The effects of acute respiratory illness on exercise and sports performance outcomes in athletes – a systematic review by a subgroup of the IOC consensus group on "Acute respiratory illness in the athlete"

Supplementary File 1: PRISMA checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2, see below for abstract checklist
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	4-5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6-9
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Online Resource File 2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	5-6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Review; no data collection
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7, see below for further details
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	8, further details below

Section and Topic	Item #	Checklist item	Location where item is reported
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	8
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Not applicable (no meta-analysis)
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	See below for details
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Qualitative, narrative synthesis
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	6-8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	See below for details
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	See below for details
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable (no meta-analysis)
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	8, see below for further details
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Not applicable
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	9, Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	See below for details
Study characteristics	17	Cite each included study and present its characteristics.	13, Table 3
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	11, Table 2 (concise) and Online Resource 3

Section and Topic	Item #	Checklist item	Location where item is reported
			(comprehensive)
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Not applicable (no meta-analysis)
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	See below for details
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable (no meta-analysis)
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	See below for details
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable (no meta-analysis)
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable (no meta-analysis)
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not applicable
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	17-20
	23b	Discuss any limitations of the evidence included in the review.	20
	23c	Discuss any limitations of the review processes used.	20
	23d	Discuss implications of the results for practice, policy, and future research.	21
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	3; 5
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Protocol can be accessed on PROSPERO
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	See below for details

Section and Topic	Item #	Checklist item	Location where item is reported
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	22
Competing interests	26	Declare any competing interests of review authors.	22
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Online Supplementary Table S1; Online Resource 2 and 3; see below for details

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

PRISMA abstract checklist:

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	Y
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Y
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Y (some) See paper for the rest
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Y
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	No, within the paper
Synthesis of results	6	Specify the methods used to present and synthesise results.	Y
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Y

Section and Topic	Item #	Checklist item	Reported (Yes/No)
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Y
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	No, within the paper
Interpretation	10	Provide a general interpretation of the results and important implications.	Y
OTHER			
Funding	11	Specify the primary source of funding for the review.	No, within the paper
Registration	12	Provide the register name and registration number.	Y

10a. List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.

Not all data from specific studies were compatible with each outcome. Originally, data were sought for sport and exercise performance outcomes relating to all types of ARill (both infective and non-infective). However, results were refined to include infective ARill (ARinf) only, and not non-infective ARill. The inclusion of non-infective ARill was deemed beyond the scope of this review, as non-infective ARill includes a comprehensive body of literature on its own, including allergic rhinitis and asthma, analysed and reported by other subgroups of the the IOC Consensus group for "Acute respiratory illness in athletes".

10b. List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.

All details of variables are in the paper. However, the assumption was made that any data that was missing or unclear was not collected.

13a. Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).

Studies were grouped based on whether they reported if ARinf had an acute (short term) or longer-term effect on sport or exercise performance. Therefore, the timing of measurements in relation to the ARinf episode determined whether studies were included in the acute (e.g. measurements conducted during an ARinf episode affecting a single bout of exercise) or longer-term (e.g. measurements over a 16-week training period) clusters for synthesis and tabulation.

13e. Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).

Qualitative sub-analysis was used to explore and adjust for heterogeneity. Data were primarily split according to whether the effect of ARinf on sport or exercise performance was acute (short-term) or longer-term. Data were then further split according to whether they reported exercise (measurable physiological parameters) or sports performance (measurements of sporting success) outcomes. The direction of change or effect was also stated (either a positive, negative, or no effect on performance).

13d. Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.

The summary approach used included the primary separation of data based on whether the reported ARinf effect on performance was acute (short term) or longer term. This distinction is important for medical, coaching and support staff involved in the care and management of athletes to understand the time-frame for which performance might be affected by an ARinf episode (e.g. during a single bout of exercise/competition/match/event, or the performance consequences of ARinf over a longer period of training and/or competing). Secondly, the data were separated and synthesised according to whether an exercise or sports performance outcome was reported, in order to understand *how* performance might be affected (i.e. which aspects of an athlete's integrated physiological response to exercise or sporting success outcomes might be impaired).

14. Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).

The domains from the modified Downs and Black tool that assessed risk of bias were (yes, no or unable to determine):

- If any of the results of the study were based on "data dredging", was this made clear?
- Were the statistical tests used to assess the main outcomes appropriate?
- Were the main outcome measures used accurate (valid and reliable)?
- Were losses of patients to follow-up taken into account?

These 4 questions were part of the quality assessment.

16b. Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.

The following articles reported the effects of acute illness in general (including ARill) on exercise or sports performance parameters, but did not separate ARill from other acute illnesses in the reporting of their results. Therefore, it could not be determined what the specific effects of ARill were, distinguished from other acute illnesses:

- Pyne DB, Hopkins WG, Batterham AM, et al. Characterising the individual performance responses to mild illness in international swimmers. *Br J Sports Med* 2005;39(10):752-6. doi: 10.1136/bjsm.2004.017475 [published Online First: 2005/09/27]
- Gordon L, Schwellnus M, Swanevelder S, et al. Recent acute prerace systemic illness in runners increases the risk of not finishing the race: SAFER study V. *Br J Sports Med* 2017;51(17):1295-300. doi: 10.1136/bjsports-2016-096964

- Raysmith BP, Drew MK. Performance success or failure is influenced by weeks lost to injury and illness in elite Australian track and field athletes: A 5-year prospective study. *J Sci Med Sport* 2016;19(10):778-83. doi: 10.1016/j.jsams.2015.12.515 [published Online First: 2016/02/04]

This review included infective ARill only. The following articles investigated the effects of ARill on exercise or sports performance parameters, but the reported ARill was non-infective:

- Sonna L, Angel K, Sharp M, et al. The Prevalence of Exercise-Induced Bronchospasm Among US Army Recruits and Its Effects on Physical Performance. *CHEST* 2001;119(6)
- Salem L, Dao VA, Shah-Hosseini K, et al. Impaired sports performance of athletes suffering from pollen-induced allergic rhinitis: a cross-sectional, observational survey in German athletes. *J Sports Med Phys Fitness* 2019;59(4):686-92. doi: 10.23736/S0022-4707.18.08556-0 [published Online First: 2018/07/17]
- Marefati H, Hossaininasab M, Aghayari A, et al. Exercise induced bronchospasm in physically fit female students of Kerman University and their pulmonary function tests. *J Bodyw Mov Ther* 2012;16(3):338-43. doi: 10.1016/j.jbmt.2011.12.002 [published Online First: 2012/06/19]

20a. For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.

This review does not include RCTs, so the bias is not as clear as in reviews of RCTs. The quality of articles, including the risk of bias, was assessed as an overall measure, validated by the outcome that no studies were rated as “poor”, and all studies were rated as “good” or “excellent” quality.

No studies were bias based on “data-dredging”, statistical measures, or unreliable outcome measures. Three studies were biased based on not reporting the “loss of patients”. No studies were biased in two domains; therefore no studies had a “high” bias.

20c. Present results of all investigations of possible causes of heterogeneity among study results.

Informal methods (i.e. no formal statistical test involved) were used to investigate heterogeneity. It was observed that the plethora of variables that qualify as exercise or sports performance outcomes, in a field of limited literature has resulted in lack of standardisation in methodology and reporting of results.

24c. Describe and explain any amendments to information provided at registration or in the protocol.

The protocol was amended by the following:
- The search period was extended by 7 months from 2019 to July 2020, due to the COVID-19-related delay of the IOC consensus meeting.
- The exclusion criteria were revised to exclude studies that only included non-infective acute respiratory illnesses.

27. Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.

- Online Supplementary Table S1: Pathological classification (main and subgroups) of acute respiratory illness (ARill) by diagnostic method.
- Online Resource 2: Search terms and results of literature search.
- Online Resource 3: Comprehensive Downs and Black Quality Assessment.