Implications for an eating disorder on bone health in rhythmic gymnasts

Heajung Suh*

Institute of Education, Konkuk University, Seoul, Korea

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ABSTRACT

Rhythmic gymnastics (RG) is an aesthetic sport. An eating disorder in RG athletes can lead to a decline in sports performance and impair health. This review addresses the implications of an eating disorder on bone health in RG athletes. In general, RG athletes have poor energy intake compared to their energy expenditure, which can lead to Ca intake deficiency or low estradiol levels. Additionally, RG is a weight-dependent sport and requires a graceful physique such as for ballet. Therefore, eating disorders among RG athletes have become a concern. Nutritional information and knowledge are important for bone health and for preventing eating disorders in RG athletes.

Keywords: rhythmic gymnastics, bone mineral density, eating disorder

INTRODUCTION

Rhythmic gymnastics (RG) has been an Olympic female sport since 1984 and is one of the most stressful sports. Many athletes including those competing in RG reduce their body weight to improve performance. Therefore, some athletes repeat body weight gain/loss cycles several times [1].

The recent rise in RG participation has increased investigations into anthropometry, motor skills, and visual-motor proficiency as predictors of female attainment in RG [2-4]. Many factors such as technical skills and different physiological factors may influence gymnastics performance [5]. Leaping ability is an essential component of RG performance [6]. Previous reports have shown that power and body composition are predictors of jumping ability [7]. Muscle strength and leaping ability are positively affected by low body fat [8].

Loss of body weight can lead to an imbalance in energy intake and expenditure. A positive correlation exists between dietary energy intake and the intake of essential nutrients including protein, carbohydrates, vitamins, and minerals [1]. In fact, nutritional surveys have shown suboptimal calcium, iron, and zinc intake in elite RG athletes [9]. The aims of the present study were to review bone density and eating disorders in RG athletes.

BONE DENSITY

Growth is a critical time for bone mass accrual [10]. Bone mass gain in the lumbar spine and femoral neck in females is particularly marked at 11-14-years-of-age, but the increase falls dramatically 2 years after menarche [10,11]. Bass et al. [12] reported that the increase in femoral neck and lumbar spine bone mineral content between the ages of 7 and 17 years reaches 50-150% due to increased bone size. However, many adolescent athletes have delayed menarche and develop menstrual disorders such as oligomenorrhea and amenorrhea [13,14] associated with an estrogen deficit known to have a deleterious effect on bone density [10].

Maïmoun [10,15] et al. reported that bone mineral content and bone mineral density (BMD) increases throughout growth in young female RG athletes, particularly between Tanner stages II and IV, with variable bone accretion time lags depending on the bone site.

In contrast to low or moderate intensity exercise, participation in elite artistic gymnastics (AG) and RG may result in a more favorable skeletal response due to the high
carefully suggested that this positive relationship between bone formation by inhibiting bone resorption. That study the reproductive system but also plays a significant role in Estradiol is not only a vital determinant for development of significantly related to estradiol levels only in RG athletes. [29]. BMD at the femoral neck and lumbar spine are controls after adjusting for age, body height, and body mass but not in sprinters, swimmers, cross-country skiers, or protein-3 molar ratio remained significant only in RG athletes like growth factor-1 (IGF-1) and the IGF-1/IGF binding weight could affect BMD [28].

Ballet dancing is similar to RG from an anthropometric aspect such as body mass index. Muñoz et al. reported that bone age is delayed 2 years and mean age at menarche was 15.0 years in RG athletes and 13.7 years in ballet dancers, compared with 12.5 years in controls [14]. Trochanteric and femoral neck BMD is significantly higher in RG athletes compared with that in ballet dancers and controls. However, forearm (non-loaded zone) BMD significantly decreases in RG athletes, ballet dancers, and controls. No difference in daily dietary calcium intake or levels of bone alkaline phosphatase and amino-terminal propeptide of procollagen I were observed, but the carboxy-terminal telopeptide of the collagen/creatinine ratio, a marker of bone resorption, increases in RG athletes. Therefore, they suggested that the decreased bone mass in RG athletes could be partially explained by an increase in bone resorption. Daly et al. [27] reported that during training RG athletes experience frequent high impact stress on the upper and lower extremities. These results mean that weight-bearing exercise during the pre- and peri-pubertal period may enhance mechanical competence of the skeleton [14,27]. It also suggests that BMD heterogeneity may be explained by the direct mechanical effects of weight bearing at weight-bearing sites, so exercise as well as body weight could affect BMD [28].

Gruodyte et al. reported that among BMD variables, insulin like growth factor-1 (IGF-1) and the IGF-1/IGF binding protein-3 molar ratio remained significant only in RG athletes but not in sprinters, swimmers, cross-country skiers, or controls after adjusting for age, body height, and body mass [29]. BMD at the femoral neck and lumbar spine are significantly related to estradiol levels only in RG athletes. Estradiol is not only a vital determinant for development of the reproductive system but also plays a significant role in bone formation by inhibiting bone resorption. That study carefully suggested that this positive relationship between estradiol levels and BMD is due to lower BMD in RG athletes who had low estradiol levels, indicating that low estradiol level could lead to decreased BMD. Therefore, a low estradiol level should be avoided to prevent low BMD in RG athletes.

Hwang et al. reported that average daily intakes of energy, protein, and calcium were 67%, 76%, and 45% of the Recommended Daily Allowances (RDA) for Koreans, respectively, in Korean adolescent RG athletes, [30]. The American Academy of Pediatrics recommends that adolescents ingest 1,200-1,500 mg of calcium/day with 400 IU vitamin D to achieve peak bone mass [31]. Therefore dietary calcium intakes are insufficient in Korean adolescent RG athletes, considering that the dietary calcium RDA for Korean is 1,000 mg per day. Consequently, RG athletes should be educated and encouraged to eat adjusted and balanced diets to enable optimal calcium utilization [32].

EATING DISORDERS

Abnormal eating behaviors and eating problems have been demonstrated through the development of specific terms including weight cycling, anorexia athletica, and the female athletic triad [33-37]. There is a continuum of disordered eating ranging from energy balance and healthy body image to clinical eating disorders such as anorexia nervosa and bulimia nervosa.

The social psychology and sports psychology literature shows that disordered eating develops from a complex interaction between personal and contextual factors [38]. Elite athletes often embody the concept of physical perfection [33]. However, not all athletes have a de facto perfect body, or they have a subjective feeling that their bodies are adapted to the optimal paradigm for their specific sport [33]. Those athletes often experience pressure to achieve this ideal body type [34]. Athletes are constantly being evaluated by coaches and officials on a daily basis [33,34]. These factors could lead to inadequate dieting, use of eating disorder behaviors, and the development of a severe eating disorder [33].

Research has shown that the prevalence of eating disorders is only slightly higher among athletes (combining all sport types and performance levels) when compared with the normal population [39-41]. High rates of eating disorders occur in elite-sports where results depend on judge’s opinions and an aesthetic evaluation, as in RG, figure skating, high diving, and dancing [38,42].

Eating disorders are behavioral syndromes associated with considerable morbidity and present with one of the highest mortality rates among mental illnesses [43]. This clinical