EFFECTS OF MARATHON RUNNING ON RISK OF INFECTION

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INTRODUCTION

The benefits of exercise for human health in general (1) and for the immune system in particular (2–4) are well-known. However, the hypothesis that an acute bout of strenuous exercise, such as a marathon running, increases the incidence of infection has intrigued many researchers and remains unexplored (5–7).

Intense exercise, in a periodized workout, causes generalized disturbances in physiological and immune biomarkers. It promotes transient changes in innate immune function and elevations in stress hormones, pro and anti-inflammatory cytokines (8–10). As well, acute exercise stimulates primarily NK cells and CD8+ T lymphocytes that exhibit high cytotoxicity and tissue migration potential may be linked to evidence that exposes that high training workloads, competition events, and associated physiological, metabolic, and psychological stress are linked to immune dysfunction, inflammation, oxidative stress, and muscle damage (11).

Previous studies have shown higher incidence of respiratory tract infections (RTI) in individuals after a marathon running compared to controls that did not exercise (7,12,13). However, exposure to crowded environments increases the chances of getting viral infections (14,15) and by comparing different group of individuals these studies cannot affirm that the individuals in the marathon running were not just more susceptible even before the race.

To eliminate the between subjects effects in the previous literature, previous research compared the risk of infections before and after a marathon running in the same individuals (7,13,16). Since some of them showed higher risk of RTI after the marathon, but many of them did not, there is still no consensus on the impact of marathon running on the risk of infection.

OBJECTIVES

To compare the number of infections before and after a marathon running in the same individuals by meta-analysis of the studies in the literature.

METHODS

Eligibility Criteria

The inclusion criteria were: Population, humans randomly exposed to infections by any pathogen; Intervention, a bout of acute exercise or a few bouts during or after the infection period; Comparator, a group that does not perform exercises; Outcomes, studies using the Wisconsin

Upper Respiratory Symptom Survey (WURSS) and presence or absence of infections; Study Type, controlled intervention studies only. Review studies (and other non-original studies), cross-sectional studies, and studies not written in English or Portuguese language were excluded.

Database

The search was run on PubMed/MEDLINE, EMBASE, Scopus, Web of Science, Cochrane, and EBSCOhost, with last updated on March 4, 2022.

Below we present an example of a syntax used in the PubMed/MEDLINE: ("Upper respiratory tract infection"[tiab] OR "URI"[tiab] OR "URTI"[tiab] OR "Upper Respiratory infections"[tiab] OR "lower respiratory tract infection"[tiab] OR “Wisconsin Upper Respiratory Symptom Survey”[tiab] OR “WURSS”[tiab]) AND ("swimmers"[tiab] OR "cyclists"[tiab] OR "runners"[tiab] OR "triathletes"[tiab] OR "swimmer"[tiab] OR "athlete" [tiab] OR " players"[tiab] OR "sport"[tiab] OR "Athletic Performance"[tiab] OR "elite players"[tiab] OR "athletic"[tiab] OR "sports" [tiab] OR "cyclist"[tiab] OR "runner"[tiab] OR "athletes" [tiab] OR "triathlete"[tiab]) NOT ("review" [publication type] OR "systematic review" [publication type] OR "meta-analysis" [Publication Type]))

Selection of Studies

After carrying out the systematic literature review, we extracted the studies from the databases and applied them to the Mendeley reference manager system; duplicates were removed, saved and sent to the Rayyan-Systematic Reviews system (OUZZANI et al., 2016). We analysed the articles using the Rayyan-Systematic Reviews system, again removing duplicates, excluding review studies (and other non-original studies), cross-sectional studies that were not written in English or Portuguese, that did not have exercise sessions acute, pre- and post-exercise infection and comparator group. Finally, after screening, we selected the articles that met the criteria established for the project (Figure 1).

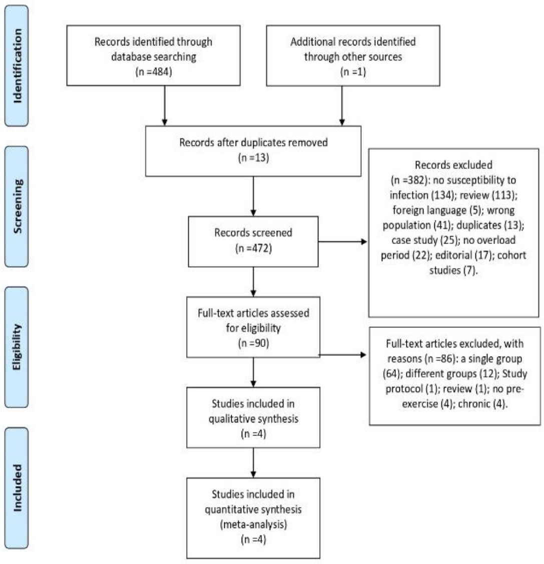

Figure 1 - *Flowchart of the results of the study selection process.*

RESULTS AND DISCUSSION

Characteristics of the studies

The main features of the analysed studies are described in table 1. The studies were performed in humans with naturally acquired RTI. The comparator subjects were the same before and after. The period in which the infection was evaluated was, on average, 15 days before and 15 days after the exercise performed.

Summary of results

In summary, the value of post-race infectious episodes was not significantly different from the pre-race incidence of infectious episodes (OR 1.097 [0.973; 1.238], P = 0.131 (Figure 2). Thus, there is no evidence that exercise increases the risk of RTI after prolonged and exhausting exercise.

***Table 1**. Characteristics of the Studies.*

First Author, Year	N.° sample size ; Age; Sex	Period that evaluated pre and post	Type of infection
Nieman, 2002	98; age 21-72 years; M/F	15 days before the race and 15 days after	RTI
Ekblom, 2006	1694; age 29-59 years; M/F	3 weeks before the race and 3 weeks after	RTI
Peters, 2010	14; age 39-40 years; M	4 weeks pre-race and 2 weeks post-race	RTI
Nieman, 1990	2002; age 29-59 years; M/F	3 weeks before the race and 3 weeks after	RTI

Legend F: Female; M: Male; N.°: Number; RTI: Respiratory Tract Infections

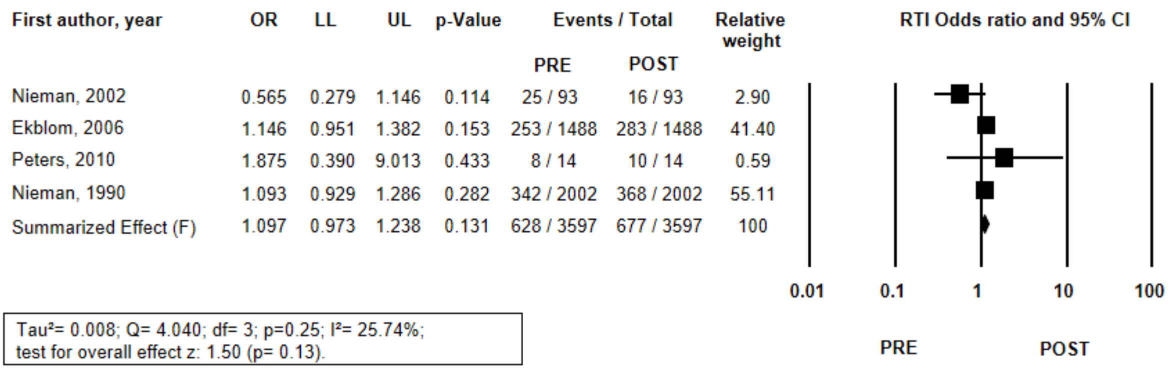

***Figure 2** - Forest Plot; CI: confidence interval; df: degrees of freedom; F: fixed effect; I2: percentage of inconsistency between studies; LL: Lower limit; OR: Odds ratio; Q: true heterogeneity; RTI: Respiratory Tract Infections; UL: Upper limit.*

The high frequency of recurrent respiratory infections following exhaustive competitions in athletes prompted this study to examine the effects of intense and prolonged exercise on susceptibility to infection. Studies state that NK cell and neutrophil function, various measures of T and B cell function, salivary IgA output, delayed-type hypersensitivity skin response, increased expression of histocompatibility complex II in macrophages, and other biomarkers of immune function can be altered for several hours may last during recovery from prolonged exercise (11,17). They hypothesize that especially intense exercise increases susceptibility through a transient depression of mucosal immunity following temporary exercise-induced changes in cortisol, leukocyte, and cytokine concentrations. Furthermore, analyses support that the metabolic capacity of immune cells is decreased during recovery from physiologically demanding exercise such as acute exercise, resulting in transient immune dysfunction (18–20).

In fact, studies have shown higher incidence of RTI after a marathon running (7,12,13); however they compared the post marathon athletes to controls that did not exercise. Here, by removing the between subjects' effects comparing same individuals before and after the marathon we confirmed there was no higher chance of RTI after the race.

CONCLUSION

Marathon running do not increase the risk of subjects acquiring RTI and likely, this myth has been diffused by studies that compared different individuals and did not isolate other confounding factors from the marathon effect. Likewise, there was no difference between women and men in the analysed studies (7,13,21–23). In any case, to strengthen this conclusion, future studies should test randomized control trials before and after marathon, considering the other confounding factors as dietary changes and other triggers to the immune system.

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