

Supplementary Material

**Does cardiovascular preparticipation screening cause psychological distress in athletes? A
systematic review**

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(2022)

Database Search Strategies

Database searches using the specified search strategies are shown below for each database or database group.

MEDLINE, EMBASE, APA PsycInfo: exported on July 22, 2021 (1734 total records)

- 1 cardiovascular.mp. (1781225)
- 2 cardiac.mp. (1906041)
- 3 heart.mp. (4136190)
- 4 cardiology.mp. (225011)
- 5 screening.mp. (1909140)
- 6 preparticipation.mp. (2157)
- 7 pre-participation.mp. (1299)
- 8 sport*.mp. (322694)
- 9 exercise*.mp. (1086973)
- 10 athlet*.mp. (231076)
- 11 psych*.mp. (5829114)
- 12 mental.mp. (2119052)
- 13 depression.mp. (1535271)
- 14 anxiety.mp. (927007)
- 15 1 or 2 or 3 or 4 (5696815)
- 16 5 or 6 or 7 (1910247)
- 17 8 or 9 or 10 (1407083)
- 18 11 or 12 or 13 or 14 (7650138)
- 19 15 and 16 and 17 and 18 (1734)

PubMed, CINAHL, SPORTDiscus, Cochrane Library: exported on July 22, 2021 (1204 total records)

(cardiovascular* OR cardiac* OR heart* OR cardiology)
AND (screening OR pre-participation* OR preparticipation*)
AND (athlet* OR exercise* OR sport*)
AND (psych* OR mental* OR depression OR anxiety)

Targeted grey literature searches using Google Scholar and the Canadian Agency for Drugs and Technologies in Health (CADTH) Grey Matters tool were also conducted. The specified search strategies are shown below.

Google Scholar: exported on July 22, 2021 (14 total records)

(cardiovascular AND athlete AND screening AND psychology)

CADTH Grey Matters: exported on July 22, 2021 (8 total records)

Searched using a combination of the terms/phrases listed above.

Supplemental Table S1. Self-administered pre-screen and post-screen questionnaires used by Asif et al., (2014), Asif et al., (2015), and Asif et al., (2017) [1].

Heart Screening Questionnaire: Pre-Screen

Your school is interested in protecting its athletes. This includes trying to detect heart conditions during your pre-participation exam. We want to know how you feel about detecting heart problems. For this questionnaire, an EKG (electrocardiogram) is a test that involves sensors to detect your heart's activity level.

Directions: For the following questions, please check the box that best describes your opinion.	Yes	No	Uncertain
1. Someone in my family or a close friend has had a heart condition at an early age (Less than 50 years old).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I have had a pre-participation exam before.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Directions: For the following questions, please check the box that best describes your opinion. Over the last four weeks, how often have you been bothered by the following problems...	Not at All	Several Days	More than Half the Days
3. Feeling nervous, anxious, on edge, or worrying a lot about different things?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If you checked "Not at All", go to question number 4.			
a. Feeling restless so that it is hard to sit still?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Getting tired very easily?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Muscle tension, aches, or soreness?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Trouble falling asleep or staying asleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Trouble concentrating on things, such as reading a book or watching TV?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Becoming easily annoyed or irritable?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Directions: For the following questions, please check the box that best describes your opinion.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
4. I have worried that I have a heart condition.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I am interested in having my heart screened prior to playing competitive sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I am interested to undergo a heart screen that includes an EKG prior to playing competitive sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I am worried that this heart screen will reveal that I have a heart condition.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. If I had a heart condition, I would rather know than play sports without knowing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. If I had a heart condition, I would rather know so that I can receive proper treatment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Directions: for the next two questions, please consider the following statement. Afterwards, please check the box that best describes your opinion.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
An EKG improves our ability to detect a heart problem. This could save your life. In some circumstances, results may require more testing (such as an ultrasound of the heart) before a final determination is made.					
10. I would want an EKG as part of my heart screen before I play competitive sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I would rather have the extra testing, even if I can't play sports temporarily, than play sports without knowing if my heart is healthy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Heart Screening Questionnaire: Post-Screen TP Result

Additional testing was performed due to: History Exam ECG

Directions: For the following questions, please check the box that best describes your opinion.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. The time period for receiving my results was appropriate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I was satisfied with this heart screen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. While undergoing the heart screen, I felt anxious.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I felt anxious or stressed while getting additional testing on my heart	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Immediately after I received my final results, I felt anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I was scared that the heart screen would reveal that I had an abnormal heart.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Even though I needed additional testing, I am glad I had this heart screen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Compared to other heart screens that I have had, I feel safer playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I feel that all athletes should receive a screen like this before playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I would recommend this heart screen to other athletes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Even though I was found to have a heart condition, I am glad I had this heart screen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. I was told that I would be able to play my sport in the future.

Yes No

After all testing, my final diagnosis was _____

Heart Screening Questionnaire: Post-Screen FP Result

Additional testing was performed due to: History Exam ECG

Directions: For the following questions, please check the box that best describes your opinion.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I feel that all athletes should receive a screen like this before playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. I would recommend this heart screen to other athletes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. While undergoing the heart screen, I felt anxious.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I felt anxious or stressed while getting additional testing on my heart	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. After I received my results, I felt anxious or stressed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I was scared that the heart screen would reveal that I had an abnormal heart.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I worried that someone would tell me I could not play sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Even though I needed additional testing, I am glad I had this heart screen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Compared to other heart screens that I have had, I feel safer playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. The time period for receiving my results was appropriate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was satisfied with this heart screen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Compared to other athletes I think that I am more likely to have a heart condition in the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. The impact that this heart screen will have on my training/competition will be...

- Strongly Negative
- Slightly Negative
- Neutral
- Slightly Positive
- Strongly Positive

Heart Screening Questionnaire: Post-Screen Negative

Directions: For the following questions, please check the box that best describes your opinion.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. The time period for receiving my results was appropriate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I was satisfied with this heart screen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. While undergoing the heart screen, I felt anxious.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Immediately after I received my final results, I felt anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I was scared that the heart screen would reveal that I had an abnormal heart.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Directions: For the following questions, please check the box that best describes your opinion.	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
6. I worried that someone would tell me I could not play sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Compared to other heart screens that I have had, I feel safer playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I feel that all athletes should receive a screen like this before playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I would recommend this heart screen to other athletes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Compared to other athletes I think that I am more likely to have a heart condition in the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. The impact that this heart screen will have on my training/competition will be...

Strongly Negative

Slightly Negative

- Neutral
- Slightly Positive
- Strongly Positive

Adapted from: Asif IM, Johnson S, Schmiege J, et al. The psychological impact of cardiovascular screening: the athlete's perspective. Br J Sports Med 2014;48:1162–6. doi:10.1136/BJSPORTS-2014-093500

Supplemental Table S2. Impact of Event Scale-Revised (IES-R) including intrusion subscale used by Morrison et al., (2021), Schurink et al., (2017), and Solberg et al., (2012) [2].

INSTRUCTIONS:

Below is a list of difficulties people sometimes have after stressful life events. Please read each item, and then indicate how distressing each difficulty has been for you DURING THE PAST SEVEN DAYS with respect to _____, which occurred on _____. How much were you distressed or bothered by these difficulties?

Item Response Anchors are 0 = Not at all; 1 = A little bit; 2 = Moderately; 3 = Quite a bit; 4 = Extremely

The **Intrusion subscale** is the MEAN item response of **items 1, 2, 3, 6, 9, 14, 16, 20**. Thus, scores can range from 0 through 4.

The **Avoidance subscale** is the MEAN item response of **items 5, 7, 8, 11, 12, 13, 17, 22**. Thus, scores can range from 0 through 4.

The **Hyperarousal subscale** is the MEAN item response of **items 4, 10, 15, 18, 19, 21**. Thus, scores can range from 0 through 4.

IES-R Items:

- | | |
|---|---|
| 1. Any reminder brought back feelings about it. | 13. My feelings about it were kind of numb. |
| 2. I had trouble staying asleep. | 14. I found myself acting or feeling like I was back at that time. |
| 3. Other things kept making me think about it. | 15. I had trouble falling asleep. |
| 4. I felt irritable and angry. | 16. I had waves of strong feelings about it. |
| 5. I avoided letting myself get upset when I thought about it or was reminded of it. | 17. I tried to remove it from my memory. |
| 6. I thought about it when I didn't mean to. | 18. I had trouble concentrating. |
| 7. I felt as if it hadn't happened or wasn't real. | 19. Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart. |
| 8. I stayed away from reminders of it. | 20. I had dreams about it. |
| 9. Pictures about it popped into my mind. | 21. I felt watchful and on-guard. |
| 10. I was jumpy and easily startled. | 22. I tried not to talk about it. |
| 11. I tried not to think about it. | |
| 12. I was aware that I still had a lot of feelings about it, but I didn't deal with them. | |

Score Interpretation (IES-R):

24-32: PTSD is a clinical concern. Those with scores this high who do not have full PTSD will have partial PTSD or at least some of the symptoms.

33-38: This represents the best cutoff for a probable diagnosis of PTSD.

39 and above: This is high enough to suppress your immune system's functioning (even 10 years after an impact event).

Adapted from: Daniel S. Weiss, Ph.D., Professor of Medical Psychology, Department of Psychiatry, University of California, San Francisco, CA 94143-0984. Mail Code: UCSF Box 0984-F. Mail Code: UCSF Box 0984-F. Tel.: (415) 476-7557. Email: daniel.weiss@ucsf.edu.

Supplemental Table S3. Scales and Items of the RESTQ-76 Sport, used by Tischer et al. (2017) [3].

Scale 1: General Stress

- (22) I felt down
- (24) I felt depressed
- (30) I was fed up with everything
- (45) Everything was too much for me

Scale 2: Emotional Stress

- (21) I was annoyed by others
- (26) Other people got on my nerves
- (38) I was upset
- (48) I was angry with someone

Scale 4: Conflicts/Pressure

- (12) I worried about unresolved problem
- (18) I couldn't switch my mind off
- (32) I felt I had to perform well in front of others
- (44) I felt under pressure

Scale 5: Fatigue

- (2) I did not get enough sleep
- (16) I was tired from work
- (25) I was dead tired after work
- (35) I was overtired

Scale 6: Lack of Energy

- (4) I was unable to concentrate well
- (11) I had difficulties in concentrating
- (31) I was lethargic
- (40) I put off making decisions

Scale 7: Somatic Complaints

- (7) I felt physically bad
- (15) I had a headache
- (20) I felt uncomfortable
- (42) I felt physically exhausted

Scale 8: Success

- (3) I finished important tasks
- (17) I was successful in what I did
- (41) I made important decisions
- (49) I had some good ideas

Scale 9: Social Relaxation

- (6) I laughed
- (14) I had a good time with my friends
- (23) I visited some close friends
- (33) I had fun

Scale 10: Somatic Relaxation

- (9) I felt physically relaxed
- (13) I felt at ease
- (29) I felt physically fit
- (38) I felt as if I could get everything done

Scale 11: General Well-being

- (10) I was in good spirits
- (34) I was in a good mood
- (43) I felt happy
- (47) I felt content

Scale 12: Sleep Quality

(19) I fell asleep satisfied and relaxed

(27) I had a satisfying sleep

(36) I slept restlessly

(46) My sleep was interrupted easily

Scale 13: Disturbed Breaks

(51) I could not get rest during the breaks

(58) I had the impression there were too few breaks

(66) Too much was demanded of me during the breaks

(72) The breaks were not at the right times

Scale 14: Burnout/Emotional Exhaustion

(54) I felt burned out by my sport

(63) I felt emotionally drained from performance

(68) I felt that I wanted to quit my sport

(76) I felt frustrated by my sport

Scale 15: Fitness/Injury

(50) Parts of my body were aching

(57) My muscles felt stiff or tense during performance

(64) I had muscle pain after performance

(73) I felt vulnerable to injuries

Scale 16: Fitness/Being in Shape

(53) I recovered well physically

(61) I was in a good condition physically

(69) I felt very energetic

(75) My body felt strong

Scale 17: Burnout/Personal Accomplishment

(55) I accomplished many worthwhile things in my sport

(60) I dealt very effectively with my teammates' problems

(70) I easily understood how my teammate felt about things

(77) I dealt with emotional problems in my sport very calmly

Scale 18: Self-Efficacy

(52) I was convinced I could achieve my set goals during performance

(59) I was convinced that I could achieve my performance at any time

(65) I was convinced that I performed well

(71) I was convinced that I had trained well

Scale 19: Self-Regulation

(56) I prepared myself mentally for performance

(62) I pushed myself during performance

(67) I psyched myself up before performance

(74) I set definite goals for myself during performance

* Each item is scored on a 7-point Likert scale, with 0 representing strong disagreement and 6 representing strong agreement. Athletes respond to each item on a self-rated 7-point Likert scale according to how well the item was deemed to be self-descriptive for the previous 3 days and nights (0=strongly disagree, 6=strongly agree) [3].

Adapted from: Kellmann, Michael, and K. Wolfgang Kallus. Recovery-Stress Questionnaire for Athletes: User Manual. Champaign, IL: Human Kinetics, 2001. C.9

Risk of Bias Assessment

Standardized instruments provided by the Joanna Briggs Institute (JBI) were used to assess the risk of bias in included studies. The following scales were used:

The Newcastle-Ottawa Scale was used to assess the risk of bias in included studies. The following scales were used:

- JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies (Supplemental Table S4)
- JBI Critical Appraisal Checklist for Qualitative Research (Supplemental Table S5).
- JBI Critical Appraisal Checklist for Quasi-Experimental (Non-Randomized Experimental) Studies (Supplemental Table S6).

The reviewer-specific scores for each included study are shown in Supplemental Table S7 (cross-sectional studies), Supplemental Table S8 (qualitative study), and Supplemental Table S9 (Quasi-experimental study).

Supplemental Table S4: JBI Critical Appraisal Checklist for Analytical Cross-sectional studies.

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the study subjects and the setting described in detail?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the exposure measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were objective, standard criteria used for measurement of the condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were confounding factors identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were strategies to deal with confounding factors stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall appraisal:	Include <input type="checkbox"/>	Exclude <input type="checkbox"/>	Seek further info <input type="checkbox"/>	

Adapted from: Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu R, Currie M, Qureshi R, Mattis P, Lisy K, Mu P-F. Chapter 7: Systematic reviews of etiology and risk . In: Aromataris E, Munn Z (Editors). JBI Manual for Evidence Synthesis. JBI, 2020. Available from <https://synthesismanual.jbi.global>

Supplemental Table S5: JBI Critical Appraisal Checklist for Qualitative Research.

	Yes	No	Unclear	Not applicable
1. Is there congruity between the stated philosophical perspective and the research methodology?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is there congruity between the research methodology and the research question or objectives?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is there congruity between the research methodology and the methods used to collect data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is there congruity between the research methodology and the representation and analysis of data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is there congruity between the research methodology and the interpretation of results?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Is there a statement locating the researcher culturally or theoretically?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Is the influence of the researcher on the research, and vice-versa, addressed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are participants, and their voices, adequately represented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall appraisal:	Include <input type="checkbox"/>	Exclude <input type="checkbox"/>	Seek further info <input type="checkbox"/>	

Adapted from: Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *Int J Evid Based Healthc.* 2015;13(3):179–187.

Supplemental Table S6: JBI Critical Appraisal Checklist for Quasi-Experimental (Non-Randomized Experimental) Studies.

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the participants included in any comparisons similar?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was there a control group?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?
7. Were the outcomes of participants included in any comparisons measured in the same way?
8. Were outcomes measured in a reliable way?
9. Was appropriate statistical analysis used?

Overall appraisal: Include Exclude Seek further info

Adapted from: Tufanaru C, Munn Z, Aromataris E, Campbell J, Hopp L. Chapter 3: Systematic reviews of effectiveness. In: Aromataris E, Munn Z (Editors). JBI Manual for Evidence Synthesis. JBI, 2020. Available from <https://synthesismanual.jbi.global>

Supplemental Table S7: JBI Critical Appraisal Checklist for Analytical Cross-sectional studies.

First Author (Year of Publication)	Scored Questions								Total Score
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	
Asif et al. (2015) [4]		1	1	1	1	1	1	1	7/8
Asif et al. (2017) [5]	1	1	1	1	1	1	1	1	8/8
Morrison et al. (2020) [6]	1	1	1	1	1		1	1	7/8
Schurink et al (2017) [7]	1	1	1	1	1		1	1	7/8
Solberg et al. (2012) [8]		1	1	1	1		1	1	7/8
Tischer et al. (2016) [9]	1	1	1	1			1	1	7/8

Supplemental Table S8: JBI Critical Appraisal Checklist for Qualitative Research.

First Author (Year of Publication)	Scored Questions										Total Score
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
Asif et al. (2015) [10]	1	1	1	1	1			1	1	1	8/10

Supplemental Table S9: JBI Critical Appraisal Checklist for Quasi-Experimental (Non-Randomized Experimental) Studies.

First Author (Year of Publication)	Scored Questions									Total Score
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	
Asif et al. (2014) [1]	1	1	1	1		1	1	1	1	8/9

Supplemental Table S10. Psychological outcomes reported among athletes before, during, and after screening

Author (Year of Publication)	Psychometric instrument(s) used	Psychological outcomes		
		Before screening	During screening	After screening
Asif et al. (2014) [1]	- Prescreen and postscreen self-administered questionnaires (psychometric parameters measured using binary response variable or a 5-point Likert scale: lowest=-2, highest=+2)	- 4.4% worried about cardiac condition - Athletes screened with ECG (and physical/history) were more worried about having cardiac condition than those who were screened without ECG (5.0% vs. 1.4%; p<0.001) - 73% preferred to know of abnormality before competing	- Both groups reported no measurable anxiety during screening, although athletes screened with ECG were more anxious than those screened without ECG (mean=-0.22 vs. mean=-0.8; p<0.001)	- Athletes screened with or without ECG reported no measurable anxiety after screening (mean=-0.85 vs. mean=-0.99; p=0.88)
Asif et al. (2015) [4]	- Prescreen and postscreen self-administered questionnaires (psychometric parameters measured using binary response variable or a 5-point Likert scale: lowest=-2, highest=+2)	- 4.2% worried about cardiac condition - 74% preferred to know of abnormality before competing	- Athletes who screened normal and those who had a FP diagnosis reported no measurable anxiety during screening (mean=-0.29 [SD=1.04] vs. mean=-0.22 [SD=1.18]; p=0.69) - Athletes who had a TP diagnosis reported measurable anxiety during screening (mean=0.08 [SD=1.24])	- Athletes who screened normal and those who had a FP diagnosis reported no measurable anxiety after screening (mean=-0.82 [SD=0.89] vs. mean=-0.94 [SD=1.03]; p=0.36) - Athletes who had a FP diagnosis felt safer during competition compared to those who screened normal (mean=0.75 [SD=1.01] vs. mean=0.48 [SD=0.88]; p<0.001) - Athletes who had a TP diagnosis reported measurable anxiety after screening (mean=0.58 [SD=1.17]) - 75% of athletes who had a TP diagnosis were satisfied with ECG screening and would recommend to others
Asif et al. (2015) [10]	- Semi-structured interviews conducted >6 months after cardiac	- NR	- NR	- Four stages of psychological impact after diagnosis by screening were identified: 1) immediate reaction and

	diagnosis by screening (thematic analysis using consensual qualitative research methods by multiple sports psychology experts)				challenge to athlete identity, 2) grief and coping, 3) adaptation, and 4) acceptance - All athletes had positive attitude towards screening (including ECG) and would repeat and recommend to others
Asif et al. (2017) [5]	- Prescreen and postscreen self-administered questionnaires (psychometric parameters measured using binary response variable or a 5-point Likert scale: lowest=-2, highest=+2)	- 4.5% worried about cardiac condition - 70.1% prefer to know of abnormality before competing	- Athletes who screened normal and those who had a FP diagnosis reported no measurable anxiety during screening (normal mean=-0.774, FP mean=-0.594; p=0.369).	- Athletes who screened normal and those who had a FP diagnosis reported no measurable anxiety after screening (normal mean=-1.054, FP mean=-0.750; p=0.135).	
Morrison et al. (2020) [6]	- Self-administered questionnaire >6 months after cardiac diagnosis by screening (psychological parameters measured using the 22-item IES-R scored on a 5-point Likert scale: lowest=0, highest=4; total sum score out of 88) *	- NR	- NR	- Total IES-R scores were normal (median=2.0, [IQR 0-6.0]) - 93% satisfied with screening - 74.6% would recommend screening to others - 44.8% feel safer when exercising after screening - 33% strongly feared sport restriction after diagnosis	
Schurink et al. (2017) [7]	- Self-administered questionnaire >6 months after screening (psychological parameters	- 8.0% experienced measurable anxiety before screening (95% CI 5.0-12%)	- 5.0% experienced measurable anxiety during screening (95% CI 2-8%)	- Total IES scores were normal (median=1, [IQR 0-2]) - Athletes diagnosed with CAD more likely to feel anxious directly after receiving result (27.1% vs.3.1%; p<0.001)	

	measured using the 7-item intrusion sub-scale of the IES graded on a 6-point Likert scale: lowest=0, highest=5; total sum score out of 35) †				<ul style="list-style-type: none"> - IES scores significantly higher in participants diagnosed with CAD compared to those who were not (CAD median=1, vs no-CAD median=2; p<0.001) - Majority were satisfied with participation (93.8%, 95% CI 91-97%)
Solberg et al. (2012)[8]	- Self-administered questionnaire 2-3 months after screening but before knowledge of results (psychological parameters measured using the 7-item intrusion sub-scale of the IES graded on a 6-point Likert scale: lowest=0, highest=5; total sum score out of 35) †	- NR	- NR		<ul style="list-style-type: none"> - Low distress after screening (median IES intrusion score=1, SD=4.8, range=0-30). - 2.8% significant psychological distress (IES intrusion sum score≥19). - Athletes who experienced significant psychological distress would more often recommend screening to others (100% vs. 83%, p≤0.006) - 64% more confident when competing - 88% happy with screening - 84% strongly recommend screening - 16% afraid screen might have consequences to their health
Tischer et al. (2016) [9]	- Prescreen and postscreen self-administered questionnaires (psychological parameters measured using scales 1-7 of the REST-Q 76 Sport questionnaire graded on a 7-point Likert scale: lowest=0, highest=6) ‡	- Mean scores related to psychological distress before screening were low for both negative and positive screened athletes (general stress: negative=0.84, positive=0.65, p=0.03; emotional stress: negative=1.12, positive=0.99, p=0.23; social stress: negative=2.00, positive=1.84, p=0.13)	- NR		<ul style="list-style-type: none"> - Mean scores related to psychological distress after screening were low for both negative and positive screened athletes (general stress: negative=0.72, positive=0.68, p=0.34; emotional stress: negative=1.00, positive=0.91, p=0.62; social stress: negative=1.82, positive=1.62, p=0.05)

CAD = Coronary Artery Disease, ECG = Electrocardiogram, FP = False Positive, IES = Impact of Event Scale, IES-R = Impact of Event Scale-Revised, NR = not reported, REST-Q 76 Sport = Recovery-stress Questionnaire for Athletes, TP = True Positive

* The IES-R is a 22-item validated tool used to assess an individual's psychological response to traumatic experience. Responses are scored on a 5-point Likert scale (lowest=0, highest=4). Total IES-R scores range from 0 to 88 (<12=no significant stress/normal, 12-32=recommended monitoring, >33=significant stress reaction).

† The intrusion subscale of the IES is a 7-item validated tool commonly applied to measure the level of psychological distress after an event. Responses are scored on a 6-point scale (lowest=0, highest=5). Total IES intrusion scores range from 0 to 35 (>19=clinically significant level of distress).

‡ The REST-Q 76 Sport is a 76 item and 19-scale validated tool to detect stress in athletes. Responses are scored on a 7-point Likert scale (lowest=0, highest=6).

Supplemental Table S11. Expanded key findings among included studies

Author (Year of Publication)	Study methods and variables	Main Findings
Asif et al. (2014) [1]	<ul style="list-style-type: none"> - 2 screening groups: (control) History and physical exam only, (experimental) History, physical exam, and ECG. - Pre- and post-screen psychological assessments administered to measure health attitudes, anxiety, and impact of screening on sport (Likert scale: -2-2). 	<ul style="list-style-type: none"> - Prior to screening 4.4% were worried about having a cardiac condition and 73% preferred to know if they had an abnormality before competing. - Both the ECG (experimental) and no-ECG (control) groups reported no significant anxiety during screening (control group mean=-0.8 [SD=1.02], experimental group mean=-0.22 [SD=1.10], p<0.001) and there was no significant difference in distress levels immediately after screening (control group mean=-0.99, [SD=0.94], experimental group mean=-0.85 [SD=0.91], p=0.88). - Those who received an ECG during their screening protocol were more satisfied with the screening process (p<0.001), felt safer during competition (p<0.01), were more supportive of cardiovascular screening in athletes (p<0.001), and stated that ECG screening positively impacted their training (p<0.001). - Compared to the no-ECG group, individuals with false positive screening results reported no difference in post-screen anxiety (p=0.775), felt safer during competition (p<0.001), would recommend ECG screening to others (p<0.001), and expressed a positive impact on their training (p<0.001). - Athletes who screened true positive (n=6) did describe anxiety during (mean=0.5, SD=1.05) and after (mean=0.14, SD=1.47) screening, however, they were still satisfied with their cardiovascular screening process (mean=0.67, SD=1.03) and would recommend ECG screening to other athletes (mean=1.5, SD=0.55).
Asif et al. (2015) [4]	<ul style="list-style-type: none"> - Pre- and post-screen psychological assessments administered to evaluate experiences, health attitudes, anxiety, and impact of screening on sport (Likert scale: -2-2). 	<ul style="list-style-type: none"> - Before screening only 4.2% were worried about having a cardiac condition and 74% preferred to know about a possible cardiovascular disorder before competing. - Athletes screening either normal or false positive reported no measurable anxiety, with no significant difference in distress between these groups both during (normal mean=-0.29, SD=1.04; FP mean=-0.22, SD=1.18, p=0.69) and after screening (normal mean=-0.82, SD = 0.89; FP =-0.94, SD = 1.03; p= 0.36). - 92% of athletes who underwent screening would recommend cardiovascular screening including ECG to other young athletes.

		<ul style="list-style-type: none"> - After screening, athletes who screened false positive (n=333) described feeling safer during competition compared to those who had normal screens (FP mean=0.75, SD = 1.01; normal mean=0.48, SD = 0.88; p<0.001). - Athletes with a true positive screen (n=13) reported anxiety both during (mean=0.08, SD = 1.24) and after (mean=0.58, SD=1.17) screening, but 75% of these athletes were still satisfied ECG screening and would recommend it to others. - When analyzed by subgroup, there were no significant differences in anxiety during (younger mean=-0.22, SD=1.09; older mean=-0.32, SD=1.06) or after (younger mean=-0.77, SD=0.96; older mean=-0.86, SD=0.91) screening in the younger age (13-15) and older age (16-18) cohorts, with both of these age groups reporting ECG screening having a positive impact on their training (younger=90%, older=92%). - African American athletes were significantly less worried about having an underlying cardiac condition (mean=-1.47, SD=0.82; p<0.001) and less concerned that their screen would be abnormal (mean=-1.09, SD=0.99; p<0.001) compared to white athletes (worried=-1.16, SD=0.88; concerned=-0.68, SD=1.00). - Males were significantly less concerned that their screening would be abnormal (males=-0.89, SD=1.00; females=-0.63, SD=1.00; p<0.001) and were less distressed during screening (males=-0.35, SD=1.09; females=-0.16, SD=1.06; P<0.01) compared to females.
Asif et al. (2015) [10]	<ul style="list-style-type: none"> - Sports psychology experts analyzed semi-structured interviews with athletes diagnosed with cardiac conditions by screening using qualitative research. 	<ul style="list-style-type: none"> - Competitive high school and collegiate athletes progress through four successive stages of psychological impact after being diagnosed with a cardiac condition by cardiovascular screening: 1) immediate reaction and challenge to athlete identity, 2) grief and coping, 3) adaptation, and 4) acceptance. - All athletes (n=25) had an overall positive attitude towards screening (including ECG) and reported that they would repeat screening and recommend it to others, despite the challenges they faced due to their diagnosis. - Risk factors associated with increased or prolonged psychological morbidity included higher level of competition (collegiate>high school), disqualification from sport (vs. temporary restriction), unanticipated outcomes, or persistent reminders of an underlying disease.
Asif et al. (2017) [5]	<ul style="list-style-type: none"> - Pre- and post-screen psychological assessments administered to evaluate experiences, health attitudes, anxiety, and impact of screening on sport (Likert scale: -2-2). 	<ul style="list-style-type: none"> - Prior to screening 4.5% were worried about having an underlying cardiac disorder and 70.1% reported they would rather know about the disorder before competition. - Athletes who screened normal (n=1098) or false positive (n=34) reported no measurable anxiety during (normal=-0.774, FP=-0.594) and after (normal=-1.054, FP=-0.750) screening. - There were no statistically significant differences in anxiety during screening across gender (male=-0.788 vs. female -0.727), race (Caucasian=-0.769 vs. African-American), collegiate athletic division (division I=-0.716 vs. division II=-0.820, vs. division III=-0.761), or sport (baseball=-0.576 vs. basketball=-0.642, cross-country/track=-0.813 vs. football=-0.861 vs. soccer=-0.721 vs. swimming=-0.671 vs. rowing=-0.855). - Athletes with false positive screening results were more concerned about potential for sports disqualification (normal=-0.734 vs. FP=0.241, p<0.001), but were significantly more likely to feel that all athletes should receive an ECG prior to athletic competition (FP=1.156 vs. normal=0.824, p<0.01) and to feel safer during athletics (FP=0.719 vs. normal=0.185, p<0.01).

Morrison et al. (2020) [6]	<ul style="list-style-type: none"> - Masters athletes diagnosed with a cardiac condition by screening were surveyed to assess experiences of psychological distress (Impact of Event Scale-Revised [IES-R] and Likert scale: 0–4). 	<ul style="list-style-type: none"> - After preparticipation screening, total IES-R scores were normal (median=2.0, [IQR 0-6.0]), with only 1 participant eliciting a significant stress reaction (IES-R=37) and none meeting the criteria for depression. - Males had significantly higher IES-R scores than female athletes (male median=3.0, [IQR 0-6.5] vs female median=0, [IQR 0-0.5]; $p=0.033$). - 93% of athletes were satisfied with cardiovascular preparticipation screening and 74.6% would recommend it to others. - 44.8% of these athletes reporting feeling safer when exercising after their screening diagnosis, whereas 26.9% felt slightly less safe. - 33% of athletes strongly feared sport restriction after their diagnosis. - 94% of participants reported that the follow-up provided was adequate to understand their diagnosis, however 72% described additional types of desired support including more time with a cardiologist (28.4%), follow-up with a general practitioner (22.4%), and/or follow-up with a dietician (16.4%).
Schurink et al (2017) [7]	<ul style="list-style-type: none"> - Masters athletes underwent a cardiovascular PPS protocol including cardiac CT. - Psychological impact was measured using the Impact of Events Scale (IES) and a Likert Scale (0–5) was used to evaluate overall experiences and impact on sports and lifestyle. 	<ul style="list-style-type: none"> - Total IES scores were normal (median=1, [IQR 0-2]), with only 1 participant experiencing clinically significant psychological distress after screening (IES sum score\geq19). - IES scores were significantly higher in participants diagnosed with coronary artery disease (CAD) compared to those who were not (CAD median=1, mean rank=175 vs no-CAD median=2, mean rank=130; $p<0.001$). - Very few participants experienced anxiety before (8.0%, 95% CI 5–12%) or during (5.0%, 95% CI 2–8%) screening involving CT scanning, and no significant differences were seen between those diagnosed with CAD and those who were not. - Participants found to have CAD were more often felt anxious directly after receiving the result (27% vs. 3.0%, $p<0.001$), were afraid of being advised to quit sports (21% vs. 3.0%, $p<0.001$) and held the opinion they were at higher risk of a cardiac condition than other master's athletes (23% vs. 4.0%, $p<0.001$). - Generally, masters athletes agreed that screening had a positive influence on sporting activities, with only 5.5% (95% CI 3.0-8.0%) disagreeing and 35% (95% CI 53-65%) holding a neutral opinion. - Majority of athletes (59%, 95% CI 53-65) felt safer exercising after screening, whereas 32% (95% CI 26-38%) experienced no difference and 9.4% (95% CI 6.0-13%) felt less safe exercising. - Those screening true positive and receiving a CAD diagnosis after screening more often felt that cardiovascular preparticipation screening was needed in master's athletes without CAD (88% vs. 68%, $p=0.007$). - The vast majority of participants were satisfied with their screening (94%, 95% CI 91-97%), would participate in screening again (95%, 95% CI 92-97%), and would recommend screening to others (93%, 95% CI 90-96%).
Solberg et al. (2012) [8]	<ul style="list-style-type: none"> - After screening, athletes completed a 10-item scale assessing their experience (Likert scale: 0–5). - Psychological distress after screening was 	<ul style="list-style-type: none"> - The degree of distress caused by cardiovascular preparticipation screening was low (median IES score=1, SD=4.8, range=0-30). - Only 2.8% of athletes experienced clinically significant psychological distress (IES sum score\geq19) due to screening. These athletes would more often recommend screening to others (100% vs. 83%, $p\leq 0.006$). - After screening, 64% of athletes reported feeling more confident when competing, 88% were happy they underwent screening, and 84% stated they would strongly recommend it to others.

	measured with the Impact of Event Scale (IES).	- 16% of athletes were afraid their screen might have consequences to their health and 13% were afraid of losing their license to play.
Tischer et al. (2016) [9]	<ul style="list-style-type: none"> - Athletes completed a questionnaire assessing stress level immediately prior to screening, immediately after screening, and 3 days after screening. - The REST-Q 76 Sport was used as a validated tool to detect stress in athletes, with each of 76 subscales scored on a Likert scale (0–6). 	<ul style="list-style-type: none"> - The majority of participants screened negative for all forms of psychological morbidity on the REST-Q Sport questionnaire after undergoing cardiovascular preparticipation screening including ECG and echocardiography. - Out of responding athletes, 88% screened negative for general stress, emotional stress, and social stress before screening and 90% screened negative 3 days after screening. - Among athletes referred for additional testing after their initial screen, these individuals reported lower levels of stress at both examination day and 3 days after. - A tendency towards a decrease in stress is observed after athletes undergo preparticipation screening, however this decrease is only statistically significant in those who screen negative.

Supplemental Table S12. Summary measures among studies reporting psychological outcomes stratified by screening result.

Psychological Outcome	Median Likert score (1 - 5) *			Number of Eligible Studies	N	Median (%)			Number of Eligible Studies	N
	N	FP	TP			N	FP	TP		
Before Screening										
Psychological distress †	1.87	1.94	-	1	1,192	7.9%	-	10.4%	1	275
During Screening										
Psychological distress †	2.71	2.78	3.29	3	3,660	5.7%	-	2.1%	1	275
After Screening										
Psychological distress †	2.18	2.06	3.36	3	3,660	3.1%	-	27%	1	275
Feel safer during sport	3.44	3.72	-	3	3,660	60%	-	54%	1	275
Positive impact on training	3.82	3.80	-	3	3,660	60%	-	63%	1	275
Satisfied with screening	4.34	4.21	3.75	3	3,660	93%	-	98%	1	275
Recommend screening to other athletes	4.32	4.35	4.46	3	3,660	92%	-	98%	1	275

* Likert scale values reported under Median Likert Score and Range of Likert Scores reflect sample mean values reported amongst each eligible study.

† Psychological distress is a composite measure describing all outcomes pertaining to athletes' self-reported distressing emotions (i.e., anxiety, worry, intrusion, fear) regarding cardiovascular preparticipation screening.

‡ Median (%) reflect the results of a single study reporting psychological outcomes stratified by screening result in proportions [4].

Supplemental Appendix A1. Detailed description of how findings of each study were modified to produce the summary measures in this review.

Summary measures (median, range) for each psychological outcome were computed across included studies. Although most studies assessed psychological outcomes using a 5-point Likert scale ranging from a score of -2 (worst) to 2 (best), some studies used a scaling system of 0 to 4 or 1 to 5, while other studies used a 6-point Likert scale ranging from 0 to 5 and or a 7-point Likert scale from 0-6. For clarity and consistency in reporting summary measures in this systematic review, the mean Likert score reported by or calculated from each study was standardized to a 5-point Likert scale ranging from 1 (worst) to 5 (best). Measures already reported using a 5-point scale were simply adjusted to range from 1 to 5, whereas measures reported on 6- or 7-point scales were adjusted to a 1 to 5 scale using previously validated methodology [11]. Among studies which did not provide a mean measurement for the cohort and instead only provided mean measurements for subgroup, an overall sample mean was produced by calculating the weighted mean amongst all subgroups in the study cohort. Due to heterogeneity in reporting amongst included studies, summary measures for both Likert scale ratings and proportions were produced.

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