Self care.[32]

Table 1 Summary of the studies regarding the association between injury and quality of life in athletes described by research design.

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Cross-sectional studies								
Kleiber et al., 1987[36]	13 points (59/moderated)	Not reported	426 men; not reported	Basketball and football	Questionnaire developed for the study to assess the history of injury	Life Satisfaction Index-A	None	The former athletes whose injuries terminated their athletic career during their final year had significantly lower life satisfaction scores than did those whose careers were not interrupted by injury (mean item score for injury = 2.80 compared to 2.94 for noninjury, $p = .021$); Being injured might also reduce subsequent informal involvement in sport and affect life satisfaction as a result.
Turner et al., 2000[32]	19 points (95/high)	United Kingdom/Not reported	284 men; mean age 56.1 ± 11.8 years	Football	Self-assessment of osteoarthritis (OA)	EuroQol (EQ-5D)	Age or other morbidity	Respondents with OA scored significantly lower ($p < 0.05$) on health index of $EQ\text{-}5D_{utility}$ (0.58 ± 0.31 vs. 0.81 ± 0.19) and perceived health rating scales than respondents without OA (Current health = 56.4 ± 25.6 vs. 70.4 ± 20.0; future health = 60.2 ± 23.3 vs. 75.2 ± 19.3), indicating poorer subjective health in the former group; A significantly higher ($p < 0.001$, all df = 1) proportion of respondents with OA reported problems on each of the five $EQ\text{-}5D_{profile}$ dimensions: pain ($x^2 = 31.04$), mobility ($x^2 = 59.27$), usual activities ($x^2 = 46.18$), self care ($x^2 = 10.93$), and anxiety/depression ($x^2 = 10.48$); In summary, the results suggest that respondents who reported that they had been diagnosed with OA have a significantly lower HRQoL than peers with no diagnosis of OA. The impact of OA was most pronounced in perceived physical dimensions of HRQoL such as pain and mobility. However, the disease also had a noticeable psychosocial impact.

Table 1 (*Continued*)

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Mcallister et al., 2001[38]	19 points (95/high)	Not reported	562 subjects (333 men, 229 women); between 18 and 24 years (mean age 19.6 years)	Baseball, softball, track and cross-country, swimming, diving, water polo, tennis, golf, football, basketball, volleyball, soccer, and gymnastics	Questionnaire developed for the study to assess the current injury	HRQoL and domains of SF-36	Classification of injury (''mild'' = minimal or no effect on participation, practice, or play; ''serious'' = significant effect on participation, practice, or play or those that resulted in the athlete's inability)	There was a trend for decreased SF-36 component scores and summary scores with increased injury severity in both men and women athletes; Serious injury was a predictor of lower scores when compared with the noninjured athletes ($p < 0.05$) in the Mental component summary scale (men = 48 ± 2.1 vs. 52 ± 0.5; Women = 50 ± 1.9 vs. 52 ± 0.5), physical component summary scale (men = 44 ± 2.2 vs. 54 ± 0.4; women = 47 ± 1.3 vs. 54 ± 0.5), and all eight component SF-36 scores (physical function: men = 85 ± 4.5 vs. 94 ± 1.2, women = 88 ± 3.5 vs. 96 ± 1.2; role physical: men = 47 ± 9.6 vs. 96 ± 1.0, women = 73 ± 7.7 vs. 91 ± 2.0; role emotional: men = 73 ± 9.2 vs. 94 ± 1.2, women = 75 ± 8.0 vs. 93 ± 1.8; bodily pain: men = 52 ± 5.0 vs. 84 ± 1.1; mental health: men = 71 ± 2.7 vs. 80 ± 1.0, women = 76 ± 2.8 vs. 79 ± 1.0; vitality: men = 59 ± 4.3 vs. 69 ± 1.1, women = 64 ± 2.8 vs. 68 ± 1.1; social function: men = 70 ± 5.6 vs. 88 ± 1.2, women = 74 ± 5.0 vs. 87 ± 1.6; general health: men = 72 ± 4.2 vs. 81 ± 1.1; women = 74 ± 3.7 vs. 79 ± 1.3); Mild injury was predictive of lower scores when compared with the noninjured athletes ($p < 0.05$) in the physical component summary (men = 50 ± 0.8 vs. 54 ± 0.4; women = 50 ± 1.1 vs. 54 ± 0.5), role physical (men = 82 ± 3.7 vs. 96 ± 1.0; women = 83 ± 4.6 vs. 91 ± 2.0), bodily pain (men = 69 ± 2.5 vs. 81 ± 1.1; women = 68 ± 3.5 vs. 82 ± 1.4), social function (men = 82 ± 3.2 vs. 88 ± 1.2; women = 82 ± 3.0 vs. 87 ± 1.6), and general health (men = 72 ± 2.6 vs. 81 ± 1.1; women = 74 ± 2.5 vs. 79 ± 1.3); Injury was found to have a strongly negative effect on all eight of the SF-36 component scores as well as on the physical and mental component summary scores.

Table 1 (*Continued*)

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Mcallister et al., 2003[39]	17 points (77/high)	Not reported	66 subjects; between 18 and 24 years	Football, basketball, soccer, gymnastics, track and field, skiing, baseball, and tennis	Self-assessment of the injury	HRQoL and domains of SF-36	None	There were no statistically significant differences ($p > 0.05$) between the anterior cruciate ligament injury group and the uninjured group in the component and summary scores of the SF-36 (physical function = 91 ± 13.3 vs. 93.3 ± 8.5; role physical = 96.2 ± 11 vs. 94.6 ± 19.5; role emotional = 91.9 ± 23.6 vs. 93.9 ± 19.4; social function = 92.4 ± 10.3 vs. 91.2 ± 15.7; bodily pain = 86.9 ± 14.9 vs. 80.5 ± 17.8; mental health = 79.5 ± 13.6 vs. 82.5 ± 9.3; vitality = 67.8 ± 15.2 vs. 66.5 ± 17.6; general health = 83 ± 13.6 vs. 84.3 ± 14.3; physical component score = 54.5 ± 5.5 vs. 53.5 ± 5.6; mental component score = 52.7 ± 7.8 vs. 53.5 ± 6.7); In summary, quality of life of elite collegiate athletes who sustained an anterior cruciate ligament injury was not significantly different from that of their uninjured teammates.
Guskiewicz et al., 2007[34]	19 points (95/high)	Not reported/2001	2552 men; mean age 53.8 ± 13.4 years	Football	Previous concussion was based on the player's retrospective Recall of injury events	Component scores of SF-36	Age, years since retirement, number of years played, physical component score on the SF-36, and diagnosed comorbidities Including osteoarthritis, coronary heart disease, stroke, cancer, and diabetes	There was an association between recurrent concussion and diagnosis of depression ($x^2 = 71.21$, $df = 2$, $p < 0.005$), with a significant test for linear trend ($x^2 = 63.76$, $df = 1$, $p < 0.005$) suggesting that the prevalence increases in a linear fashion with increasing concussion history. Thus, retired players reporting a history of three or more previous concussions were three times more likely (prevalence ratio of 3.06; 95% CI: 2.29, 4.08) to be diagnosed with depression, and those with a history of one or two previous concussions were 1.5 times more likely (prevalence ratio of 1.48; 95% CI: 1.08, 2.02) to have been diagnosed with depression, relative to retirees with no concussion history; After the adjustment for confounding variables only a small reduction in the prevalence ratios was observed (2.58; 95% CI: 1.90, 3.55 and 1.39; 95% CI: 1.03, 1.96, respectively), suggesting that the significant association between concussion history and diagnosis of depression was not attributable to confounding by these factors; The findings suggest that professional football players with a history of three or more concussions are at a significantly greater risk for having depressive episodes later in life compared with those players with no history of concussion.

Table 1 (*Continued*)

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Irgens et al., 2007[35]	20 points (91/high)	Norway/March 2004	230 men; between 40 and 59 years of age (mean age 52 ± 6.7 years)	Diver	Questionnaire developed for the study to assess the history of injury (decompression sickness)	HRQoL and domains of SF-36	Concussion or head injury, other neurological disorder and psychological problems in divers with and without decompression sickness	Divers with a history of decompression sickness reported considerably lower scores for all scales ($p < 0.001$) than divers with no history of decompression sickness (physical = 62 ± 32 vs. 88 ± 32; bodily pain = 56 ± 30 vs. 72 ± 30; general health = 48 ± 26 vs. 72 ± 25; vitality = 49 ± 27 vs. 70 ± 27; social functioning = 61 ± 36 vs. 84 ± 36; emotional = 73 ± 31 vs. 91 ± 30; Mental health = 71 ± 23 vs. 84 ± 22); The linear trends remained after adjustment for confounding variables for all domains of HRQoL ($p < 0.05$); The study demonstrated a decreasing trend for all scales of SF-36 when comparing the scores in divers with no reported decompression sickness.
Nicholas et al., 2007[40]	19 points (95/high)	Not reported	36 men; mean age 62 ± 3 years	Football	The injury status of the players was recorded by the team orthopedist and internist	Component scores of SF-36	None	SF-36 physical health scores were 21% lower in players who reported having arthritis ($p < 0.01$) and back pain ($p < 0.05$) compared with the other players. Physical health scores were 19% above normal for players without arthritis ($p < 0.01$) and not different from normal for players with arthritis (6% lower, $p < 0.6$). Physical health scores were 11% above normal for players without back pain ($p < 0.05$) and tended to be below normal for players who reported having back pain (12% lower, $p = 0.12$). The combination of arthritis and back pain appeared to have a compounding effect on physical health scores; Mental health scores were 53.1 ± 8.9 vs. 53.3 ± 6.4 for players with and without arthritis ($p = 0.95$) and 51.7 ± 8.7 vs. 54.0 ± 7.8 for players with and without chronic low back pain ($p = 0.42$); Physical and mental health scores were not different between the 16 players with no significant injury history in 1969 (physical health score, 45.5 ± 13.6; mental health score, 53.4 ± 7.8) compared with the 20 players who had significant previous injuries (physical health score, 50.1 ± 9.7, $p = 0.24$; mental health score, 53.1 ± 8.4, $p = 0.92$); In summary, the combination of arthritis and back pain appeared to have a compounding effect on physical health scores. Mental health scores were unaffected by the presence or absence of any of the reported medical problems.

Table 1 (*Continued*)

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Huffman et al., 2008[41]	18 points (82/high)	USA, Canada/seasons 2005–2006 and 2006–2007	696 subjects (409 male,287 female); between 17 and 23 years of age (mean age 18.5 years)	Crew, lacrosse, fencing, wrestling, baseball, Softball, swimming/diving, volleyball, field hockey, golf, basketball, tennis, cross-country/track, squash, soccer, and gymnastics	Questionnaire developed for the study to assess the history of injury	Domains of SF-36	None	Athletes with no history of injury scored significantly higher ($p < 0.05$) than athletes who reported any previous injury in terms of all health domains (Physical functioning = 98.6 ± 7.0 vs. 97.3 ± 8.3; physical = 96.2 ± 15.2 vs. 92.9 ± 20.1; bodily pain = 88.8 ± 15.0 vs. 80.2 ± 19.3; general health = 86.3 ± 12.7 vs. 83.3 ± 13.6; vitality = 70.7 ± 13.9 vs. 67.8 ± 13.7; social functioning = 96.3 ± 9.9 vs. 92.9 ± 13.4; mental health = 83.4 ± 10.0 vs. 81.6 ± 11.1); except role limitations due to emotional problems (98.1 ± 10.3 vs. 95.8 ± 16.8); this latter difference approached, but did not reach, significance ($p = 0.057$); In summary, among athletes who are cleared for participation, any history of injury—even remote minor injuries in some cases—has a detrimental effect on an athlete's perceived health status.
Kuehl et al., 2010[37]	18 points (82/high)	Not reported	302 subjects (210 male, 92 female); mean age 19.8 ± 2 years	Football, lacrosse, women's soccer, softball, baseball, volleyball, wrestling, water polo, swimming, and tennis	A demographic form including concussion history	HRQoL and domains of SF-36	Number of concussion (0 group = No concussion; 1–2 group = 1–2 concussion; 3+ group = $\geq$3 concussion)	Significant differences between groups were noted on the bodily pain, social functioning, and vitality subscales of the SF-36 ($p < 0.05$). Pairwise tests revealed that the 3+ group had significantly lower scores for bodily pain (48.07 ± 8.88) compared with the 1–2 group (52.07 ± 7.74; $U(1) = 1363.0$, $z = -2.5$) and the 0 group (53.50 ± 8.32; $U(1) = 2158.0$, $z = -3.7$). The 3+ group had significantly lower scores on social functioning (48.47 ± 9.43) than the 1–2 group (51.55 ± 7.31; $U(1) = 1433.5$, $z = -2.2$) and the 0 group (51.86 ± 8.03; $U(1) = 2461.5$, $z = -3.0$] and had lower scores on vitality (52.40 ± 8.40) than the 0 group (55.92 ± 8.35; $U(1) = 2506.5$, $z = -2.6$); A significant negative correlation was found between the bodily pain ($r_s = -0.204$; $r^2 = 0.042$), social functioning ($r_s = -0.139$; $r^2 = 0.019$), and vitality ($r_s = -0.165$; $r^2 = 0.027$) subscales, with the lower HRQoL scores associated with the groups who had more self-reported concussions. All other subscale correlations were not significant; Significant correlations suggest a dose–response relationship where the groups with higher numbers of previous sport-related concussion are associated with lower HRQoL, and may have negative consequences on certain domains of HRQoL in collegiate athletes.

Table 1 (*Continued*)

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Malinauskas, 2010[31]	18 points (82/high)	Not reported	123 subjects (69 male, 54 female); between 18–25 years of age (mean age 21.22 ± 1.28 years)	Basketball, football, track and field, eastern martial arts, volleyball, and gymnastics	A demographic questionnaire provided additional information about their injury	Satisfaction with Life Scale (SWLS)	Classification of injury (''minor'' or ''severe'' based on the number of days lost to participation in the athlete's sport)	There were significant differences ($p < 0.001$) with the major injuries group having the less life satisfaction (16.50 ± 5.98; $t = 5.11$) when compared with the minor injuries group (22.17 ± 6.21); The level of injury of the participants was found to be related to life satisfaction, in summary, participants with a major injury had the least life satisfaction.
Follow-up studies								
Von Porat et al., 2004[33]	19 points (95/high)	Sweden/1986–2000	1986 = 344 men, 2000 = 154 men; between 30 and 56 years (mean age of 38 years)	Soccer	Disease specific knee injury and osteoarthritis outcome score (KOOS)	Domains of SF-36	None	The injured players reported significantly worse outcome in knee specific quality of life (60 ± 24.6, 95%IC 56.2–63.9 vs. 92 ± 13.5, 95%CI 88.6–95.7) and in the SF-36 subscales physical functioning (84.5 ± 14.5, 95%CI 82.1–86.8 vs. 93.1 ± 15.4, 95%CI 92.1–94.1) and role physical (81.4 ± 30.9, 95%CI 76.5–86.4 vs. 88.5 ± 26.7, 95%CI 86.7–90.2) compared with Swedish men aged 35–44. However, in the subscales social functioning (93.6 ± 13.9, 95%CI 91.3–95.8 vs. 89.5 ± 20.0, 95%IC 88.2–90.8) and mental health (86.4 ± 12.9, 95%CI 84.4–88.5 vs. 82.2 ± 18.6, 95%CI 81.0–83.4) the players scored significantly higher than the reference group; The injury and the osteoarthritis, irrespective of the treatment provided to these patients, often result in knee related symptoms that severely affect the knee related quality of life by middle age.

Table 1 (*Continued*)

Author	Points of quality assessment (%/classification)	Country/date of collect	Sample; age	Sports category	Measurement of injury	Measurement of quality of life	Adjustment variables	Main findings
Kerr et al.[42]	19 points (95/high)	Not reported/2001–2010	899 men; mean age 62 ± 10.9 years	Football	Previous concussion was based on the player's retrospective Recall of injury events	Component scores of SF-36	None	The comparison of physical health composite scores (PCS) by change in self-report concussion history of former professional football players in 2001 and 2010 showed in the greater number reported the score 45.5 (95%CI 44.2–46.7) and 42 (95%CI 40.7–43.3), and in the same number reported the score was 46.7 (95%CI 45.8–47.6) and 44.1 (95%IC 43.2–45); and the comparison of mental health composite scores (MCS) in 2001 and 2010 showed in the greater number reported the score 53.4 (95%CI 52.3–54.6) and 49.8 (95%IC 48.4–51.2), and in the same number reported the score was 53 (95%CI 52.2–53.8) and 51.4 (95%CI 50.5–52.3); When the change in PCS and MCS scores from 2001 to 2010 was compared by change in self-report concussion history, the greater number-reported group reported lower average PCS and MCS scores in the 2010 than the same-number reported group (PCS: $t = -2.1$, $p = 0.011$; MCS: $t = -2.0$, $p = 0.045$). Furthermore, the greater-number-reported group had a greater average drop in MCS score from 2001 to 2010, relative to the same-number-reported group ($t = -2.7$, $p = 0.008$). Curiously, the greater-number reported group tended to have a greater average drop in PCS from 2001 to 2010 than the same-number reported group ($t = -1.1$, $p = 0.277$); Furthermore, increases in concussion reporting were associated with declines in SF-36 PCS and MCS, suggesting a possible relationship between concussion reporting and changes in health status.

Abbreviations: HRQoL: Health Related Quality of Life, OA: Osteoarthritis and CI: Confidence Interval.
Assessing the quality of articles: It was used the checklist of Observational Studies in Epidemiology-STROBE (Elm et al., 2007), for cross-sectional and follow-up studies (with scores from 0 to 22 points).
Injury assessing instruments:
Knee injury and osteoarthritis outcome score (KOOS): is a 42 item self administered questionnaire based on the WOMAC osteoarthritis index (Bellamy et al., 1988), proven valid for subjects with anterior cruciate ligament injury and early osteoarthritis covering five separate dimensions: pain, symptoms, activities of daily living, sport and recreation function, and knee related quality of life.
Instruments assessing QoL:
SF-36: Short Form-36 is a shortened version of the MOS questionnaire comprising 36 items covering eight components (domains): functional capacity, physical aspects, pain, general health, vitality, social, emotional aspects, mental health.
Life Satisfaction Index A: composed of ten items that examine the life satisfaction and well-being over the life course.
The Satisfaction with life scale (SWLS): composed of five items that seek to estimate the overall life satisfaction.
EuroQol (EQ-5D): European Quality of Life is a questionnaire that measures the health-related quality of life covering five domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.

Table 2 Summary of the association of injury and different aspects of Quality of Life (QoL).

Domains of QoL	Total of studies	Direction of association with injury (the numbers are the study reference number)					% total
		Negative[a]		Zero[b]		Positive[c]	
		C	*F*	*C*	*F*	*F*	
Life satisfaction	2	31,36					100.0
Bodily pain	7	32, 35, 37, 38, 41		39	33		71.4
Physical component score	8	32, 34, 38, 40	33, 42	37			75
Physical functioning	6	32, 38, 41	33	37, 39			66.7
Physical	6	35, 38, 41	33	37, 39			66.7
Vitality	6	35, 37, 38, 41		39	33		66.7
Social functioning	6	35, 37, 38, 41		39		33	66.7
Mental health	8	31, 32, 35, 38, 41		37, 39		33	62.5
General health	7	32, 35, 38, 41		37, 39	33		57.1
Mental component score	6	34, 38	42	37, 39, 40			50.0
Emotional	6	35, 38		37, 39, 41	33		33.3

[a] Negative (−): Studies with negative association between injury and QoL.
[b] Zero (0): Studies without a significant association between injury and QoL.
[c] Positive (+): Studies with a positive association between injury and QoL. *C* – cross-sectional studies; *F* – follow-up studies.
Studies that had the purpose to identify a common QoL domain, independently of the instrument used to assess the QoL, were grouped into the same class of the evidence summary, as follows: *Mental health*: stress,[31] anxiety and depression[32]; *General Health*: perceived health[32]; *Physical component score*: Health Index[32] and Knee Specific Quality of Life[33]; *Physical functioning*: usual activities and self care.[32]

Results

The literature search yielded 615 potentially relevant articles. After reading the titles, 288 articles were selected on the basis of the inclusion criteria. The 288 abstracts were reviewed and 40 articles were selected for full text review. Of these, 71.43% were excluded for the following reasons: 11 studies (36.7%) did not present QoL as an outcome, nine studies (30%) did not present the design criteria (cross-sectional or follow-up studies), six studies (20%) did not consist of athletes, and four studies (13.3%) did not meet the sample criteria (≥17 years). Two additional studies were obtained from the reference search. Therefore, 12 studies were reviewed (Fig. 1).

Of the 12 studies included, ten (83.3%) were cross-sectional studies[31,32,34–41] and two (16.7%) were follow-up studies.[33,42] Most studies did not include the survey year (58.33%),[31,32,36–40] and five (41.67%) were conducted between 2001 and 2010.[34,35,38,39,41] All of the characteristics and main results of the studies can be observed in detail in Table 1 of this review.

The mean age of the participants of the studies ranged between 18.5[41] and 62 years.[40,42] Most studies (58.33%) only included men[32–36,40,42] and five studies (41.67%) included both genders.[31,37–39,41] Six studies (50%) evaluated more than one sport category,[31,36–39,41] and the majority were included in the collective sport category foremost with football,[31,32,34,36–40,42] followed by soccer,[33,37–39,41] basketball,[31,36,38,39,41] volleyball,[31,37,38,41] baseball[37–39,41] and softball.[37,38,41] In the individual sport category, the majority of the studies included tennis,[37–39,41] gymnastics,[31,38,39,41] track and field,[31,38,39] and swimming categories.[37,38,41]

Some studies only classified the injury severity[31,38] while others did not classify or report the type of injury.[36,41] The majority reported the type of injury (66.67%), and the more commonly evaluated was the concussion,[34,37,42] followed by the anterior cruciate ligament injury,[33,39] osteoarthritis,[32] and decompression sickness.[35] Only one study evaluated more than one injured structure, including knee, back, shoulder and ankle injuries.[40]

Quality of studies

None of the studies achieved a maximum score (22 points) on the STROBE checklist,[29] and the scores ranged from 20[35] to 13 points.[36] Of the cross-sectional studies, four studies[32,34,38,40] obtained 19 points and four studies[31,37,39,41] obtained the minimum score (17 points, see Table 1). Of the follow-up studies, all obtained 19 points on the STROBE checklist.[33,42] Based on the proposed cut off points,[30] 91.67% of the studies were classified as high quality, and only one study (8.33%) was moderate quality.[36]

Evaluation of injury and QoL

In 11 studies (91.67%), the history of the injury was obtained through self-assessment methods. In these studies, a questionnaire developed for the study was the most frequently used (83.33%) to evaluate the history of the injury.[31,32,34–39,41,42] One study[33] used the Disease specific knee injury and osteoarthritis outcome score (KOOS), and only one study[40] used a direct measure of the injury provided from the evaluation of an orthopedist.

The most widely used questionnaire to assess QoL (75%) was the Short Form-36 (SF-36),[33–35,37–42] followed by the Life Satisfaction Index-A,[36] European Quality of Life is a questionnaire (EuroQol),[32] and the Satisfaction with

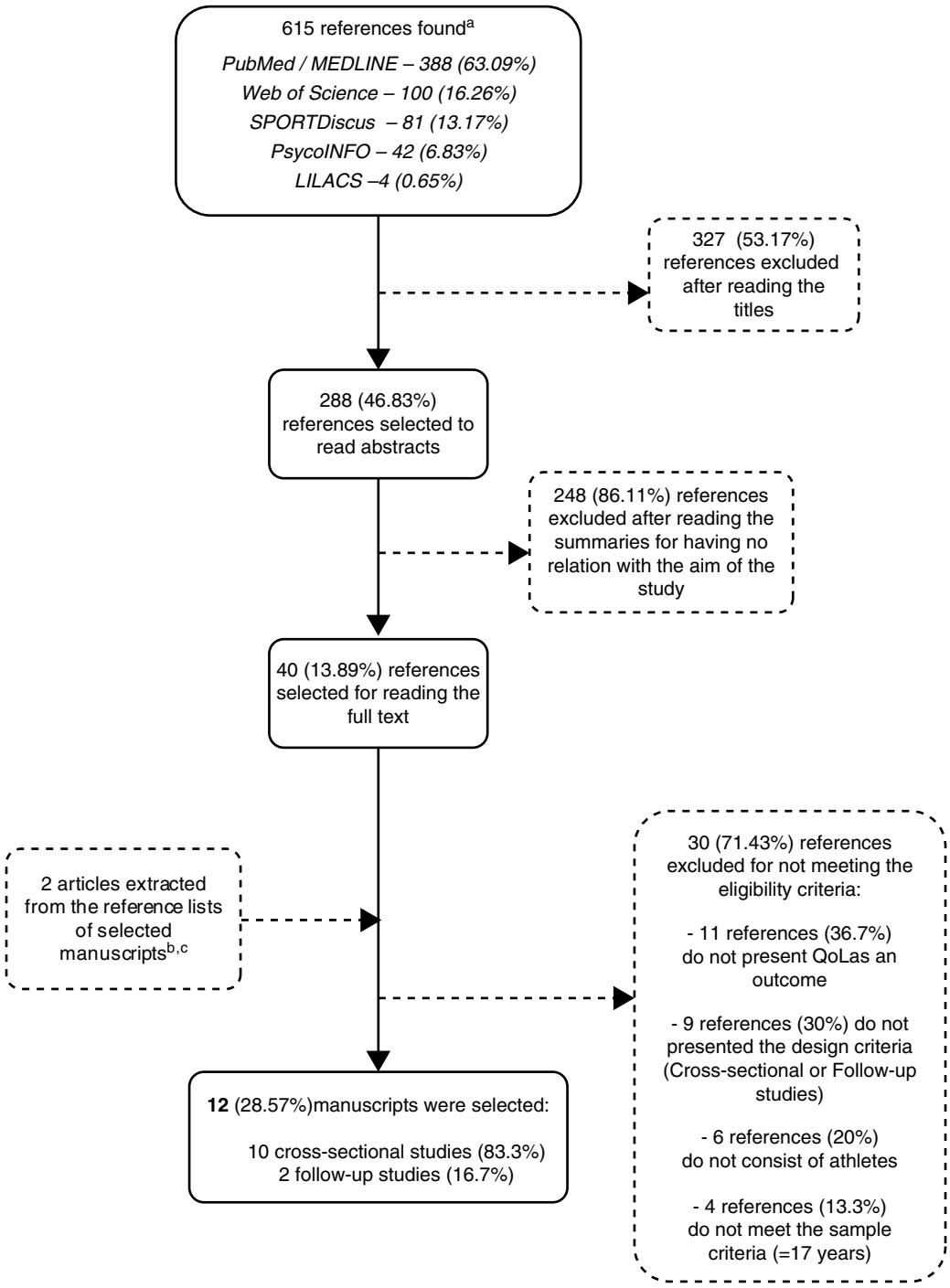

Figure 1 Flowchart of the study selection process. [a]The overlapped references were excluded. [b]McAllister et al. (2003). [c]Turner et al. (2000).

life scale (SWLS).[31] Due to the variability of injury and QoL assessment tools, it was not possible to perform a meta-analysis.

Characteristics of cross-sectional studies

Of the 10 cross-sectional studies, seven (70%) did not report the country that conducted the research.[31,34,36–40] Each of the other studies included the following countries: United Kingdom,[32] Norway,[35] USA and Canada.[41]

Of these, only one[40] used a direct measure of injury (evaluation of an orthopedist) while the remainder of the studies (90%) used self-assessment of the injury.[31,32,34–39,41] To evaluate the QoL, the majority of the studies (70%) used the SF-36,[34,35,37–41] one study used the Life Satisfaction Index-A,[36] one study used the EuroQol,[32] and one study used the SWLS.[31] Of the studies that used the SF-36 to evaluate the

athletes' QoL, five studies used the domains of QoL[35,37–39,41] and two studies used the component score of QoL.[34,40]

The majority of the studies (40%) used variance analysis,[35,36,39,41] three studies (30%) used regression[31,34,38] and covariance analysis.[32,37,40] Six studies (60%) used statistical approaches that allowed for the inclusion of possible confounding variables.[31,32,34,35,37,38] The most commonly used variables were classification/number of injuries, age, and other comorbidities. For more details about the studies, see Table 1.

Characteristics of the follow-up studies

Of the two follow-up studies, one was performed in Sweden,[33] and one did not report the country where the study was performed.[42]

Among the follow-up studies, Von Porat et al.[33] evaluated the athletes for the first time in 1986 and the second time in 2000, and used the KOOS to assess the injury of the athletes. Kerr et al. (2012) evaluated the athletes for the first time in 2000 and the second time in 2010, and used a previous concussion based on the player's retrospective recall of injury events. Both studies used the SF-36 to evaluate the athletes' QoL, but one[33] used the domains of SF-36 and other[42] used the component scores of SF-36.

All the follow-up studies[34,42] used the variance model in the data analysis, and did not include confounding variables into the model. For more details about the studies, see Table 1.

Summary of evidence for the association between injury and QoL

Table 2 summarizes the main results regarding the association between injury and domains of QoL. The majority of the studies used the SF-36 to evaluate QoL; in this way, the most commonly evaluated domains were *mental health*, *physical component score*, *bodily pain*, *general health*, *physical functioning*, *physical*, *vitality*, *social functioning*, *mental component score* and *emotional*.

The evaluation of the direction of the association between injury and domains of QoL revealed that most studies included in this review showed high percentages of negative association in the *life satisfaction* domain (100%), followed by *bodily pain* (71.4%), *physical component score* (75%), *physical functioning*, *physical*, *vitality*, *social functioning* (66.7% each), *mental health* (62.5%), *general health* domains (57.1%). Furthermore, domains with low percentages of negative association included the *mental component score* (50%), and *emotional domain* (33.3%) (see Table 2). The consistency of the studies was not evaluated due to its design (cross-sectional and follow-up).

Discussion

The literature has showed an increasing interest in the QoL of athletes,[18,43–46] however, there are few studies that associate QoL with injuries in this population. The reviewed studies[1,18] did not use a systematic search in the literature which may have limited or inadequately directed the results and conclusion. Additionally, these studies[1,18] did not identify the direction of the association between injury and QoL with the athletes. Thus, it becomes evident that there is a lack of a systematic review study that examines the association between injury and QoL in adult athletes.

According to the search performed in this study, it was possible to note an increase in research after 2007. This evolution can be related with the development and popularity of the new instruments based on the self-reported health status and which can be applied in a variety of diseases and injuries.[41] Furthermore, the high prevalence of sports injuries and the possibility of generating negative effects on athlete's health has drawn the attention of researchers.[34,37,40]

Most studies included in this review did not report the location of the research[31,34,36–40,42] which made it impossible to conclude if there was a concentration of studies in a particular country or location. Regarding the gender of the sample, most studies evaluated only men.[32–36,40,42] This fact can be explained by sports participation in which men have a higher number of participants; although, women's participation has increased over the last two decades, it has not reached the male contingent yet.[47]

Another noted fact with the analysis of the results was the variety of sports categories evaluated in the same study[31,36–39,41] which exhibits advantages and disadvantages. The advantage is related to the possibility of explaining the possible aspects that influence athletes' QoL in several sports categories, because a specific preventive approach to the athletes might be difficult because each sports category has particularities and specific sports gestures and training methods. Thus, the individual search and analysis of the sports categories becomes important in order to create an intervention with greater specificity.

Even with the sports category analysis, most studies evaluate the collective category,[31–34,36–42] especially football.[31,32,36–40,42] Football is popular worldwide both as a spectacle and as a form of recreational exercise and involves major sources of investment. Moreover, it is a sport with high speed contact and a high incidence of injuries[32] and due to these factors, there is growing scientific interest as evidenced by the increasing number of studies with this category. However, all sports present a risk of injury demonstrating the need for more studies in other sports category.

This review shows some variability among the studies regarding how injury is measured, with instruments without validity and reliability.[31,32,34–39,41,42] This fact draws attention because the inadequate assessment for injuries can generate bias in epidemiologic studies when the proportion of events recalled is associated with the health end points of interest, such as depression or QoL. Associations observed in these studies may be spurious if athletes differ in their knowledge and recognition of injury symptomatology, resulting in inadequate associations with health status.[42] Thus, the standardization of injury assessment instruments is essential for future research because, in addition to avoiding misinterpretation, it would facilitate the comparison between studies, amplifying the professionals' action involved with the performance of athletes.

Unlike the injury assessment, QoL assessment showed uniformity in the questionnaires used for evaluation. Among the studies included in this review, the most widely used instrument for measuring QoL was the SF-36.[33–35,37–42]

SF-36 is a generic instrument to assess HRQoL and has been translated into several languages and validated for several cultures. This questionnaire contains 36 items that are divided into eight scales and can also be grouped into *physical* and *mental* components.[48] In Brazil, the instrument was translated and validated by Ciconelli et al.[49] Additionally, the instrument allows for the measurement of health dimensions and can assess the impact of disease and the benefits of treatment. It is also a good predictor of mortality.[50] There is evidence to suggest that the physical and bodily pain subscales of the SF-36 may be used to follow-up musculoskeletal conditions, which would justify its widespread use to evaluate the influence of injuries on HRQoL.[51]

Regarding the association between the injury and QoL, most studies analyzed in this review showed negative results, in other words, the injured athletes reported lower QoL scores, ranging according to the QoL domains. The physical domains assess any limitation caused by physical health problems, and lower scores indicate the patient's sense that physical health is associated with work problems or performance of other daily activities.[48] Essentially evaluating the concept of disability, it is defined as the inability of a person to fulfill his or her desired or necessary social or personal roles.[52]

These associations suggest that the injury has a negative influence on the physical and social aspects of athletes' QoL. This fact can be explained by the physical consequences caused by injury that generate major impact on the athletes' activities; among them, we can mention the pain which is the first symptom of the injury and comprises the bodily pain domain.[32]

Another example is the physical limitation caused by the injury, such as difficulty moving independently and performing daily activities, comprising physical functioning and physical domains, and the combination of such domains comprise the physical component score (physical functioning, physical and bodily pain). Jointly, high levels of pain can be debilitating and may contribute to lower social functioning and vitality,[37] which would explain the negative association between injury and social functioning and vitality domains.

Moreover, lower scores in the social domain show that injuries do not affect only athletes' physical aspects. The social domain is designed to assess the effect of physical health or emotional problems on the individual's ability to participate in social activities,[48] which is often neglected in the individual's assessment. Thus, the individual's approach evaluation, containing the unique needs of each individual, taking into consideration all the aspects related to injury and personal relationships, allow for an overall focus of the prospects, not neglecting issues affecting the well-being of athletes.[53]

The studies included in this review suggests that injury affects in a less aggressive way the mental and emotional aspects of athletes' QoL, as well as their health perception or the contribution for work problems and daily activities, as a result of emotional problems. These findings can be explained by the report of the evaluated athletes regarding the type of injuries in this review, and jointly, to the fact that these athletes did not have to deal with these injuries for a long period to affect their QoL. In other words, most of the injured athletes were probably still participating in their sport, to some extent, therefore limiting the effect of significant changes in mental and emotional domains. This information points to the need to assess the withdrawal time from activity due to sports injury, so in this way, preventive interventions could be estimated in efficiency and new methods could be implemented, generating ongoing benefits for athletes, and confirm or refuse this hypothesis.

Briefly, based on this review, it was possible to observe that injury was negatively associated with adult athletes' QoL, ranging according to QoL domains. Regarding practical applicability of these approaches, such information will help to establish and emphasize the need for prevention and awareness programs about the circumstances surrounding the injuries in masters athletes.

Reduction on athlete's QoL perception due to injuries can generate negative thinking, and is a risk factor for diminished feelings of self-esteem, increased mood disturbance, depression, anger, confusion, and fatigue, and decreased sports performance or even withdraw from sport.[54] Constant review of aspects related to injury and athlete's QoL perception can be addressed in a comprehensive manner, avoiding long recovery periods, always paying attention to the impact caused by sports injuries that goes beyond momentary physical limitations, but also its role in the perception of QoL in both aspects of physical as mental health. However, information is still limited and scarce demonstrating the need for studies with standardized assessments of injury, furthermore, controlling for possible confounding variables (e.g., presence of another comorbidities or absence in the sport due to injury) in the statistics model to help results be broader and more reliable.

Limitations of the study

This review had some limitations that should be highlighted. The first limitation relates not only to this review but also to most studies included in it: the use of questionnaires to evaluate the injury among athletes. Many studies did not test the validity of the questionnaires. Thus, the real prevalence rates may be different than those found in these studies.

A second limitation is related to the possibility that some studies were not included in this review. The electronic search was limited to studies published between 1980 and 2013 in the following databases: MEDLINE/PubMed, Web of Science, SPORTDiscus, PsycINFO and LILACS. It is possible that relevant studies published prior to that period and in other databases are missing. The search for studies was also limited to *peer-reviewed* literature, so unpublished data, theses, dissertations and institutional position papers were not included. It is important to emphasize that the study of the association between injury and QoL is a topic of relatively recent interest, as the main instruments for assessing QoL were only developed in the 1990s. Therefore, it is believed that the most important studies that examine the association between injury and QoL published in this period are summarized in this review.

Conclusion

This systematic review revealed that there are few studies that have sought to investigate the influence of injury on QoL in adult athletes. Different questionnaires are used to

assess the injury of athletes and most of them were created by the authors themselves and do not present a standardized assessment. For the assessment of QoL, most studies used the SF-36. The association between injury and QoL showed a negative relationship and above 65% in 7 domains (life satisfaction, bodily pain, physical component score, physical functioning, physical, vitality, and social functioning), and between 62.5 and 33.3% in 4 domains (mental health, general health, mental component score, and emotional). These results show that the injury negatively affects QoL for athletes, especially in physical and social aspects.

Studies assessing the injury in a standardized way and approaching individualized sport categories are needed so more reliable and specific comparisons can be made. Also mediating factors such as practice time and sporting gesture, as well as confounding factors such as comorbidity or absence in the sport due to injury, should be taken into consideration in future studies.

Conflict of interest

Authors declare that they don't have any conflict of interests.

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