UNIVERSIDADE FEDERAL DOS VALES DO JEQUITINHONHA E MUCURI
Programa de Pós-Graduação em Reabilitação e Desempenho Funcional
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EXISTE RELAÇÃO ENTRE DISCINESE ESCAPULAR, DOR E FUNÇÃO DO OMBRO EM ATLETAS ARREMESSADORES E NÃO ARREMESSADORES? UMA REVISÃO SISTEMÁTICA COM RECOMENDAÇÕES DA GRADE

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RESUMO

O movimento escapular é fundamental para facilitar a transferência de energia produzida pelos membros inferiores para os membros superiores e na presença de alguma alteração escapular, é frequentemente associado ao aparecimento das queixas do ombro. É comum encontrar estudos que associam a discinese escapular com a dor e função no ombro em atletas arremessadores devido à alta prevalência nessa população, entretanto, esses fatores também apresentam alta prevalência em atletas não arremessadores. Apesar disso, até o momento foram realizadas somente revisões sistemáticas com atletas arremessadores e nenhuma outra revisão com atletas não arremessadores. Sendo assim, não é possível definir a associação da discinese escapular com a dor e função no ombro exclusivamente em atletas arremessadores. O objetivo desta revisão sistemática foi determinar a associação da discinese escapular com a dor e função do ombro e identificar a associação da discinese escapular com outros fatores intrínsecos em atletas arremessadores e não arremessadores. Foram realizadas pesquisas em 5 bancos de dados com critérios de elegibilidade para estudos observacionais sobre discinese escapular, dor e função no ombro em atletas arremessadores e não arremessadores. Oito estudos foram incluídos. Um total de 1.673 atletas arremessadores e não arremessadores foram incluídos nesta revisão sistemática. Foram encontradas associações em atletas arremessadores: dor no ombro com discinese escapular óbvia e do tipo III; redução da força com discinese escapular tipo III. Foram encontradas associações em atletas não arremessadores: redução da rotação interna do ombro com discinese escapular e dor no ombro. Não foram encontradas associações em atletas arremessadores: discinese escapular do tipo I e II com dor no ombro; discinese escapular com função do ombro em atletas com e sem dor no ombro; discinese escapular com idade em atletas com e sem dor no ombro. Os estudos incluídos apresentaram baixo risco de viés de acordo com a escala NOS e a qualidade da evidência de acordo com a abordagem GRADE foi muito baixa para as associações investigadas. Com base nesses resultados, não podemos afirmar que a presença de discinese escapular esteja associada à dor e função do ombro, sexo, amplitude de movimento, idade e força em atletas arremessadores e/ou não arremessadores.

Palavras chaves: extremidade superior; movimento; escapula; estudo observacional.

ABSTRACT

The scapular movement is essential to facilitate the transfer of energy produced in the lower limbs to the upper limbs and, in the presence of some scapular alteration, it is often associated with the appearance of shoulder complaints. It is common to find studies that associate scapular dyskinesis with shoulder pain and function in throwing athletes due to the high prevalence in this population, however, these factors also have a high prevalence in non-throwing athletes. Despite this, only systematic reviews were performed with throwing athletes and no other reviews with non-throwing athletes. Therefore, it is not possible to define the association of scapular dyskinesis with shoulder pain and function exclusively in throwing athletes. The objective of this systematic review was to determine the association of scapular dyskinesis with shoulder pain and function and to identify the association of scapular dyskinesis with other intrinsic factors in throwing and non-throwing athletes. Search strategies were conducted in five electronic databases with eligibility criteria for observational studies about scapular dyskinesis, shoulder pain and function in overhead and non-overhead athletes. A total of 1.673 overhead and non-overhead athletes were included in this systematic review. The following associations have been found in overhead athletes: shoulder pain with obvious and type III scapular dyskinesis; strength reduction with scapular dyskinesis type III. The following associations were found in non-overhead athletes: reduction of internal rotation of the shoulder with scapular dyskinesis and shoulder pain. No associations were found in throwing athletes: scapular dyskinesis of type I and II with shoulder pain; scapular dyskinesis with shoulder function in athletes with and without shoulder pain; scapular dyskinesis with age in athletes with and without shoulder pain. The included studies had a low risk of bias according to NOS scale and the quality of evidence according to the GRADE approach was very-low for the associations investigated. Based on these results, we cannot affirm that the presence of scapular dyskinesis is associated to shoulder pain and function, sex, range of motion, age and strength in overhead and/or non-overhead athletes.

Keywords: upper extremity; movement; scapula; observational study.

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1 REFERENCIAL TEÓRICO

O movimento de arremesso acima da cabeça envolve uma ação sequencial no tempo de início e pico de ativação, transferindo-se a energia produzida nos membros inferiores e no tronco para os membros superiores.[11,20] Embora o movimento de arremesso seja um movimento extremamente rápido, que ocorre em apenas 0,145s, o sequenciamento síncrono efetivo dos segmentos corporais é vital para maximizar a eficiência da cadeia cinética.[21] Os membros superiores são influenciados por vários fatores, incluindo a mobilidade dos tornozelos e joelhos, amplitude de movimento do quadril, força do tronco, movimento escapular e da força e amplitude de movimento dos ombros.[5] Quando toda essa cadeia cinética se apresenta eficiente, ocorre a diminuição das cargas nas articulações, o aumento da velocidade máxima do arremesso e produção de força máxima durante o arremesso. Na presença da disfunção da cadeia cinética em algum desses fatores, durante o arremesso há o aumento do estresse local nos segmentos distais que pode alterar o gesto esportivo.[20]

É amplamente aceito que o movimento escapular desempenha um papel importante no fornecimento de mobilidade e estabilidade no complexo do ombro e é fundamental para facilitar essa transferência de energia dos membros inferiores e tronco para os membros superiores.[9,18,20] Durante a elevação do membro superior, a escápula se move por meio de rotação para cima, inclinação posterior e rotação interna ou externa, onde a alteração de um ou mais desses movimentos escapulares, são conhecidos como discinese escapular.[2,16] Na presença de alterações escapulares, foi calculada uma diminuição de 20% na transferência da energia cinética dos membros inferiores para os membros superiores, onde foi necessário um aumento de 34% na velocidade rotacional do ombro para gerar a mesma quantidade de força para a mão, o que pode aumentar os riscos de dor e lesões nos ombros.[6,12]

A discinese escapular não é um diagnóstico, mas um comprometimento clínico que indica alterações do ritmo escapulo-umeral ideal.[10] Essas alterações incluem: escapula alada ou proeminência das bordas escapulares; ausência de movimento suave e coordenado; elevação escapular rápida durante a elevação do úmero ou rotação rápida para baixo durante a depressão do úmero.[11] A causa da discinese escapular é considerada multifatorial, porém, pode surgir por alguns motivos como: patologia da articulação acromioclavicular ou glenoumeral, lesão de nervo torácico longo, fraturas claviculares, inflexibilidade de tecidos moles como o encurtamento do peitoral menor e fraqueza ou desequilíbrio da musculatura da cintura escapular.[11,22]

A etiologia das queixas de ombro em atletas arremessadores é multifatorial, mas a discinese escapular é um fator frequentemente sugerido para contribuir com o aparecimento e persistência das queixas de ombro.[1,7] De acordo com a literatura, a alta prevalência de discinese escapular é frequente em atletas arremessadores com e sem dor no ombro e também é presente em patologias do ombro, incluindo instabilidade glenoumeral, síndrome do impacto, tendinopatia do manguito rotador e ruptura labral.[14] A dor no ombro demonstrou uma prevalência acima de 30% em atletas arremessadores, onde os sintomas dolorosos nos ombros são frequentemente persistentes e recorrentes em 40-50% dos atletas com relatos de sintomas após 6 a 12 meses e destes, 14% ainda se mantem em tratamento após 2 anos.[13] Atletas com dor no ombro apresentaram menor resistência dos flexores laterais do tronco, mau controle neuromuscular póstero-lateral e póstero-lateral do tronco, função do ombro diminuída e atletas com discinese escapular, apresentaram alterações no efeito da carga quando mostraram diminuição da força de rotação externa.[8,11,15,19] Apesar dessas alterações com discinese escapular e dor no ombro, sabe-se que a melhora da função do ombro pode melhorar o escore da discinese escapular em uma população de não atletas com dor no ombro. Ainda não está claro se a discinese escapular é uma causa ou consequência na disfunção do ombro. Portanto, é extremamente importante manter um movimento escapular eficiente para evitar alterações que possam prejudicar o atleta.

É comum encontrar estudos que associam a discinese escapular com a presença de dor e disfunção no ombro devido à alta prevalência em atletas arremessadores, entretanto, a discinese escapular e a dor no ombro também apresentam alta prevalência em atletas não arremessadores. São definidos como atletas não arremessadores quando realizam atividades repetitivas, sustentadas e vigorosas com os membros superiores, mas não acima do nível dos ombros.[1] A discinese escapular estava presente em 61% dos atletas arremessadores e em 33% dos atletas não arremessadores.[1] A dor no ombro estava presente em 30% dos atletas arremessadores e em 10% dos atletas não arremessadores.[1,17] Uma possível explicação para essa alta prevalência de discinese escapular e dor no ombro em atletas arremessadores, é pelo uso completo da função do membro superior ao realizar o gesto esportivo.[1,3,14] Para atletas não arremessadores, a causa da sua alta prevalência de discinese escapular e dor no ombro ainda não foi esclarecida. Apesar disso, até o momento foram realizadas somente revisões sistemáticas com atletas arremessadores e nenhuma outra revisão com atletas não arremessadores. Sendo assim, não é possível confirmar a associação da presença de discinese escapular com a dor e disfunção no ombro exclusivamente em atletas arremessadores, pois esses fatores também estão presentes

em atletas não arremessadores. Portanto, o objetivo desta revisão sistemática foi determinar a associação da discinese escapular com a dor e função do ombro e identificar a associação da discinese escapular com outros fatores intrínsecos em atletas arremessadores e não arremessadores.

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2 ARTIGO CIENTÍFICO

Is scapular dyskinesis associated with shoulder pain and function in overhead and non-overhead athletes? A systematic review with GRADE recommendations.

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ABSTRACT

Objective: To determine the association of scapular dyskinesis with shoulder pain and function, and to identify the association of scapular dyskinesis with other intrinsic factors in overhead and non-overhead athletes.
Design: Systematic review.
Data sources: Five electronic databases up to December 2020.
Eligibility criteria: Observational studies that investigated scapular dyskinesis, shoulder pain and function in overhead and/or non-overhead athletes were included.
Results: Of the 8 studies included, only 1 had non-overhead athletes in the sample. A total of 1.673 overhead and non-overhead athletes were included in this review and the following sports were found in the sample: swimming; handball; rugby; volleyball; badminton; tennis; kayaking; baseball. The following associations were found in overhead athletes: shoulder pain with scapular dyskinesis; reduced strength with scapular dyskinesis. The following associations were found in non-overhead athletes: reduced shoulder internal rotation with scapular dyskinesis and shoulder pain. All studies had low risk of bias according to the Newcastle-Ottawa Scale. The quality of the evidence according to the GRADE approach was rated moderate to very-low for the associations between scapular dyskinesis and shoulder pain and function (primary outcome) and the associations between scapular dyskinesis and sex, range of motion, age and strength (secondary outcomes).
Conclusion: This systematic review suggests that it is not possible to affirm that the presence of scapular dyskinesis is associated to shoulder pain and function, sex, range of motion, age and strength in overhead and/or non-overhead athletes. New studies with better quality of evidence are needed to provide greater certainty of this evidence.
PROSPERO registration number: CRD42020190467

INTRODUCTION

The overhead throwing involves sequential activation in onset timing and peak activation, transferring the energy produced in the lower extremities to the upper

extremities.[17,28] The overhead throwing motion is an extremely fast movement that depends on the effective synchronous sequence of the body segments to maximize the efficiency of energy transfer over all the kinetic chain.[29] Upper limbs motion is influenced by multiple factors such as ankle mobility, hip range of motion, trunk strength and scapular motion.[6,9] It is widely accepted that the scapular motion plays an important role in providing mobility and stability for the shoulder joint complex and, together with the glenohumeral joint, is the key in facilitating energy transfer produced by lower limbs and trunk to the upper limbs.[16,24,28] Altered scapular motion may reduce about 20% of kinetic energy transfer from the lower limbs to the upper limbs and may cause about 34% increase in the rotational velocity of the shoulder to generate the same amount of force to the hand.[18] This increased stress can alter the sportive gesture, increasing the risk of pain and injuries in the shoulder.[9]

The etiology of shoulder complaints is multifactorial however, scapular dyskinesis is one factor that is frequently suggested to contribute to shoulder complaints.[1,4,12] During upper limb elevation, the scapula moves in upward rotation, posterior tilt, internal or external rotation and, when any of these movements are altered, they are known as scapular dyskinesis.[2,22] Scapular dyskinesis is highly prevalent in overhead athletes with and without shoulder pain and is also present in shoulder injuries such as glenohumeral instability, impingement syndrome, rotator cuff tendinopathy and labral tears.[20] Overhead athletes also have a high prevalence of shoulder pain and painful symptoms are often persistent and recurrent in 40-50% of the athletes who reported persistent symptoms that last for 6 to 12 months. Moreover, 14% remain on treatment after 2 years.[19] Athletes with shoulder pain presented lower resistance of the lateral trunk flexors, poor posterolateral and posterolateral neuromuscular control of the trunk, decreased shoulder function and athletes with scapular dyskinesis, showed changes in the load effect, when they presented a decrease in external rotation strength.[13,17,21,25] Despite these changes with scapular dyskinesis and shoulder pain, it is known that improved shoulder function can improve the scapular dyskinesis score in a population of non-athletes with shoulder pain. It is not yet clear whether scapular dyskinesis is a cause or consequence of shoulder dysfunction. Therefore, it is extremely important to maintain an efficient scapular movement to avoid changes that may harm the athlete.

It is common to find studies that associate scapular dyskinesis with the presence of shoulder pain and dysfunction due to the high prevalence in overhead athletes however, scapular dyskinesis and shoulder pain also has a high prevalence in non-overhead athletes. Defined as non-overhead athletes when they perform repetitive, sustained and vigorous activity with the upper limbs but not above the level of the shoulder.[1] Scapular dyskinesis was present in 61% of overhead athletes and in 33% of non-overhead athletes.[1,2] Shoulder pain was present in 30% of overhead athletes and in 10% of non-overhead athletes.[1,23] A possible explanation for this high prevalence of scapular dyskinesis and shoulder pain in overhead athletes, is the complete use of the function of the upper limb when performing the sports gesture, increasing the chances of injuries.[1,20] For non-overhead athletes, the high prevalence of scapular dyskinesis,

shoulder pain and its consequences on shoulder function has not yet been clarified. Therefore, there is no certainty that the scapular dyskinesis is associated with the presence of shoulder pain and function exclusively in overhead athletes, as these factors are also found in non-overhead athletes. The purpose of this systematic review was to determine the association of scapular dyskinesis with shoulder pain and function and to identify the association of scapular dyskinesis with other intrinsic factors in overhead and non-overhead athletes.

METHODS

The present systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. The protocol was previously registered on PROSPERO with number CRD42020190467.

Search strategy and eligibility criteria

Search strategies were conducted on December 2020 on the following databases: COCHRANE Library, MEDLINE, PUBMED, SPORTDiscus and Web of Science, without language or date restrictions. Search terms used were related to “scapular dyskinesis”; “shoulder pain”; “athletes”; “shoulder function”; “function”; “pain”; “performance”; “overhead”; “non-overhead”; “scapula”; “shoulder” and “throwing” (appendix A). The reference lists of the included studies were also hand searched for additional missing studies.

The inclusion criteria for eligibility were: (1) athletes classified as overhead/ throwers/ hitters (e.g. baseball, softball, american football, javelin athletes, tennis, volleyball and handball) and non- overhead/ throwers/ hitters (e.g. golf, table tennis, bowling, kayaking and archery), athletes from both sexes (female or male), of different competitive levels (recreational, regional, state, national and international); (2) use of measures to assess shoulder pain and function and scapular dyskinesis. The exclusion criteria were: (1) non-observational studies; (2) sport that does not require repetitive activities with shoulders; (3) inclusion of contact injuries; (4) injuries to the lower limbs and spine; (5) studies that evaluated the effectiveness of specific interventions to reduce the risk of shoulder injuries; (6) abstracts, books, book chapter, dissertations and thesis.

Study selection

Retrieved references were exported to an Endnote®[7] file and duplicates were removed. Two independent reviewers (MO and EM) screened potential studies by titles and abstracts first and then evaluated potential full texts. Those studies fulfilling the eligibility criteria were included in the review. Discrepancies between reviewer were solved by a third reviewer (LDM).

Assessment of methodological quality

Newcastle-Ottawa Scale

Two independent reviewers (MO and EM) assessed the risk of bias for each included study, using the Newcastle Ottawa Scale (NOS) score of 1 to 9 (http://www.ohri.ca). For each type of observational study (cohort, case-control and cross-sectional), the indicated scale was used. For the cross-sectional NOS, a re-adaptation was performed based on the example found in the study of the Herzog *et al*.[11] so that the final score was also 9, such as the cohort and case-control scales. When there was no consensus between the two reviewers, a third reviewer (LDM) was consulted to make the final decision.

GRADE

Two independent reviewers (MO and EM) assessed the certainty in evidence and the strength of recommendations using the Grading of Recommendations Assessment, Development and Evaluation (GRADE).[10] In the GRADE approach, randomized controlled trials start as high-quality evidence and observational studies as low-quality evidence. In this review, observational studies started with high-quality of evidence, as it is the most appropriate type of study for the assessed outcomes. The quality of the evidence can be classified into four levels: high, moderate, low or very-low. These levels represent the confidence in estimating the effects presented. From the initial classification, the criteria are defined and the judgment of these aspects allows reducing or increasing the level of evidence. The factors responsible for the downgrading the level of evidence are: risk of bias, inconsistency, indirectness, imprecision and publication bias. When there was no consensus between the two reviewers, a third reviewer (LDM) was consulted to make the final decision.

Data extraction

One reviewer extracted the data (MO), which was checked for consistency by a second reviewer (EM). When there was no consensus between the two reviewers, a third reviewer (LDM) was consulted to make the final decision. The following information were obtained: (1) author, (2) year of publication, (3) study design, (4) inclusion and exclusion criteria, (5) sport, (6) study population, (7) sample size, (8) sex, (9) age, (10) tests and questionnaires used, (11) participants lost in the follow-up, (12) number of participants included in the analysis, (13) number of seasons and (14) outcome.

Primary outcome measures

Scapular dyskinesis

Assessments for scapular dyskinesis were accepted if the data are dichotomized into "present scapular dyskinesis" or "absent scapular dyskinesis". Visual observation in dynamic position with weight was accepted for screening scapular dyskinesis. The definitions for scapular dyskinesis are described in table 1.

Shoulder pain

Assessments for shoulder pain were accepted if the data are dichotomized into "present shoulder pain" or "absent shoulder pain". Visual Analogue Scale, Numerical Pain Rating Scale, Fahlström Questionnaire, Shoulder Disability Questionnaire, Penn

Shoulder Score and questionnaire prepared by the authors were the tests accepted for screening shoulder pain.

Shoulder function

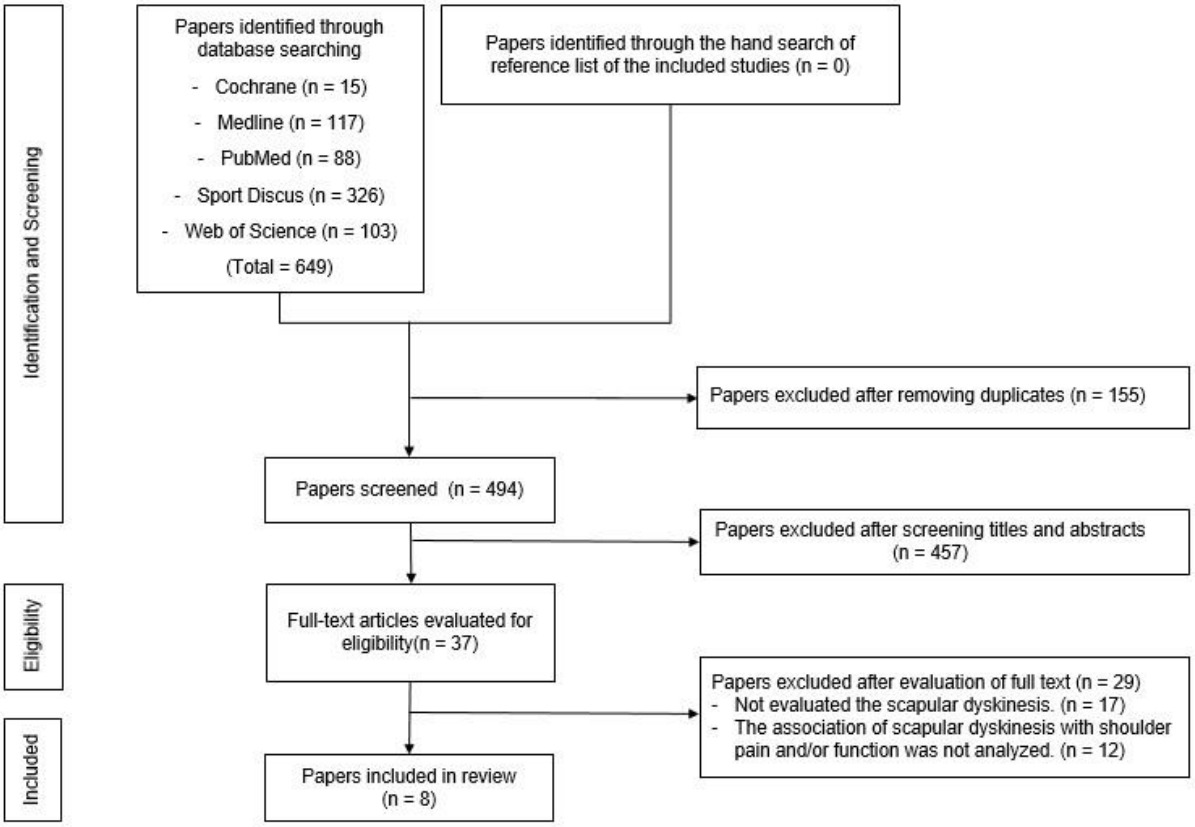
Instruments for assessing shoulder function were accepted if the data are valid and reliable. Disabilities of the Arm, Shoulder and Hand Questionnaire (complete and/or modified) and Constant-Murley Score were the tests accepted for screening shoulder function.

RESULTS

Study selection

The database search was completed on December 2020. After removal of duplicates, 494 references were identified and screened. Eight studies were included in the review. A flow-chart of the search process with the main reasons for exclusion is shown in Figure 1.

Figure 1 – Flow-chart of studies through the review.



Studies characteristics

Table 1 summarizes the characteristics of the included studies. Eight studies were selected, including: 3 cohorts,[3,15,32] 1 case-control[31] and 4 cross-sectional[14,26,27,33] studies. Of the 8 included studies, only 1[14] had non-overhead athletes in the sample. A total of 1.673 overhead and non-overhead athletes were included in this review and the following sports were found in the sample: swimming (n=967); handball (n=222);

rugby (n=120); volleyball (n=65); badminton (n=54); tennis (n=44); kayaking (n=31); baseball (n=8); 162 athletes and their respective sports were not specified in the studies. Four studies included athletes of both sexes, 3 studies included only male athletes and 1 study included only female athletes. At the end of the studies, 257 athletes were missing in the follow-up, with a final total of 1.416 athletes, with only 31 non-overhead athletes.

Methodological quality

NOS

The methodological quality of the included studies (table 2) was rated between 7 and 9 points, according to the NOS scale from 1 to 9. All studies were rated with high quality, considering the following classification: 0-3 low quality; 4-6 moderate quality; 7-9 high quality. The reasons for reducing the methodological quality were: Clarsen *et al.*[3] for not describing the exclusion criteria; Struyf *et al.* (2011)[31] and Struyf *et al. (*2014)[32] for a follow-up rate <80%; Johansson *et al.* [14] and Tate *et al.*[33] for not justifying the sample size; Santana *et al.*[27] and Standoli *et al.*[26] for not justifying the sample size and for inappropriate statistical analysis.

Table 1 - Characteristics of the included studies

Table 1 - Characteristics of the included studies

Study	Design	Source	Eligibility Criteria	Participants	Outcome Definition	Outcome Measures
Clarsen[3]	Cohort	All teams in the Norwegian elite handball series	The inclusion criteria was the contract with a Postenliga club in the season 2011-2012, irrespective of whether they had current or previous shoulder pain/injury. No exclusion criteria information.	N initial = 206 male N final = 164 Age = 24 (SD ± 4)	Scapular dyskinesis: premature or excessive elevation or protraction lowering, or rapid downward rotation during arm lowering (dysrhythmia); and/ or the medial border and/or inferior angle of the scapula are posteriorly displaced away from the posterior thorax (winging).	Scapular dyskinesis: Classification in 3 types: normal, slight or obvious scapular dyskinesis. Shoulder pain: Fahlström questionnaire.
Johansson[14]	Cross-sectional	Five different canoe clubs	No inclusion criteria information. The exclusion criteria were earlier shoulder surgery.	N = 31 11 female (age = 16.6 – SD ± 1.4) 20 male (age = 18.2 – SD ± 3.0)	Scapular dyskinesis: abnormal static scapular position and/or dynamic scapular motion characterized by medial border prominence; or inferior angle prominence and/or early scapular elevation or shrugging on arm elevation; and/or rapid downward rotation during arm lowering.	Scapular dyskinesis: Classification in scapular dyskinesis in present or absent Shoulder pain: Fahlström questionnaire (modified).
Kawasaki[15]	Cohort	Top-league rugby teams in Japan	No inclusion criteria information. The exclusion criteria were shoulder or elbow surgeries in the past and a time-loss injury to shoulder or elbow in the previous 3 months.	N initial = 120 male N final = 103 Age = 24.6 (SD ± 3.3)	Scapular dyskinesis: type I is prominence of the inferior medial scapular angle; type II is prominence of the entire medial scapular border; type III is prominence of the superior scapular border; type IV is normal scapular control.	Scapular dyskinesis: Classification in 4 types: type I, II, III or IV. Shoulder pain: questionnaire form prepared by the authors.
Santana[27]	Cross-sectional	No information	No inclusion criteria information. The exclusion criteria were the presence of previous surgery and / or fracture in the adjacent region, history of adhesive capsulitis and sports practice time less than one year.	N initial = 37 male N final = 36 Age = 25.1 (SD ± 4.7)	Scapular dyskinesis: type I is prominence of the inferior medial scapular angle; type II is prominence of the entire medial scapular border; type III is prominence of the superior scapular border; type IV is normal scapular control.	Scapular dyskinesis: Classification in 4 types: type I, II, III or IV. Shoulder pain: questionnaire form prepared by the authors.
Standoli[26]	Cross-sectional	National Youth Swimming Championships (2014-2016)	The inclusion criteria were voluntary participation and swimmers under 18 years old. The exclusion criteria were explicit and appreciable scoliosis, shoulder injuries and shoulder pain or	N initial = 694 N final = 661 317 female (age = 15 – SD ± 1.9) 344 male (Age = 16.5 - SD ± 2.1)	Scapular dyskinesis: type I is prominence of the inferior medial scapular angle; type II is prominence of the entire medial scapular border; type III is prominence of the superior scapular border; type IV is normal scapular control.	Scapular dyskinesis: Classification in 4 types: type I, II, III or IV. Shoulder function: Quick-DASH; Constant-Murley Score

			surgery during the previous 12 months.			
Struyf (2011)[31]	Case-control	Variety of sports associations	The inclusion criteria were the over 18 years old, had to participate in an overhead sport at least once a week and at least 140° of humeral abduction in the coronal plane. The exclusion criteria were a history of injury or surgery to the shoulder complex, upper thorax and back, and humerus in the past year.	N initial = 153 N final = 72 Age = 33 (SD ± 11)	Scapular dyskinesis: the inferior angle of the scapula becomes prominent dorsally (tilting); and/ or the entire medial border of the scapula becomes prominent dorsally (winging). If one (or more) of the criteria listed positive, the scapular positioning as impaired (score = 1). If none of the criteria satisfy, the scapular positioning as normal (score = 0).	Scapular dyskinesis: Classification in scapular dyskinesis present or absent. Shoulder pain: Shoulder Disability Questionnaire
Struyf (2014)[32]	Cohort	Variety of sports associations	The inclusion criteria were the over 18 years old, had to participate in an overhead sport at least once a week and at least 140° of humeral abduction in the coronal plane. The exclusion criteria for all athletes were shoulder pain, neck pain and a history of injury or surgery to the shoulder complex, upper thorax and back, and humerus in the past year.	N initial = 196 N final = 113 Age = 34 (SD ± 12)	Scapular dyskinesis: the inferior angle of the scapula becomes prominent dorsally (tilting); and/ or the entire medial border of the scapula becomes prominent dorsally (winging). If one (or more) of the criteria listed positive, the scapular positioning as impaired (score = 1). If none of the criteria satisfy, the scapular positioning as normal (score = 0).	Scapular dyskinesis: Classification in scapular dyskinesis present or absent. Shoulder pain: Shoulder Disability Questionnaire
Tate[33]	Cross-sectional	Swimmers in the Philadelphia (Pennsylvania) area.	No inclusion and exclusion criteria information.	N = 236 female Age = 8 to 77 years (SD ± 20.5)	Scapular dyskinesis: premature or excessive elevation or protraction lowering, or rapid downward rotation during arm lowering (dysrhythmia); and/ or the medial border and/or inferior angle of the scapula are posteriorly displaced away from the posterior thorax (winging).	Scapular dyskinesis: Classification in 3 types: normal, slight or obvious scapular dyskinesis. Shoulder pain: Penn Shoulder Score Shoulder function: Quick-DASH

DASH = Disabilities of the Arm, Shoulder and Hand

Table 2 - Newcastle-Ottawa Scale (NOS)

Table 2 – Newcastle-Ottawa Scale (NOS)

Studies	Selection	Comparability	Outcome/Exposure	Score
Clarsen[3]	3	1	3	7 (high quality)
Johansson[14]	4	1	3	8 (high quality)
Kawasaki[15]	4	2	3	9 (high quality)
Santana[27]	4	2	2	8 (high quality)
Standoli[26]	4	2	2	8 (high quality)
Struyf (2011)[31]	4	2	2	8 (high quality)
Struyf (2014)[32]	4	2	2	8 (high quality)
Tate[33]	4	1	3	8 (high quality)

GRADE

The quality of the evidence analysed according to the GRADE approach is presented in table 3. The initial classification of the quality of evidence is defined from the design of the studies and in this case, with observational studies, the quality of the evidence started as high.

Table 3 – Grading of Recommendations, Assessment, Development and Evaluations (GRADE)

Table 3 – Grading of Recommendations, Assessment, Development and Evaluations (GRADE)

No of studies	Design	Methodologic Limitations	Incon-sistency	Indirect-ness	Impreci-sion	Publication Bias	No of participants	Quality
Scapular Dyskinesis x Shoulder Pain								
6	3 cohorts; 1 case-control; 2 cross-sectional	No	Yes[1]	Yes[2]	No	No	519	⊕⊕OO LOW
Scapular Dyskinesis x Shoulder Function								
1	Cross-sectional	No	No	No	Yes[3]	No	661	⊕⊕⊕O MODERATE
Scapular Dyskinesis x Sex								
2	1 cross-sectional; 1 case-control	No	Yes[1]	Yes[2]	Yes[3]	No	103	⊕OOO VERY LOW
Scapular Dyskinesis x Range of Motion								
1	Cross-sectional	No	No	No	Yes[3]	No	31	⊕⊕⊕O MODERATE
Scapular Dyskinesis x Age								
1	Cross-sectional	No	No	No	Yes[3]	No	236	⊕⊕⊕O MODERATE
Scapular Dyskinesis x Strength								
1	Cohort	No	No	No	Yes[3]	No	103	⊕⊕⊕O MODERATE

[1] There were results heterogeneity between grouped studies, less than 75% of agreement. [2] Lack of

generalizability between measures. [3]Sparse data with <400 participants in grouped studies or evidence form a single study.

The primary outcome was the association between scapular dyskinesis and shoulder pain. This group was composed by 6 studies and was rated with low quality of evidence. For the other primary outcome, the association between scapular dyskinesis and shoulder function, the group consisted of 1 study and was rated with moderate quality of evidence. The reasons for downgrading the quality of evidence in both primary outcomes (shoulder pain and function) were inconsistency in results between grouped studies, indirectness and imprecision.

One of the secondary outcomes was the association between scapular dyskinesis with sex (n = 2 studies) and was rated with very-low quality of evidence. The reasons for downgrading the quality of evidence in sex were the inconsistency in results between grouped studies, indirectness and imprecision. For the others secondary outcomes, the association between scapular dyskinesis and range of motion (n = 1 study), age (n = 1 study) and strength (n = 1 study), all were rated with moderate quality of evidence. The reason for downgrading the quality of evidence in range of motion, age and strength was the imprecision.

Primary outcome measures

The results for the association between scapular dyskinesis and shoulder pain and function are described in table 4.

Scapular dyskinesis and shoulder pain

Clarsen *et al*.[3] and Kawasaki *et al.*[15] found an association between the presence of scapular dyskinesis and the presence of shoulder pain in overhead athletes (OR 8.41 and OR 4.4, respectively). Johansson *et al.*[14] found an association between the presence of scapular dyskinesis and a history of shoulder pain in non-overhead athletes (RR 3.1). Santana *et al.*[27] found that scapular dyskinesis was present in 80% of the overhead athletes with shoulder pain, but there was no significant difference due to the small sample size. Struyf *et al.* (2011)[31] found an association between the presence of scapular dyskinesis and the presence of shoulder pain in overhead athletes (p = 0.01). Kawasaki *et al.*[15] found an association between the presence of scapular dyskinesis pre-season and the presence of shoulder pain during the season in overhead athletes (OR 3.6). Struyf *et al.* (2014)[32] found no association between the presence of tilting (Exp(B) 0.91) or winging (Exp(B) 2.51) of the scapula as risk factors for shoulder pain in overhead athletes.

Scapular dyskinesis and shoulder function

Standoli *et al.*[26] found no significant difference in shoulder function in overhead athletes with or without scapular dyskinesis.

Secondary outcome measures

The results for the association between scapular dyskinesis and sex, range of motion, age and strength are described in table 5.

Scapular dyskinesis and Sex
Johansson *et al.*[14] found that female athletes had lower frequency of scapular dyskinesis than male non-overhead athletes (p = 0.007). Struyf *et al.* (2011)[31] found no differences in scapular positioning in overhead athletes with or without shoulder pain between men and women.

Scapular dyskinesis and Range of Motion
Johansson *et al*[14] found a significantly lower internal rotation in the right shoulder (p = 0.007) and in the left shoulder (p = 0.034) in non-overhead athletes with scapular dyskinesis.

Scapular dyskinesis and Age
Tate *et al.*[33] found no significant difference between the presence of scapular dyskinesis in overhead athletes with or without shoulder pain of different ages: 8 to 11 years (p = 0.69); 12 to 14 years (p = >0.99); 15 to 19 years (p = 0.95); 20 to 77 (p = 0.63).

Scapular dyskinesis and Strength
Kawasaki *et al.*[15] found that type III scapular dyskinesis had an association with motor weakness (OR 3.3) in overhead athletes.

Table 4 – Outcomes of Shoulder Pain and Function

Table 4 – Outcomes of Shoulder Pain and Function				
Outcomes	**N of participants**	**Studies**	**Population**	**Results**
Scapular Dyskinesis x Shoulder Pain	519 (six studies)	Clarsen[3]	Overhead	Obvious scapular dyskinesis was significantly associated with average severity scores (OR 8.41; 95% CI 1.47 – 48.1; p = 0.02). Slight scapular dyskinesis failed to achieve statistical significance (OR 3.48; 95% CI 0.83 – 14.5; p=0.09).
		Johansson[14]	Non-Overhead	Scapular dyskinesis there was a significantly higher frequency in the kayakers who had experienced shoulder pain (RR 3.1; 95% CI 1.3 – 7.2; p = 0.001).
		Kawasaki[15]	Overhead	Scapular dyskinesis type III had: an association to shoulder discomfort (OR 4.4; 95% CI 1.8 - 10.7; p = 0.001); a past history of shoulder injury (OR 2.3; 95% CI 1.0 - 5.4; p = 0.04). The presence of asymptomatic scapular dyskinesis during the preseason was found to be associated with newly developed shoulder discomfort during the season (OR 3.6; 95% CI 1.0 - 12.5; p = 0.04).
		Santana[27]	Overhead	The majority (80%) individuals with positivity on the Slide Lateral Scapular Test had shoulder pain. They had no statistically significant association between scapular dyskinesis and shoulder pain because the small sample size.
		Struyf (2011)[31]	Overhead	Within the group of athletes with shoulder pain, tilting was found to be more present on the painful side (33%) then on the pain-free side (22%) (p = 0.01). Winging was found to more present on the pain-free side (14%) than on the painful side (11%) (p = 0.01). When comparing scapular upward rotation between the two groups, no significant differences were found. The positive KMRT scores in both athletes with and without shoulder pain, no significant difference were found between groups.
		Struyf (2014)[32]	Overhead	No risk factors were found for the development of shoulder pain by means of the presence of forward tilting (Exp(B) 0.91; 95% CI 0.25 – 3.30; p = 0.46) or winging (Exp(B) 2.51; 95% CI 0.82 – 7.73; p = 0.14). When comparing the dominant with the non-dominant shoulders of all athletes, dominant shoulders demonstrated significantly more forward shoulder posture (p = <0.01), upward scapular rotation (p = 0.045), winging and forward tilting (p = <0.01) than the non-dominant shoulders.
Scapular Dyskinesis x Shoulder Function	661 (one study)	Standoli[26]	Overhead	- Female Constant: Right shoulder: Scapular Dyskinesis 97.21 ± 4.60; Without Scapular Dyskinesis 96.90 ± 6.59 Left shoulder: Scapular Dyskinesis 98.76 ± 2.22; Without Scapular Dyskinesis 97.24 ± 4.02 QuickDASH: Scapular Dyskinesis 9.46 ± 9.39; Without Scapular Dyskinesis 8.55 ± 9.38 Sport module of QuickDASH: Scapular Dyskinesis 9.93 ± 13.08; Without Scapular Dyskinesis 10.37 ± 14.40 - Male Constant: Right shoulder: Scapular Dyskinesis 98.55 ± 3.00; Without Scapular Dyskinesis 97.83 ± 3.78 Left shoulder: Scapular Dyskinesis 97.97 ± 3.19; Without Scapular Dyskinesis 98.16 ± 3.37 QuickDASH: Scapular Dyskinesis 6.53 ± 8.65; Without Scapular Dyskinesis 7.07 ± 8.04 Sport module of QuickDASH: Scapular Dyskinesis 6.73 ± 10.30; Without Scapular Dyskinesis 10.54 ± 15.69 No significant difference were detected.

KMRT = Kinetic Medial Rotation Test; QuickDASH = short version of the Disabilities of the Arm, Shoulder and Hand

Table 5 - Outcomes of Sex, Range of Motion, Age and Strength

Table 5 – Outcomes of Sex, Range of Motion, Age and Strength

Outcomes	No of participants	Studies	Population	Results
Scapular Dyskinesis x Sex	103 (two studies)	Johansson[14]	Non-Overhead	The female kayakers with a scapular dyskinesis had a significantly lower frequency than male kayakers (p = 0.007).
		Struyf (2011)[31]	Overhead	No differences were seen between men and women in any factors analysed.
Scapular Dyskinesis x Range of Motion	31 (one study)	Johansson[14]	Non-Overhead	The kayakers with scapular dyskinesis had a significantly lower internal rotation in right shoulder (*d* 1.37; 95% CI 0.58 – 2.15; p = 0.007) and in left shoulder (*d* 1.15; 95% CI 0.38 – 1.91; p = 0.034).
Scapular Dyskinesis x Age	236 (one study)	Tate[33]	Overhead	Athletes with scapular dyskinesis ages 8 to 11 years (p = 0.69): Shoulder Pain: 77.8%; Without Shoulder Pain: 63.6% 12 to 14 years (p = >0.99) Shoulder Pain: 50%; Without Shoulder Pain: 57.1% 15 to 19 years (p = 0.95) Shoulder Pain: 31.6%; Without Shoulder Pain: 32.3% Masters (p = 0.63): Shoulder Pain: 53.8%; Without Shoulder Pain: 46.3%
Scapular Dyskinesis x Strength	103 (one study)	Kawasaki[15]	Overhead	Scapular dyskinesis type III had an association with motor weakness (OR 3.3; 95% CI 1.4 - 8.2; p = 0.01).

DISCUSSION

This systematic review investigated the association of scapular dyskinesis with shoulder pain and function and identified the association of scapular dyskinesis with other intrinsic factors in overhead and non-overhead athletes. The following associations were found in overhead athletes: shoulder pain with obvious and type III scapular dyskinesis; reduced strength with type III scapular dyskinesis. The following associations were found in non-overhead athletes: reduced shoulder internal rotation with scapular dyskinesis and shoulder pain. There was no association in overhead athletes between: type I and II scapular dyskinesis with shoulder pain; scapular dyskinesis with shoulder function in athletes without shoulder pain; scapular dyskinesis with age in athletes with and without shoulder pain. The studies had a low risk of bias and were rated moderate to very-low quality of evidence according to GRADE approach.

Of the 5 studies that analysed the association of scapular dyskinesis with shoulder pain in overhead athletes, 3 found an association[3,15,31] and 2 found no association.[32,33] This conflicting result is also found in two other reviews that assessed scapular dyskinesis as a risk factor for shoulder pain. In view of these results, we hypothesize that scapular dyskinesis may only be a muscle adaptation caused by a sporting gesture with the upper limbs however, it is not possible to define it as a positive or negative adaptation for the athlete.

Only one study was found that analysed and resulted in the association of scapular dyskinesis with shoulder pain in non-overhead athletes.[14] Following our hypothesis of scapular dyskinesis as muscle adaptation in overhead athletes, we also follow this hypothesis in non-overhead athletes. Although they do not perform the full movement of the shoulder (over 90 degrees), non-overhead athletes who use the upper limbs also present repetitive and vigorous sporting gestures. Therefore, the same attention should be paid to this population when investigating scapular dyskinesis because it also has a high prevalence of this factor.

Regarding shoulder function, only one study was found.[26] In this study, asymptomatic overhead athletes with scapular dyskinesis were evaluated using 3 different instruments: Constant - Murley Score, QuickDASH and Sport Module of QuickDASH. Scapular dyskinesis was not associated with shoulder function in asymptomatic overhead athletes of both sexes. Since motor skills can be influenced by factors such as strength, flexibility and muscular endurance, and these are improved over time, kinematic differences in the scapula and muscle action are found in children and adolescents athletes compared to adults.[5,8,30] In this Standoli[26] study, younger athletes with scapular dyskinesis (12 to 19 years old) represent 92% of the sample. This reinforces the hypothesis that scapular dyskinesis in adolescents may be attributed to compensatory actions through motor action in sport combined with immaturity in motor skills.

Our results identified that the prevalence of scapular dyskinesis was higher in overhead and non-overhead male athletes. In asymptomatic overhead athletes,[26] scapular dyskinesis was found in 11.4% of men and 5.7% of women (p = 0.006). In symptomatic non-overhead athletes,[14] scapular dyskinesis was found in 80% of men and 27.2% of women (p = 0.007). Although the prevalence was found to be higher in symptomatic male athletes, Struyf *et al.* (2011)[31] found no difference in the prevalence of scapular dyskinesis between male and female overhead athletes, symptomatic and asymptomatic. It is common to find studies with a smaller number of female athletes recruited and it might not be representative in a larger group of male athletes, demonstrating that more studies with overhead and non-overhead female athletes are needed.

We did not found association between scapular dyskinesis and shoulder pain in overhead athletes regardless of age. Tate *et al.*[33] investigated the association of scapular dyskinesis in overhead athletes with and without shoulder pain and did not found a significant difference in the age groups of 8 to 77 years. These results may suggest a possible association with training time and not with the athlete's age. No studies were found that investigated the association of career time with scapular dyskinesis in overhead and non-overhead athletes.

Regarding range of motion outcome, only one study[14] investigated the association of scapular dyskinesis and shoulder pain. Non-overhead athletes with shoulder pain showed a reduction in the internal rotation of the right shoulder (p = 0.009) and the left shoulder (p = 0.0001). Non-overhead athletes with scapular dyskinesis also showed a reduction in internal rotation of the right shoulder (p = 0.007) and the left shoulder (p = 0.034). In the strength outcome, only one study[15] investigated the association of scapular dyskinesis. Kawasaki *et al.*[15] found that overhead athletes with scapular dyskinesis type III (excessive upward translation) presented muscle weakness (p = 0.01). Although they were not the primary outcomes of this systematic review, we expected to find more studies with this data as they are important modifiable factors and should be present in all athletes' assessments.

Our study has some limitations. Initially, it was planned to perform a meta-analysis but it, was not possible due to methodology’s differences between the studies. To assess scapular dyskinesis, four studies used Kibler's methods,[14,15,26,27] two studies used McClure's methods[3,33] and two studies assessed scapular alterations in a segmented way.[31,32] Studies that used the Kibler method, evaluated shoulder pain in different ways and the same occurred with studies that used McClure's methods. As previously mentioned, the lack of consistency in the assessment made it difficult to confront the information. Another limitation was that, although there were others studies in the search that assessed scapular dyskinesis and shoulder pain and function, they did not perform the analysis of the association between these factors, which was the objective

of this systematic review. According to the findings of this systematic review, it is not possible to confirm that scapular dyskinesis was associated with shoulder pain and function in overhead and non-overhead athletes.

This was the first systematic review to determine the association of scapular dyskinesis with shoulder pain and function in overhead and non-overhead athletes that apply the GRADE approach of quality of the evidence. A low to moderate quality of evidence was identified to support the association between scapular dyskinesis and shoulder pain and function (respectively). These results indicate that this association is not clear and more research is needed to determine whether or not there is an association between these factors. Future studies, should carefully consider some aspects, such as: (1) having scapular dyskinesis and shoulder pain and function as the primary outcome; (2) precise/standardized definition of assessment methods; (3) explicit inclusion and exclusion criteria; (4) adequate sample size.

Finally, based on the data presented in this systematic review, we suggest that early intervention to prevent the scapular changes found in pre-season assessments may prevent shoulder pain in overhead and non-overhead athletes. It is important to note that the identification of single modifiable risk factors is an important component of injury prevention models, but does not take into account the complex and fluctuating interactions between other risk factors that may be present in athletes.

CONCLUSION

The included studies had a low risk of bias according to NOS scale and the quality of evidence according to the GRADE approach was moderate to very-low for the associations investigated. Based on these results, we cannot affirm that the presence of scapular dyskinesis is associated to shoulder pain and function, sex, range of motion, age and strength in overhead and/or non-overhead athletes. New studies with better quality of evidence are needed to provide greater certainty of this evidence. Especially, shoulder function should be included as a primary outcome in future studies, since our review identified only one study that considered function analysis.

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APPENDIX A – Search terms used to query databases

Keywords:

“scapular”; “dyskinesis”; “dysfunction”; “shoulder”; “function”; “pain”; “performance”; “overhead”; “non-overhead”; “athletes”; “athletic”; “throwing”; “pitching”; “injury”; “injuries”; “baseball”; “handball”; “tennis”; “volleyball”; “javelin”; “softball”

Search terms:

“scapular dyskinesis”; “scapular dyskinesia”; “shoulder injury”; “shoulder injuries”; "shoulder dysfunction; “shoulder function”; “shoulder pain”; "overhead athletes”; "throwing athletes"; “pitching athletes”; “non-overhead athletes”; “athletic injury”; "athletic function”; “athletic injuries”; “athletic dysfunction”; “athletes performance”; “throwing performance”; “overhead performance”; “non-overhead performance”; "pitching performance"; “baseball athletes”; "handball athletes"; "tennis athletes”; "volleyball athletes"; "javelin athletes"; “softball athletes”.

Combinations:
Population (10 terms): "overhead athletes” OR "throwing athletes" OR “pitching athletes” OR “non-overhead athletes” OR “baseball athletes” OR "handball athletes" OR "tennis athletes” OR "volleyball athletes" OR "javelin athletes" OR “softball athletes”.

AND
Scapular dyskinesis (2 terms): “scapular dyskinesis” OR “scapular dyskinesia”

AND
Shoulder pain and function (14 terms): “shoulder injury” OR “shoulder injuries” OR "shoulder dysfunction” OR “shoulder function” OR “shoulder pain” OR “athletic injury” OR "athletic function” OR “athletic injuries” OR “athletic dysfunction” OR “performance athletes” OR “throwing performance” OR “overhead performance” OR “non-overhead performance” OR "pitching performance"

DATABASES

PUBMED
All fields
((((((((((overhead athletes) OR (handball athletes)) OR (javelin athletes)) OR (softball athletes)) OR (tennis athletes)) OR (throwing athletes)) OR (pitching athletes)) OR (volleyball athletes)) OR (non-overhead athletes)) OR (baseball athletes)) AND ((scapular dyskinesis) OR (scapular dyskinesia))) AND ((((((((((((shoulder injury) OR (shoulder injuries)) OR (shoulder dysfunction)) OR (shoulder function)) OR (shoulder pain)) OR (athletic injury)) OR (athletic function)) OR (athletic injuries)) OR (athletic dysfunction)) OR (performance athletes)) OR (throwing performance)) OR (overhead performance)) OR (non-overhead performance)) OR (pitching performance))

Total = 88 studies

MEDLINE
All fields
TX overhead athletes OR TX handball athletes OR TX javelin athletes OR TX softball athletes OR TX tennis athletes OR TX throwing athletes OR TX pitching athletes OR TX volleyball athletes OR TX non-overhead athletes OR TX baseball athletes AND TX scapular dyskinesia OR TX scapular dyskinesis AND TX shoulder injury OR TX shoulder injuries OR TX pitching performance OR TX shoulder dysfunction OR TX shoulder function OR TX shoulder pain OR TX athletic injury OR TX athletic function OR TX athletic injuries OR TX athletic dysfunction OR TX performance athletes OR throwing performance OR overhead performance OR TX non-overhead performance

Total = 117 studies

COCHRANE

All fields

((overhead athletes) OR (handball athletes) OR (javelin athletes) OR (softball athletes) OR (tennis athletes) OR (throwing athletes) OR (pitching athletes) OR (volleyball athletes) OR (non-overhead athletes) OR (baseball athletes)) AND ((scapular dyskinesis) OR (scapular dyskinesia)) AND ((shoulder injury) OR (shoulder injuries) OR (shoulder dysfunction) OR (shoulder function) OR (shoulder pain) OR (athletic injury) OR (athletic function) OR (athletic injuries) OR (athletic dysfunction) OR (performance athletes) OR (throwing performance) OR (overhead performance) OR (non-overhead performance) OR (pitching performance)) (Word variations have been searched)

Total = 15 studies

SPORT DISCUS

All fields

TX overhead athletes OR TX handball athletes OR TX javelin athletes OR TX softball athletes OR TX tennis athletes OR TX throwing athletes OR TX pitching athletes OR TX volleyball athletes OR TX non-overhead athletes OR TX baseball athletes AND TX scapular dyskinesia OR TX scapular dyskinesis AND TX shoulder injury OR TX shoulder injuries OR TX pitching performance OR TX shoulder dysfunction OR TX shoulder function OR TX shoulder pain OR TX athletic injury OR TX athletic function OR TX athletic injuries OR TX athletic dysfunction OR TX performance athletes OR throwing performance OR overhead performance OR TX non-overhead performance

Total = 326 studies

WEB OF SCIENCE

All fields

ALL=(overhead athletes OR handball athletes OR javelin athletes OR softball athletes OR tennis athletes OR throwing athletes OR pitching athletes OR volleyball athletes OR non-overhead athletes OR baseball athletes) AND ALL= (scapular dyskinesis OR scapular dyskinesia) AND ALL=(shoulder injury OR shoulder injuries OR shoulder dysfunction OR shoulder function OR shoulder pain OR athletic injury OR athletic function OR athletic injuries OR athletic dysfunction OR performance athletes OR throwing performance OR overhead performance OR non-overhead performance OR pitching performance)

Total = 103 studies

3 CONSIDERAÇÕES FINAIS

O estudo apresentou como objetivo desta revisão sistemática determinar a associação da discinese escapular com a dor e a função do ombro e identificar a associação da discinese escapular com outros fatores intrínsecos em atletas arremessadores e não arremessadores. A partir da revisão sistemática, foram encontradas as seguintes associações em atletas arremessadores: dor no ombro com discinese escapular óbvia e do tipo III; redução da força com discinese escapular tipo III. As seguintes associações foram encontradas em atletas não arremessadores: redução da rotação interna do ombro com discinese escapular e dor no ombro. As seguintes associações não foram encontradas em atletas arremessadores: discinese tipo I e II com dor no ombro; discinese escapular com função do ombro em atletas sem dor no ombro; discinese escapular com a idade em atletas com e sem dor no ombro. Ao utilizar esses achados na prática clínica, deve-se ter cautela pois, apesar dos estudos apresentarem baixo risco de viés, foram classificados com muita baixa qualidade de evidencia de acordo com o GRADE.

Ao realizarmos uma pesquisa geral inicial nos bancos de dados para definição da revisão sistemática, ficamos com a impressão de ter um número alto de artigos que investigassem sobre as associações da discinese escapular e a dor e função do ombro. Para nossa surpresa, após a primeira seleção dos estudos, restaram menos de 40 artigos. Alguns artigos foram excluídos por apresentarem resultados de associações com dados de prevalência (erro de interpretação) e outros por avaliarem os fatores e não analisarem as associações entre eles. Na prática clínica é essencial se basear em evidências científicas onde o profissional deve não só basear no resultado final divulgado, mas sim, ler o estudo por completo com um olhar mais crítico para ter uma correta interpretação das informações.

Os artigos incluídos na revisão sistemática, em sua maioria não tinham a discinese escapular e a dor e função do ombro como desfechos primários pois, é encontrado na literatura uma importância maior em investigar sobre as lesões sofridas pelos atletas. Em geral, existe uma falha de um raciocínio clínico, onde esquece-se de investigar os fatores intrínsecos e decide-se encontrar respostas das lesões somente em fatores extrínsecos, mesmo sabendo que as lesões esportivas são multifatoriais e são resultado de uma interação complexa entre esses fatores.

Apesar de não ter encontrado um resultado definitivo sobre a associação da influência da discinese escapular sobre a dor e função do ombro em atletas arremessadores e não

arremessadores, foi possível apontar as falhas na literatura para direcionar novos estudos em ambas populações, com melhor qualidade de evidência e resultados mais bem fundamentados para a prática clínica.

ANEXO A – CARTA DE ENCAMINHAMENTO PARA A REVISTA

No momento não temos a carta de encaminhamento pois, o artigo ainda será submetido à revista British Journal of Sports Medicine.

ANEXO B – REGRAS DE FORMATAÇÃO DA REVISTA

British Journal of Sports Medicine

Systematic reviews provide Level One evidence; they form a critical part of the literature.

- We are looking for experts to synthesise the literature and to comment on the outcomes of the review in a meaningful and clinically relevant way.
- The topic must be of relevance to clinicians with the key question 'will the findings change what practitioners do?''
- Succinct and focussed reviews, with questions that are topical, novel or controversial that will attract readers and researchers to the journal are more likely to be accepted.
- The literature search should have been completed within 12 months of manuscript submission.
- A completed PRISMA checklist and flow diagram should accompany the submission.
- All systematic reviews (with or without meta-analysis) should address all the items recommended in the PRISMA statement.
- All titles should include 'a Systematic Review'
- A structured Abstract should be added to the Main Document. Including headings Objective, Design, Data sources, Eligibility criteria for selecting studies, Results and Summary/Conclusion.
- We have a Systematic Review Prize for the best Systematic Review every half year.
- Please include a summary box summarising in 3-4 clear and specific bullet points 'What is already known' and 'What are the new findings'.
- Please provide 5 multiple choice questions (MCQs) each with 4-5 possible answers (only 1 correct answer), so the reader can test his or her understanding of the article. These MCQs will be published online-only in the form of an E-learning module.
- Systematic review registration: registry and number (if registered)

Word count: up to 4500 words
Abstract: up to 250 words
Tables/illustrations: Maximum 6 tables and/or figures
References: up to 100
Checklist: Prisma checklist/statement and flowchart

ANEXO C – REGISTRO DO PROSPERO

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Is there a relationship between scapular dyskinesis, shoulder pain and function in overhead and non-overhead athletes? A systematic review and metanalysis.

Mayra Orlandi, Eliane Machado, Paula Camargo, Jonatas Santos, Luciana Mendonça

Citation

Mayra Orlandi, Eliane Machado, Paula Camargo, Jonatas Santos, Luciana Mendonça. Is there a relationship between scapular dyskinesis, shoulder pain and function in overhead and non-overhead athletes? A systematic review and metanalysis.. PROSPERO 2020 CRD42020190467
Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020190467

Review question

Is there a relationship between scapular dyskinesis, shoulder pain and function in overhead and non-overhead athletes?

Searches

The search will be conducted in the following databases: PubMed, MEDLINE, Cochrane Library, Web of Science and SPORTDiscus without language or date restrictions. The search terms in English will be: "scapular dyskinesis"; "shoulder pain"; "athletes"; "shoulder function"; "function", "pain"; "performance"; "overhead"; "non-overhead"; "scapula"; "shoulder" and "throwing".

Types of study to be included

Will be included observational studies about scapular dyskinesis, shoulder pain and function in overhead and/or nonoverhead athletes.

Articles will be excluded: (1) animal or cadaver (rather than human) studies, (2) involved children younger than 18 years, (3) focused on basic science or physiology (rather than clinical parameters), (4) focused on processes outside of shoulder motion (tumors, skin, vascular), (5) focused on questionnaires or radiographic studies without patient examination, (6) were biomechanic or kinematic studies that lacked physical examination specifically for scapular dyskinesis, (7) did not include information on athletic participation.

Condition or domain being studied

Health condition of interest will be a scapular dyskinesis, shoulder pain and function.

Participants/population

-The inclusion criteria to determine eligibility will be: (1) athletes classified as overhead/ throwers/ hitters (including baseball, softball, american football, javelin throwers, tennis, volleyball, handball) and non-overhead/ throwers/ hitters (including all others sports or sports activities), either gender (male or female) and adults, of different competitive; (2) use of measures to assess shoulder pain and function and athlete performance; and (3) shoulder injuries throughout the season.

-The exclusion criteria will be: (1) sport that does not require repetitive activities; (2) inclusion of contact injuries; (3) injuries to the lower limbs and spine; (4) studies that evaluated the effectiveness of specific interventions to reduce the risk of shoulder injuries; (5) articles without full text available; (6) abstracts; books; book chapter; dissertations and theses.

Intervention(s), exposure(s)

None

Comparator(s)/control

None

Main outcome(s)

- Scapular dyskinesis is the change in the scapular kinematics, related to some changes present in the glenohumeral and / or acromioclavicular joint, in the subacromial space and in the activation of the shoulder muscles. It will be evaluated through the following tests: Visual observation in static and / or dynamic position with weight; Lateral Scapular Slide Test; 3D analysis of the scapular position. The use of any other measurement tool to determine the presence of scapular dyskinesia will be accepted, since the data are dichotomized as "scapular dyskinesis present" or "absent scapular dyskinesis".

* Measures of effect

The odds ratio will be used.

Additional outcome(s)

- Pain is the unpleasant sensation felt in one or more parts the body, which indicates potential or existing injury to some body structure. It will be evaluated through the following tests: Visual Analogue Scale; Numerical Pain Rating Scale; Penn Shoulder Score.

- Function are the physiological functions of body systems, including psychological functions. It will be evaluated through the following tests: International Classification of Functioning, Disability and Health; Scapular Assistance Test; Scapular Retraction Test; Shoulder Pain and Disability Index; Disabilities of the Arm, Shoulder and Hand Questionnaire; UCLA Shoulder Rating Scale; Short Form Health Survey (SF-36); Athletic Shoulder Outcome Rating Scale.

* Measures of effect

The odds ratio will be used.

Data extraction (selection and coding)

After systematic searches in the databases, the bibliographic references list of the included studies will be searched by hand to add studies that were not identified in the online search. The references found will be exported to an Endnote® and the duplicates will be removed. Then, two independent reviewers will screen possible studies by titles and abstracts first and then evaluate possible full texts.

Risk of bias (quality) assessment

This systematic review will follow the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) checklist and Cochrane recommendations. Two independent reviewers will score the methodological quality of each included study, using the Newcastle-Ottawa Scale (NOS)

Strategy for data synthesis

Meta-analysis will be conducted using random-effects model. Weighted mean differences (WMDs) and 95% confidence intervals (CIs) will be presented in the forest-plots. Estimated effect sizes will be assessed using mcid when possible. All analyses will be conducted using Comprehensive Meta-analysis software, version 2.2.04 (Biostat, Englewood, NJ).

Analysis of subgroups or subsets

None planned

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Type and method of review
Epidemiologic, Meta-analysis, Prognostic, Systematic review

Anticipated or actual start date
22 June 2020

Anticipated completion date
22 February 2021

Funding sources/sponsors
None

Conflicts of interest

Language
English

Country
Brazil

Stage of review
Review Ongoing

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
MeSH headings have not been applied to this record

Date of registration in PROSPERO
19 July 2020

Date of first submission
18 June 2020

Stage of review at time of this submission

Stage	Started	Completed
Preliminary searches	Yes	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.

The record owner confirms that they will update the status of the review when it is completed and will add publication details in due course.

Versions
19 July 2020