

HEALTH AND FITNESS OF HANDBALL REFEREES

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INTRODUCTION

Handball is a fast-paced, intense sport that demands peak physical and mental performance from its players. However, often overlooked are the individuals who play a crucial role in ensuring fair play and enforcing the rules – the referees. In the dynamic world of handball, referees face unique challenges that demand exceptional health and fitness levels to excel in their roles.

At a handball match, two equal referees contribute to the game with dynamically changing functions. In each offense, one referee is considered the court referee, while the other is the goal referee. These positions automatically switch with ball turn-over, such that the two referees are exposed to a similar physical load during the match and therefore need identically good fitness levels.

As there are many levels of matches, from regional friendly matches to the world championship, the referees need to obtain satisfactory physical fitness for the given load of the games to which they contribute. Most currently available studies focus on the top-level referees as they are exposed to the most significant physical and mental strain during the games. To achieve the required fitness and routine for a top-class game, the referees have to practice and officiate games regularly for years in order to rise through

the ranks and be able to lead even the most difficult matches.

The International Handball Federation (IHF), the major organization of handball, states in their regulations for IHF referee courses, that beyond the rule- and video tests, medical fitness should be reviewed, and physical testing should be performed¹.

PHYSICAL DEMANDS OF THE REFEREES DURING THE GAME

Handball referees must possess a high level of physical fitness to keep up with the rapid pace of the game. Unlike many other sports, handball referees are constantly moving, covering significant distances on the court to maintain proper positioning and make accurate calls. The sport's quick transitions from defense to offense and vice versa require referees to be agile and responsive.

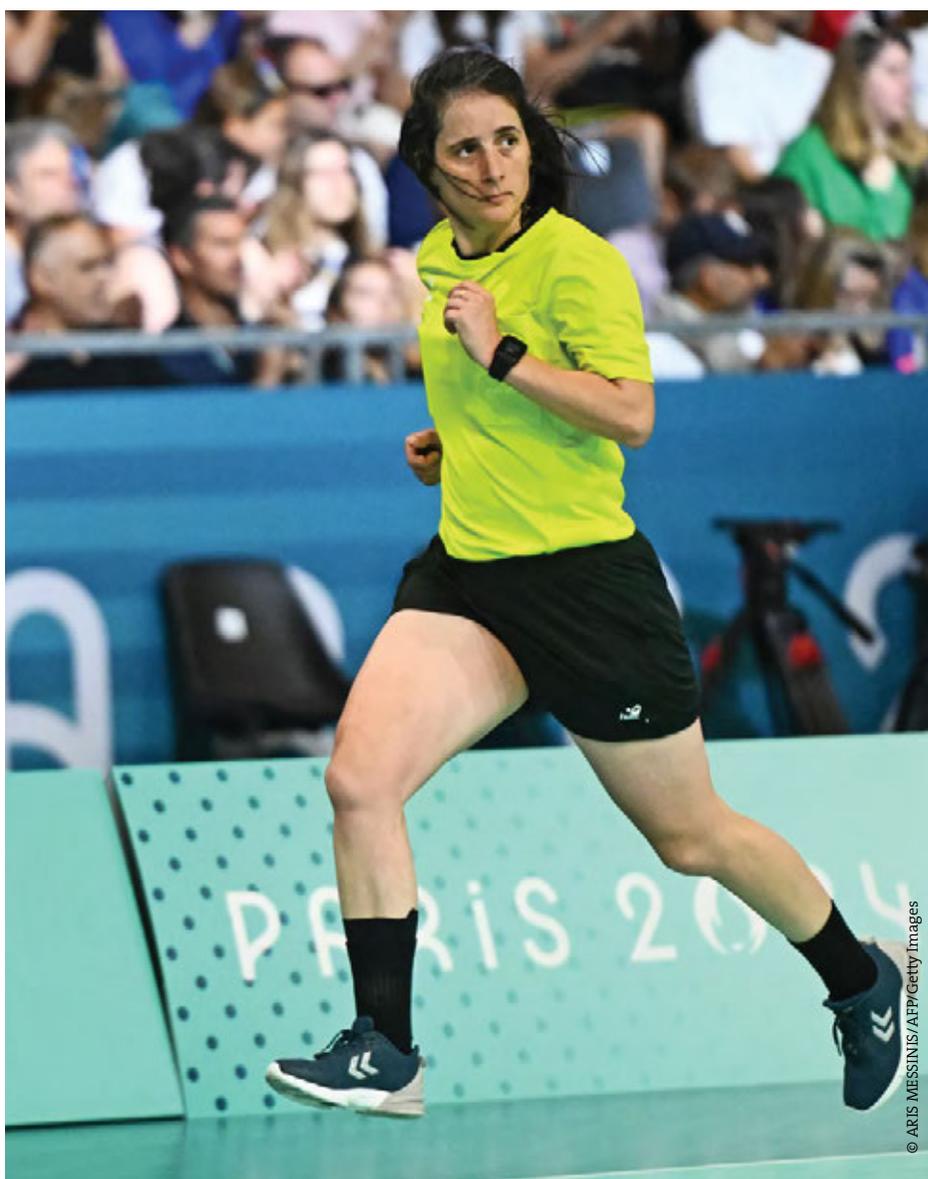
Moreover, handball matches can be physically demanding, lasting up to an hour or more, during which referees must maintain focus and concentration without any breaks. Referees, tasked with maintaining proper positioning and making split-second decisions, are constantly on the move throughout the match. This prolonged physical exertion necessitates endurance and stamina to ensure consistent decision-making during the game.

The perceived physical load could significantly influence the decision-making

during the games. Most calls need to be immediate, except for a few cases where video assistance is available. To simulate the in-game physical stress and decisions, a German research group conducted a study to examine the referees' decision-making during an interval running test with video tests. Interestingly, the referees achieved similar or better results in decision-making at medium load compared to the initial resting results. However, the correctness of the decisions decreased at maximal intensity. Therefore, with good physical fitness, the referees could perform better under the same load².

There were some studies where the physical demands of the referees were examined during the matches. In these examinations, the referees spent most of the time in a moderate-intensity heart rate zone. These measurements showed that the referees were only less than 2% of the game in the maximal zone^{3,4}. In terms of the average and maximal heart rates, no significant differences were found in previous studies among the first- and second halves⁵.

Also, the pace and distance covered during the match suggest that the referees are exposed to moderate-high intensity, mixed physical load. In previous measurements, the referees traveled around 4-5 kilometers, mainly at lower speeds during the games,



Illustration

but they had to achieve a maximal speed of 20 km/h in some situations⁶. These distances, covered by the referees during the games, were comparable to the athletes^{7,8}.

However, these results suggest that while the referees can largely perform without excellent physical fitness, in intense game situations, mostly occurring during the fastest and most demanding parts of the matches, the referees need to follow the game properly and make the right decisions. These important match moments require very good physical fitness. The need for rapid recovery between intense bursts of activity further compounds the cardiovascular strain experienced by handball referees. Unlike players who rotate on and off the court, referees must maintain continuous engagement throughout the match, leaving

limited time for rest and recovery. Also, with lower fitness, the recovery could take longer, accordingly, the fatigue from these situations endures and could impact their decision-making and increase injury risk.

PHYSICAL STATUS OF THE REFEREES

One of the primary physical attributes required of handball referees is endurance. Refereeing a handball match is not a leisurely stroll; it's a continuous, high-energy endeavor. Endurance training, including cardiovascular exercises and interval training, is crucial for referees to meet the demands of the game and maintain performance levels over extended periods. Agility drills, footwork exercises, and reaction time training are essential to a referee's physical preparation.

The referees need to accomplish multiple physical tests during a season, usually in pre-season and mid-season as well. These tests are generally either the 12-minute continuous running Cooper test or the 20-meter multi-stage fitness test. With the Cooper test the endurance fitness can be measured well, while with the shuttle run test the basic endurance and the aerobic and anaerobic thresholds could also be determined. These multi-stage fitness tests also better imitate the load of a handball game, with higher speeds and the need for accelerations, decelerations, and fast direction changes. While laboratory tests will give more accurate estimations of the parameters, the applicability of these and other field tests make them more relevant to most settings.

Considering the effect of age, younger referees were compared to more experienced referees, and in terms of motor and functional capacities, no significant differences were found between the groups. However, the younger referees achieved higher maximal oxygen uptake on a treadmill cardiopulmonary exercise test; the older referees had better seasonal grades regarding the overall quality of refereeing⁹. In other studies, similar maximal oxygen uptake was measured in elite handball referees, with averages ranging around 42-48 ml/kg/min^{3,10,11}. These values are generally lower compared to the results of handball players^{7,8}.

In a comprehensive study, the top one hundred referees were examined in Hungary and set against by the league they work in. The first divisional referees were older, possibly due to the experience needed to officiate a game for the best teams. Interestingly, the maximal oxygen uptake did not differ significantly in the two groups. However, there was significant individual variance in fitness among the referees. On the same incremental effort uphill running protocol, the most aerobically fit male referee achieved nearly 3.5 times more running time than the least fit male referee. In terms of the maximal oxygen uptake, there was a 37 ml/kg/min difference between the highest and lowest values¹⁰.

These huge individual differences could impact the quality of refereeing. Therefore, proper training planning and individual exercises should be prescribed to the handball referees to achieve the necessary fitness levels for even the most challenging

games and provide a balanced quality in refereeing among the different referees.

HEALTH STATUS OF THE REFEREES

Handball referees are exposed to various cardiovascular risk factors, and understanding these is crucial for safeguarding the health and well-being of referees. It is essential to remember that any sports activity, including handball refereeing, carries inherent risks of sudden cardiac death, and unfortunate incidents can occur during refereeing or gameplay. Previous studies showed that with proper preparticipation screenings, the incidence rates of sudden cardiac death could be significantly lowered in competitive and leisure athletes¹². Since the referees perform regular physical activity, train regularly, and contribute to high-intensity sports events, they can be considered athletes. However, we do not have guidelines for screening referees; in some countries, for example in Hungary, preparticipation screening is obligatory for handball referees to take part in games¹³.

Cardiovascular risks

Outside of officiating matches, handball referees may lead sedentary lifestyles, particularly if officiating is not their full-time occupation. Prolonged periods of sitting or inactivity can contribute to poor cardiovascular health, including an increased risk of obesity, hypertension, and metabolic disorders. Also, it is essential to highlight that the referees are usually older than the athletes they are officiating,

thereby more health issues may arise in their case. A broad examination of elite handball referees found that 13% were overweight or obese. In 3% of the referees, new antihypertension treatment was indicated, or the previous therapy was modified due to elevated blood pressure¹⁴.

Furthermore, lifestyle factors such as smoking, poor dietary habits, and inadequate sleep can further exacerbate cardiovascular risk. As per the previously mentioned study, more than a fifth of the referees were smoking, and 41% had dyslipidemia. Together, for 58% of them, lifestyle changes were advised. In one referee, non-significant coronary artery atherosclerosis was also revealed. Coronary artery diseases with strenuous physical activity could lead to myocardial infarction and sudden cardiac death, therefore early recognition and optimal medical therapy started on time is crucial in these conditions.

In the case of referees, many medical conditions impairing physical performance could occur, as in elite athletes. These conditions could be, for example, iron deficiency, which could be observed in more than one-fifth of the referees and was more frequent among the female referees.

All these factors could elevate the risk of a fatal cardiovascular event. Therefore, proper screening, treatment, and follow-up of these conditions are necessary to maintain the good health of the referees.

Injuries

Besides the cardiovascular risks, in addition to the demands of the game itself, handball

referees are susceptible to injuries while officiating matches. Quick directional changes, abrupt stops, and the potential for collisions with players pose inherent risks to referees on the court. Therefore, it is essential for referees to engage in regular strength and conditioning exercises to minimize the likelihood of injuries.

Not surprisingly, the most common injuries are ankle and knee injuries among the referees, and these incidents are more frequent during training. The mechanisms were mainly during changing rapid direction, during sprints, or due to physical contact with a player or with the ball. Most of these injuries impacted their everyday life; in 72% the regular refereeing was also affected. More than 10% of these injuries needed surgical interventions. Also, one-third of the referees reported sport-related pain in a one-year period, 37% of the referees officiated at matches despite the pain, and more than one-tenth did it regularly. Altogether, 2.6 injuries per 1000 training hours were reported among the referees, whereas an even higher ratio, 11.6 injuries per 1000 match hours, was reported¹⁵.

Furthermore, proper warm-up routines and flexibility exercises are crucial to prepare referees' bodies for the physical demands of officiating a handball match. Strength training, focusing on core stability, lower body strength, and upper body strength, can help referees maintain stability, prevent injuries, and withstand physical challenges on the court. By maintaining optimal physical conditioning and adopting injury prevention strategies,

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referees can minimize the risk of sidelining injuries that could compromise their ability to officiate effectively.

Fluid and energy consumption

Proper nutrition and hydration are essential components of maintaining the health and fitness of handball referees. Referees must fuel their bodies with nutritious foods to sustain energy levels throughout the duration of a match. Consuming a balanced diet rich in carbohydrates, proteins, and healthy fats can provide referees with the necessary nutrients to support physical performance and mental acuity. Previous studies examined the average energy expenditure of a handball game from the view of a referee, and on average, 1000 kilocalories of energy was necessary for officiating a game⁴.

Additionally, staying adequately hydrated is crucial for referees to prevent fatigue and maintain cognitive function during matches. Dehydration can impair decision-making abilities and physical performance, underscoring the importance of prioritizing hydration before, during, and after officiating a handball match. The referees should consume small amounts of fluids (water or isotonic drinks) to prevent dehydration during the time-outs and the half-time break.

MENTAL FITNESS

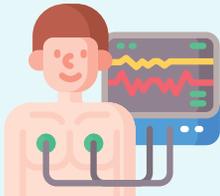
In addition to the physical demands, handball referees face considerable mental strain and stress during matches. Officiating a high-stakes match requires strong decision-making abilities, clear communication skills, and the capacity to remain calm under pressure. Referees must possess a comprehensive understanding of the rules and regulations of handball to interpret and apply them accurately during gameplay.

Moreover, referees often face intense scrutiny and criticism from players, coaches, and spectators, adding another layer of mental pressure to their role. Therefore, resilience and emotional intelligence are invaluable traits for referees to navigate challenging situations and maintain control over the match^{16,17}. Chronic exposure to stress and psychological strain has been linked to an increased risk of cardiovascular disease, highlighting the importance of managing stress levels among referees.

TAKE HOME MESSAGES



Regular Physical Activity
Encouraging referees to engage in regular physical activity outside of officiating matches can improve cardiovascular fitness and reduce the risk of cardiovascular diseases and injuries.



Regular Health Screenings
Implementing regular health screenings and cardiovascular assessments for referees can help identify underlying risk factors and facilitate early intervention and management.



Stress Management Techniques
Providing referees with tools and resources to manage stress effectively, such as relaxation techniques, mindfulness, and mental resilience training, can help mitigate the negative impact of psychological strain.



Healthy Lifestyle Promotion
Educating referees about the importance of maintaining a healthy lifestyle, including balanced nutrition and smoking cessation, can empower them to make positive lifestyle choices that support cardiovascular health.

Due to these mental stress of the referees during the games, this kind of profession may only be suitable for some. Research among German elite handball referees showed significantly higher conscientiousness, extraversion, agreeableness, and lower negative emotionality domains compared to the general population¹⁸. These personality domains showed similar patterns among the amateur German handball referees, but the values were closer to the general population results¹⁹. The players and the coaches both consider conscientiousness as an important personality trait for a referee. Surprisingly, neither the players nor the coaches believed that the agreeableness of the referees was very important for officiating the games²⁰.

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