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Asymmetry in body composition in female hockey players

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ABSTRACT

The aim of the study was to determine if a sport in which one side of the body is dominant, like field hockey, influences regional body composition and bone mineral density (BMD) distribution in particular body segments, and whether the sporting level is a determining factor. Dual energy X-ray absorptiometry (DXA) method (Lunar Prodigy Advance; General Electric, Madison, USA) with the whole body scan was used to measure bone mineral density, fat mass and lean mass in 31 female field hockey players divided according to their sporting level. The morphological asymmetry level was assessed between two body sides and body segments in athletes from the National Team ($n = 17$) and from the Youth Team ($n = 14$) separately and between groups.

Bone mineral density in the lower extremity and of the trunk was significantly asymmetric in favor of the left side in the National Team. In the case of the Youth Team, only the trunk BMD indicated clear left–right difference with left side dominance. Both the lean mass and fat mass values were relatively higher on the left side of all body segments and it related to both analyzed groups of athletes.

The present study shows that playing field hockey contributes to laterality in body composition and BMD and that the sporting level is a determining factor. In most cases the left side dominated. A greater asymmetry level was observed in more experienced female field hockey players.

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Introduction

The asymmetry in the human body has been studied for a long time and its many aspects have been of interest to the representatives of many scientific disciplines, e.g. anthropology, physiology, anatomy, neurology and sport. It has been shown that within the internal structure of the body deviations from bilateral symmetry occur and result in asymmetry of internal organs, both paired and unpaired, reflected in differences in their size, shape, position, build and function (Bergman, 1993). Humans are characterized by cross asymmetry which is reflected in greater dimensions of the right upper extremity and – in terms of many dimensions – left lower extremity. This is related to the fact that more frequent use of the upper right (dominant) extremity determines more frequent use of the lower left extremity in order to maintain balance or to use force more effectively, which manifests in greater circumferences of extremities which are more frequently used (Wolański, 2005).

The asymmetry in dimensions of upper and lower extremities was shown in many studies. According to some authors (Munter, 1936; Tomkinson et al., 2003; Ulijaszek and Mascie-Taylor, 2005) upper extremities present a greater morphological asymmetry compared to lower extremities, with dominance of the right side. On average, the right arm and forearm are longer and their circumferences are greater. The left hand is longer and narrower. The right upper extremity is longer by approx. 10 mm compared to the left one. The left foot is longer, and the circumferences of the thigh, lower leg and ankle of the left lower extremity are greater (Malinowski, 2004), as well as the length of the left lower extremity compared to the right one (Singh, 1970; Wolański, 1962).

According to some studies, the development of the right and left body sides is determined by genetic and environmental factors (Al-Eisa et al., 2004; Livshits and Smouse, 1993). Bergman et al. (1962) drew similar conclusions, and according to them a significant part in the development of asymmetry is played by genetics (heredity). However, the asymmetry may increase due to functional factors, e.g. work or training (Bergman et al., 1962). Asymmetry is one of the phenomena which plays a very significant part in sports training, and its smaller or greater extent is determined by factors including the unique nature of a given sports discipline. There are many studies that confirm its existence in this area (Starosta, 1990; Dorado et al., 2002; Auerbach and Ruff, 2006).

Some authors have reported that the level of body composition changes according to specific physical activity (Fornetti et al., 1999; Nindl et al., 2000; Greene and Naughton, 2006). It appears that a long-term preference of one extremity, e.g. the left hand and left leg, similar to a permanent tendency to turn in a given direction when rotating round the long body axis, may lead to asymmetry manifested in morphological characteristics, which as a consequence may affect the volume of bone mass in competitive athletes (Starosta, 2008). It has been shown that asymmetry is greater in the dominant extremity due to its more frequent use in the majority of activities performed during the day, which in turn leads to greater bone dimensions in this body segment (Chilibeck et al., 2000).

According to Duncan et al. (2002) osteogenic response is related to the type of exercise which could lead to different values of bone mineral density (BMD) at different sites, while strength-based and high-impact sports seem to be associated with higher BMD. Non-weight-bearing sports have, in turn, neutral or negative relationships (Egan et al., 2006).

Field hockey is a unilateral sports discipline with heavy demands on the athlete's physiology (Reilly and Borrie, 1992). Whereas in most sports disciplines it is possible to choose the better limb to perform a movement (such as kicking a ball by a soccer player or an attack by a volleyball player), in field hockey athletes have to adapt themselves to the specific demands of the sport. This one-side dominant sport is characterized by very rigorously specific rules relating to holding the hockey stick and hitting the ball, which has an impact on body posture of the players, which is very unnatural. Moreover, every action with a stick and ball is generally carried out with the body performing a turn to the left (Kerr and Ness, 2006; McLaughlin, 1997).

There are limited data concerning the BMD and body composition of female field hockey players (Calo et al., 2009; Sparling et al., 1998; Wassmer and Mookerjee, 2002) and, to our knowledge, no studies examining side-to-side differences in BMD, fat and lean body mass in female hockey players have been carried out.