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LETTER TO THE EDITOR

How should we study the impact of professional sport on female longevity?

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We read with great interest the recent article by Altulea et al. [1], which presents a large observational analysis of the association between professional sports participation and longevity among international athletes. The authors are to be commended for assembling a uniquely extensive dataset across multiple historical periods and sport categories, addressing a question that remains underexplored despite its relevance to public health, aging research, and sports science. Studies directly comparing the lifespan of elite athletes with that of the general population in a sport-specific and sex-stratified manner are rare, making this work an important contribution to the field.

The main findings in men are largely intuitive and biologically plausible. Male athletes across many sports tend to live longer than the general population, consistent with the benefits of long-term physical activity, superior cardiorespiratory fitness, and favorable metabolic profiles. Conversely, reduced longevity among athletes in boxing, martial arts, mountaineering, and sumo wrestling is expected, reflecting cumulative trauma, extreme body mass requirements, and elevated cardiometabolic risks. These results highlight the long-term health consequences of certain high-risk or weight-dependent sports, while underscoring the overall positive impact of athletic participation on lifespan in men.

What particularly captured our attention were the sex-specific findings in female athletes. Unlike men, a longer lifespan was observed only in women competing in golf and racquet sports (tennis and badminton), while women in swimming, skiing, sprinting, mixed track and field, cricket, table tennis, and basketball had a shorter lifespan compared with the reference population. These results are striking, not least because they could be misinterpreted by readers beyond the scientific community. Without careful contextualization, one might wrongly conclude that intensive sport participation is harmful to women's health or that certain sports should be avoided to preserve longevity. Careful interpretation is therefore essential, emphasizing possible explanations for these patterns rather than drawing premature conclusions.

Altulea et al. [1] acknowledge that the small sample size of female athletes limits the ability to draw definitive conclusions regarding the association between elite sport and lifespan, and they discuss

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potential reasons why women may not exhibit the same longevity benefits as men. We additionally wish to highlight other relevant confounding factors and emphasize the importance of considering these in future research, with the aim of better understanding the complex interplay between biological, lifestyle, and sport-specific factors in shaping female athletes' long-term health outcomes.

First, selection into professional sport is not random, and this is particularly relevant for women. Elite athletes typically possess biological traits that confer competitive advantages, such as tall stature or elevated testosterone levels. While these traits enhance sporting performance, they are also independently associated with health outcomes and mortality. In many sports, such as swimming, sprinting, volleyball, handball, ice hockey, cricket, and basketball, tall stature is often a key selection criterion. However, there is evidence that taller athletes tend to have shorter lifespans than their shorter counterparts within specific sports [2]. This association can be partly explained by increased cancer mortality in taller people [3] and, in some cases, by conditions such as polycystic ovary syndrome and hyperandrogenism, which are often associated with tall stature [4]. Naturally high testosterone levels or hyperandrogenism may enhance performance in certain sports [5, 6] but can also increase the risk of metabolic disturbances that compromise long-term health [7]. From this perspective, comparisons between female athletes and the general population would ideally be conducted using height-matched reference groups rather than unadjusted population averages. In addition, testosterone levels and the presence of hyperandrogenism should be considered when evaluating health outcomes and longevity in female athletes in well-controlled studies.

Second, the professional sporting environment for women is frequently characterized by prolonged and strenuous training combined with low energy availability, commonly conceptualized within the framework of relative energy deficiency in sport. If training and nutrition are not appropriately managed, when sustained over time, especially in combination with psychological stress, this state may lead to chronic elevations in cortisol, suppression of gonadotropin secretion, menstrual dysfunction, and persistently reduced estrogen levels [8]. Given the well-established cardioprotective, skeletal, metabolic, and anti-inflammatory effects of estrogens, long-term hypoestrogenism may plausibly increase the risk of cardiovascular disease, osteoporosis, fractures, immune dysfunction, mood disorders, chronic inflammation, and ultimately premature mortality [9]. Such mechanisms may be particularly relevant for women competing in sports emphasizing leanness, endurance, or repeated high training volumes.

Finally, the apparent positive association between longevity and participation in golf and racquet sports among women deserves careful contextualization. Both golf and tennis are commonly associated with higher socioeconomic status, given the costs of equipment, facilities, coaching, and club membership. Higher socioeconomic position is itself a powerful predictor of longevity, reflecting advantages in nutrition, healthcare access, health literacy, and living conditions [10]. Consequently, it remains unclear whether the observed survival benefit reflects the physiological effects of these sports, the social and economic environments surrounding them, or a combination of both. Adjustment for socioeconomic status is therefore essential before attributing longevity differences to sport type alone.

Taken together, the findings of Altulea et al. [1] highlight the complexity of studying longevity in female professional athletes. To determine more definitively how elite sport influences women's lifespan, while acknowledging that conducting such studies is methodologically challenging, future research will require larger samples and a broader consideration of confounding factors, including stature, training characteristics, hormonal profiles during and after athletic careers, menstrual and reproductive history, exposure to relative energy deficiency, psychosocial stress, lifestyle behaviors, use of performance-enhancing substances, and socioeconomic status. Only such multidimensional approaches will allow disentangling the effects of sport itself from the biological and social characteristics of elite athletes.

In conclusion, we thank Altulea et al. for providing a rich, thought-provoking dataset and for stimulating discussion on sex-specific associations between sport and longevity. Their study is an important step forward and lays the groundwork for more refined future analyses, helping ensure that interpretations remain balanced, nuanced, and supportive of both scientific progress and public understanding of physical activity and healthy aging.

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Declarations

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