

RISK FACTOR OF ROTATOR CUFF TENDINOPATHY: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Rotator cuff tendinopathy is an umbrella term that includes different shoulder conditions affecting subacromial structures, such as rotator cuff tendinitis/tendinosis, subacromial bursitis and shoulder impingement syndrome. Rotator cuff tendinopathy is refractory to treatments, results in impaired activities of daily living and has a significant socio-economic burden due to loss of work and treatment costs.

The aim: This study aims to show risk factor for rotator cuff tendinopathy.

Methods: By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

Result: In the PubMed database, the results of our search brought up 75 articles, whereas the results of our search on SagePub brought up 151 articles. The results of the search conducted for the last year of 2013 yielded a total 58 articles for PubMed and 53 articles for SagePub. The result from title screening, a total 7 articles for PubMed and 18 articles for SagePub. In the end, we compiled a total of 10 papers. We included five research that met the criteria.

Conclusion: The most well-established RCD risk factor is advanced age, with higher prevalence associated with age in multiple studies. Other important and potentially modifiable risk factors exist, such as occupational physical demands, but few epidemiologic studies have evaluated associations specific to RCD.

Keyword: Rotator cuff, tendinopathy, tendinitis.

INTRODUCTION

High incidence rates and functional disability determine the overall significant socioeconomic impact of rotator cuff pathologies. Concerning the natural history of tendon disorders, rotator cuff tears (RCT) represent the final stage of a long-lasting continuum. The vast majority of scientific studies revealed an atraumatic pathoetiology, related to degenerative changes within the tendon tissue secondary to patient-specific characteristics, such as age and physical load. Generally, increasing age has been shown to be a major contributing factor as the prevalence of RCTs rises markedly from the fourth decade of life onwards, affecting >50% in the elderly. In addition, mechanical overuse is an additional major causative factor contributing to rotator cuff disorders. Recently, further anatomical (e.g., acromial shape or scapular dyskinesia) and environmental (e.g., obesity or metabolic syndrome) characteristics have been indirectly associated with the onset of tendinopathy. Taken together, there is evidence to support the theory that initially mainly extrinsic variables contribute to and drive tendon degeneration.^{1,2}

Muscle weakness may be a factor modulating tendon loading. This is a relative term referring to the failure to generate a desired or expected force. The mechanism of how weakness in rotator cuff muscles may lead to rotator cuff tendinopathy has been hypothesized by multiple groups. As suggested by previous literature, rotator cuff muscles counteract the deltoid to prevent humeral head elevation. Without the rotator cuff, humeral head elevation will decrease the size of subacromial space, increasing the risk of supraspinatus impingement. The reduction of subacromial space in patients with rotator cuff tendinopathy was also demonstrated by a previous retrospective study. Another study suggested that external rotation strength is crucial for the deceleration of arm swinging movements. Its weakness in athletes with repetitive forceful arm swings was hypothesized to lead to strains and tears in the tendon.³

Muscle stiffness was also suggested to lead to muscle weakness *via* reciprocal inhibition from a tight antagonist. Stiffness of the upper trapezius muscle was demonstrated in patients with rotator cuff tendinopathy. There is a possibility that muscle stiffness of the shoulder may be one of the causes leading to muscle weakness and the development of rotator cuff tendinopathy. Muscle stiffness could be detected with ultrasound elastography, or by physical examination demonstrating a limited range of motion of the shoulder. However, it has to be acknowledged that other causes such as osteoarthritis or frozen shoulder may also lead to reduced range of motion.^{3,4}

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast of risk factor for rotator cuff tendinopathy. It is possible to accomplish this by researching or investigating risk factor for rotator cuff tendinopathy. As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about the risk factor for rotator cuff tendinopathy. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2013, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used "risk factor for rotator cuff tendinopathy." as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: (*"Tendinopathy"[MeSH Subheading] OR "Rotator cuff"[All Fields] OR "Rotator cuff disease" [All Fields]*) AND (*"Rotator cuff tendinopathy"[All Fields] OR "Risk factor of tendinopathy" [All Fields]*) AND (*"Risk factor of rotator cuff disease"[All Fields] OR "Risk factor of rotator cuff tendinopathy" [All Fields]*) used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

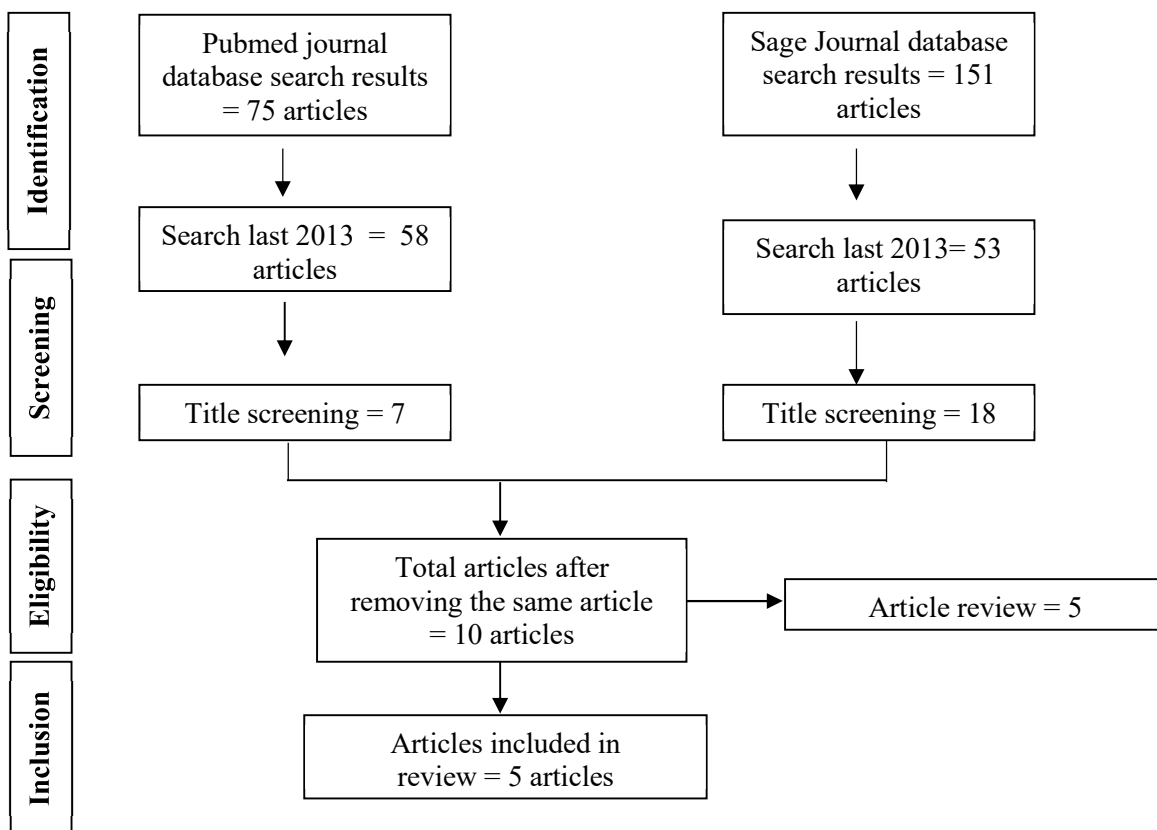


Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. In order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

In the PubMed database, the results of our search brought up 75 articles, whereas the results of our search on SagePub brought up 151 articles. The results of the search conducted for the last year of 2013 yielded a total 58 articles for PubMed and 53 articles for SagePub. The result from title screening, a total 7 articles for PubMed and 18 articles for SagePub. In the end, we compiled a total of 10 papers. We included five research that met the criteria.

Mohammadi, S *et al* (2022)⁵ showed that age over 45, excessive hand raising, repetitive tasks, upper arm flexion, and awkward postures were significantly associated with RCT, with the accompanying occupational risk factors increasing the risk of RCT in the workplace. Based on the findings of this study, the existence of over one mechanical risk factor in the workplace can be associated with a higher increase in RCT. In most workplaces, there is usually over one mechanical risk factor, so it is necessary to pay attention to the cumulative effects of all of them.

Song, A *et al* (2021)⁶ showed In a large imaging and operative report–verified case-control study, we identified advancing age, male sex, higher BMI, and diagnosis of carpal tunnel syndrome as risk factors significantly associated with an

increased risk of rotator cuff tears. Left shoulder symptoms and depression/anxiety were less likely to be associated with rotator cuff tears compared with symptomatic shoulders without rotator cuff tears. Contrary to some prior reports in the literature, smoking was not associated with rotator cuff tears.

Table 1. The literature include in this study

Author	Origin	Method	Sample Size	Result
Mohammadi, S <i>et al.</i> , 2022 ⁵	Iran	Cross-sectional study	470 patients	Risk factors, such as excessive hand raising, repetitive tasks, upper arm flexion, and awkward posture had a significant association with the frequency of rotator cuff tendinopathy ($p < 0.05$). Our study showed that shoulder tendinopathy had a statistically significant association with having at least one affecting risk factor (OR=3.96 95%CI: 2.26-6.96), two affecting risk factors (OR=6.82 95%CI: 4.13-11.26), three affecting risk factors (OR=10.25 95%CI: 4.35-24.14), and four affecting risk factors (OR=12.61 95%CI: 1.69-93.63).
Song, A <i>et al.</i> , 2021 ⁶	USA	A case-control study	2738 patients	A total of 2738 patients were selected from the Synthetic Derivative, which included 1731 patients with rotator cuff tears and 1007 patients without rotator cuff tears. Compared with individuals without tears, those with rotator cuff tears were more likely to be older (odds ratio [OR], 2.44; 95% confidence interval [CI], 2.12–2.89), to have a higher BMI (OR, 1.45; 95% CI, 1.24–1.69), to be of male sex (OR, 1.56; 95% CI, 1.32–1.85), and to have carpal tunnel syndrome (OR, 1.41; 95% CI, 1.03–1.93). Patients with rotator cuff tears were less likely to have left shoulder symptoms (OR, 0.68; 95% CI, 0.57–0.82) and to have depression/anxiety (OR, 0.77; 95% CI, 0.62–0.95) compared with the control group, which had symptomatic shoulder pain without rotator cuff tears.
Meyers, AR <i>et al.</i> , 2021 ⁷	USA	A Prospective Study	694 person	We observed 39 incident RCS cases in 694 person-years (incidence rate = 5.62 per 100 person-years). Adjusting for confounders, we found increased risk of incident RCS associated with forceful hand exertions per minute for three upper arm posture tertiles: flexion $\geq 45^\circ$ ($\geq 28.2\%$ time, HR = 1.11, CI [1.01, 1.22]),

				abduction $\geq 30^\circ$ (11.9–21.2%-time, HR = 1.18, CI [1.04, 1.34]), and abduction $>60^\circ$ ($\geq 4.8\%$ time, HR = 1.16, CI [1.04, 1.29]). We failed to observe statistically significant effects for other interactions or any separate measures of biomechanical exposure.
Applegate, KA et al., 2017⁸	American	A Cross-Sectional Study	1226 participants	The age of those with rotator cuff tendinopathy was greater at 45.6 (± 10.7) than at 41.6 (± 11.4) in those without rotator cuff tendinopathy. The average systolic BP among those with rotator cuff tendinopathy was higher, 130.8 (± 18.3) mm Hg, than in those without, 127.2 (± 16.8) mm Hg. There was a little difference in BMI between the two groups, 29.7 (± 6.4) kg/m ² in those with rotator cuff tendinopathy and 29.5 (± 6.8) kg/m ² in those without. The average CVD risk scores were higher in the group with rotator cuff tendinopathy 8.9 (± 5.0) than among those without tendinopathy 7.2 (± 4.7). A strong association was observed between CVD risk scores and both glenohumeral joint pain and rotator cuff tendinopathy. Peak odds ratios (ORs) of the adjusted models were 4.55 [95% confidence interval (95% CI) 1.97 to 10.31] and 5.97 (95% CI 2.12 to 16.83), respectively. The results show a dose-response trend of increasing risk.
Yanik, EL et al., 2021⁹	American	Prospective cohort	421,894 people	Of the 421,894 people included, 47% were men. Mean age at enrollment was 56. In total, 2156 incident RCD surgery cases were identified. Each decade increase in age was associated with a 55% increase in RCD surgery (95%CI=46%–64%). Male sex, non-white race, lower area deprivation, and higher BMI were significantly associated with higher RCD surgery risk (all $P \leq 0.01$). Greater occupational physical demands were associated with higher RCD surgery rates (HRs=2.1, 1.8, and 1.4 for always, usually, and sometimes doing heavy physical work vs. never). Former smokers had higher RCD surgery rates than

				<p>never smokers (HR=1.23[95%CI=1.12–1.35]), while current smokers had similar rates as never smokers (HR=0.94[95%CI=0.80–1.11]). Among never smokers, RCD surgery risk was higher among those with >1 household member who smoked (HR=1.78[95%CI=1.08–2.92]), but other secondhand smoke measures were not significant.</p>
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Meyers, AR *et al* (2021)⁷ showed This study highlights the importance of assessing forceful repetition and upper arm elevation as risk factors when developing JEMs and interventions for preventing RCS. Based on these results, interventions that reduce exposure to forceful repetition (i.e., lower force levels and/or slower exertion rates) may reduce the risk of RCS, especially when upper arm elevation cannot be avoided. Likewise, when forceful and repetitive work cannot be eliminated, limiting time spent with upper arms elevated $\geq 30^\circ$ abduction and $\geq 45^\circ$ flexion may reduce risk of RCS.

Applegate, KA *et al* (2017)⁸ showed this cross-sectional study’s data demonstrate a strong correlation between CVD risk factors and rotator cuff tendinopathy. The results show a dose–response trend of increasing risk is consistent with prior research linking individual risk factors to rotator cuff tendinopathy, and are biologically plausible. Although these results present a potentially modifiable disease mechanism, prospective studies are needed to confirm this mechanism and test whether modification of CVD risk factors changes the clinical course, or prevents rotator cuff tendinopathy

Yanik, EL *et al* (2021)⁹ showed numerous factors were independently associated with RCD surgery, including older age, male sex, higher BMI, lower area deprivation, and higher occupational physical demands. Several identified risk factors are modifiable suggesting that the healthcare burden of RCD might be reduced through the pursuit of public health goals such as reducing obesity and modifying occupational demands. A number of factors that were independently associated with RCD surgery risk, including older age, male sex, less social deprivation, higher BMI, and higher occupational physical demands. Several identified risk factors are potentially modifiable with important implications for the current burden on healthcare systems. Specifically, our findings suggest a potential for interventions that align with other public health goals to be effective in reducing the rate of surgery needed for painful rotator cuff tears. Future studies assessing specific modifiable risk factors and corresponding interventions will be essential to exploring this potential further.

DISCUSSION

Rotator cuff tendinopathy is an umbrella term describing pain and loss of function in the rotator cuff tendons. Entities including tendinosis, tendinitis, subacromial impingement, and subacromial bursitis are often regarded under the term rotator cuff tendinopathy. As reported in previous studies, rotator cuff tendinopathy is common among athletes, having severe impacts on their performance and athletic career.^{3,10}

The pathogenesis of tendinopathy is believed to involve a failed healing process with a multifactorial etiology. Overuse of the rotator cuff tendons was suggested to be one of the factors leading to developing rotator cuff tendinopathy. To explain the association of tendinopathy with overuse, previous studies have demonstrated that tendon loading, in terms of compression or tensile loads, would induce apoptosis and inflammation in tendon cells. An increased activity level would increase tendon loading. However, the fact that athletes with similar training load present inconsistently with tendinopathy suggest that some factors may play a role in the modulation of tendon loading under given training load.^{3,11}

If a diagnosis of tendinopathy has been made, it is important to take the diagnosis a step further and decipher whether the tendinopathy is from extrinsic causes, intrinsic causes, or a combination of the two. When a patient partially tears their rotator cuff (RC), it is common that they present with reduced shoulder function (i.e. dyskinesia, weakness, pain, and stiffness). They may also have pain at rest, night pain, or a painful arc. Upon evaluation, the clinician may find weak external rotators, a weak supraspinatus, and signs of impingement. Signs of impingement may include painful overhead reaching, an inflamed subdeltoid bursa, or positive special tests meant to provoke symptoms. In patients over the age of 60 with two out of three of the aforementioned symptoms (i.e. weak external rotators, weak supraspinatus, impingement signs previously listed), there is a 98% chance of a RC tear. Patients can also present with pain radiating to the lateral mid-humerus or anterolateral acromion, pain while lying on the shoulder or sleeping with the arm overhead, and pain that occurs when reaching above the head. In addition, Fukuda observed that PRCTs are more painful than full thickness tears.^{12,13}

Factors taken into account when considering surgery include the patient's functional needs, age, health, size of the tear, and amount of fatty infiltration into the muscle. It is estimated that 75,000 RC surgical repairs are performed in the United States each year. Age plays a factor as it is unusual for young patients to have RC tears requiring surgery. If a young patient presents with acute, post-traumatic weakness without any pre-existing RC problem, then it is generally accepted as an absolute indication for surgery. In terms of tear size, if the RC tendons are greater than 50% torn, then surgery is commonly recommended.^{12,14}

A risk factor is something that increases the chance of developing a condition such as tendinopathy of the shoulder. Risk factors can be modifiable or non-modifiable, and knowledge of such factors might guide treatment prescription. Non-modifiable risk factors including increasing age, sex and, to an extent, working practice, i.e. repeated working above shoulder height, have been reported, but such knowledge might be regarded as being of limited interest if the factor cannot be changed or targeted with treatment. Although most contemporary treatments focus on local issues, tissues and tendon, there is a developing body of research evidence highlighting the role of lifestyle factors in relationship to the onset and persistence of tendinopathies.¹⁵

CONCLUSION

The most well-established RCD risk factor is advanced age, with higher prevalence associated with age in multiple studies. Smoking and obesity has been identified as independent risk factors, but most used clinical control groups which do not accurately represent the population from which RCD cases develop and could lead to biased associations. Other important and potentially modifiable risk factors exist, such as occupational physical demands, but few epidemiologic studies have evaluated associations specific to RCD.

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