Original Article

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Analysis of Association between Obesity and Musculoskeletal System Outcomes in Children and Adolescents: An Institutional Based Study

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Abstract

Background: The identification of an elevated fracture risk in obese children has prompted an examination of the interplay between adipose tissue, bone health, and the effects of obesity on skeletal maturation. Hence, the present study was conducted to analyze association between obesity and musculoskeletal system outcomes in children and adolescents. **Materials & Methods:** A total of 50 obese children (study group) and 50 non-obese healthy children (Control group) were enrolled. Complete demographic and clinical details of all the patients were obtained. All participants in the study were aged between 8 and 16 years. Arthrometric measurements for each subject were documented. A comprehensive assessment of the musculoskeletal system was conducted, incorporating various screening techniques for musculoskeletal disorders in children. This assessment included evaluations of range of motion (ROM), the timed up and go test (TUG), and the standing time on one leg (STOOL) tests. Data analysis was carried out using SPSS software, employing the Chi-square test and Student's t-test to determine the significance levels. **Results:** Mean age of the subjects of the study group and control group was 12.3 years and 11.7 years respectively. There were 31 males and 19 females in the study group while there were 28 males and 22 females in the control group. Significantly better results of STOLL test and TUG test were seen among control group. Also, while comparing the range of motion among the non-obese and obese groups, subjects of the non-obese group showed better shoulder flexion, elbow flexion, wrist flexion, knee flexion and foot flexion. **Conclusion:** Obesity and overweight represent significant global health challenges that particularly impact children and adolescents. Excess weight during these formative years can profoundly affect the health and overall well-being of young individuals, potentially leading to chronic health issues such as musculoskeletal pain and dysfunction of bones and joints in adulthood.

Keywords: Obesity, Musculoskeletal, Children.

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Introduction

The identification of an elevated fracture risk in obese children has prompted an examination of the interplay between adipose tissue, bone health, and the effects of obesity on skeletal maturation. Initial research indicated that, despite a heightened risk of fractures, obese children tend to possess greater bone mass. However, when adjustments for body size were made to account for the significant variability among children, it became evident that obese children exhibit lower total body and regional bone mass in relation to their body size. Recent advancements in skeletal imaging techniques have shifted the emphasis from merely quantifying bone mass in obese children to assessing alterations in bone microarchitecture, which are critical for understanding bone quality and strength.[1, 2]

Evidence suggests that the strength of the appendicular skeleton does not adequately adapt to increases in body size, leading to a disparity between bone strength and the forces exerted during falls. Furthermore, emerging research highlights the distinct effects of various fat depots on skeletal development; for instance, visceral fat may negatively influence bone health due to its association with a detrimental metabolic environment, whereas marrow adipose tissue may independently affect the development of trabecular bone in obese children.[3] The recent focus on brown adipose tissue has revealed differences in its impact on bone mass compared to white adipose tissue. Additionally, obesity alters the secretion of growth and pubertal hormones, as well as the release of adipokines, which collectively influence bone development. This hormonal shift offers valuable insights into the skeletal changes observed in childhood obesity.[4, 5] Hence; the present study was conducted to analyze association between obesity and musculoskeletal system outcomes in children and adolescents.

Subjects and Methods

A total of 50 obese children (study group) and 50 non-obese healthy children (Control group) were enrolled. Complete demographic and clinical details of all the patients were obtained. All participants in the study were aged between 8 and 16 years. Arthrometric measurements for each subject were documented. A comprehensive assessment of the musculoskeletal system was conducted, incorporating various screening techniques for musculoskeletal disorders in children. This assessment included evaluations of range of motion (ROM), the timed up and go test (TUG), and the standing time on one leg (STOOL) tests. Data analysis was carried out using SPSS software, employing the Chi-square test and Student's t-test to determine the significance levels.

Table 1: Demographic data.

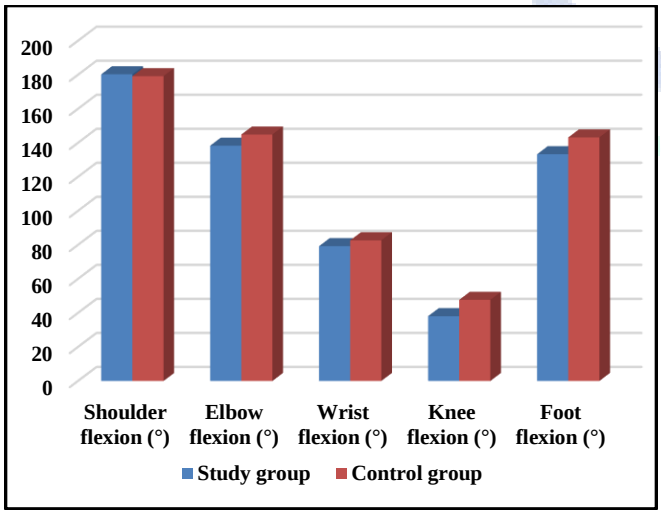
Variable	Study group	Control group	p-value
Mean age (years)	12.3	11.7	0.77
Males	31	28	0.26
Females	19	22	0.54
Mean BMI (Kg/m^2)	32.3	23.8	0.69

Table 2: Comparison of one leg test and timed up and go test (TUG).

Variables		Study group	Control group	p-value
STOLL test (secs)	Right	93.2	141.3	0.000*
	Left	93.5	161.1	0.003*
TUG (sec)		7.13	8.25	0.001*

Table 3: Comparison of range of motion (average of right and left side)

Variable	Study group	Control group	p-value
Shoulder flexion (°)	180.3	179.2	0.28
Elbow flexion (°)	138.3	144.9	0.004*
Wrist flexion (°)	79.3	82.7	0.001*
Knee flexion (°)	38.1	47.7	0.000*
Foot flexion (°)	133.3	143.2	0.001*



Graph 1: Comparison of range of motion (average of right and left side)

Results

The mean age of the subjects of the study group and control group was 12.3 years and 11.7 years respectively. There were 31 males and 19 females in the study group while there were 28 males and 22 females in the control group. Significantly better results of STOLL test and TUG test were seen among control group. Also, while comparing the range of motion among the non-obese and obese group, subjects of the non-obese group showed better shoulder flexion, elbow flexion, wrist flexion, knee flexion and foot flexion.

Discussion

Obesity in childhood is a significant predictor of continued obesity in adulthood. This persistence is alarming due to the established links between obesity and various chronic health conditions in later life, including cardiovascular diseases, diabetes, musculoskeletal disorders, and certain types of cancer.[6] Although there is documented evidence indicating that children with obesity tend to utilize healthcare services more frequently, there is a scarcity of longitudinal studies that connect childhood obesity with specific health outcomes diagnosed clinically during this developmental stage. Recent research has increasingly highlighted the detrimental effects of obesity on skeletal muscle function, which include impairments in oxidative capacity, abnormal organization of muscle fibers, disruptions in calcium cycling, increased susceptibility to fatigue, declines in contractile function, and a shift from slow-twitch to fast-twitch muscle fibers.[7] Conversely, clinical investigations into the impact of obesity on muscle size and functionality have revealed that individuals with obesity often exhibit greater muscle torque and power compared to their normal-weight counterparts.[8-10] Hence; the present study was conducted to analyze association between obesity and musculoskeletal system outcomes in children and adolescents.

The mean age of the subjects of the study group and control group was 12.3 years and 11.7 years respectively. There were 31 males and 19 females in the study group while there were

28 males and 22 females in the control group. Significantly better results of STOLL test and TUG test were seen among control group. Also, while comparing the range of motion among the non-obese and obese group, subjects of the non-obese group showed better shoulder flexion, elbow flexion, wrist flexion, knee flexion and foot flexion. Smith S et al conducted a comprehensive review of musculoskeletal pain among children who are overweight or obese. They systematically searched several databases, including Academic Search Complete, CINAHL, Medline, Proquest Health and Medical Complete, Scopus, Google Scholar, SPORTDiscuss, and Trove, for studies published over a twelve-year period. The authors defined the age range of children as being between 3 and 18 years. Their search strategy incorporated a variety of terms such as obesity, morbid obesity, overweight, pain, musculoskeletal pain, child, adolescent, chronic pain, back pain, lower back pain, knee pain, hip pain, foot pain, and pelvic pain. Initially, ninety-seven records were identified through the use of these terms related to children, obesity, and musculoskeletal pain. After applying specific inclusion criteria, ten studies were selected for thematic analysis. The literature revealed three primary themes: bone deformity and dysfunction, pain reporting, and the effects of being overweight or obese on physical activity, exercise, and overall quality of life. The interplay of chronic pain, obesity, and diminished physical functioning may create a cycle of weight gain that adversely impacts a child's quality of life.[10]

The association between obesity in children and an increased risk of musculoskeletal pain is particularly significant, with research indicating that these children may experience a higher prevalence of general musculoskeletal discomfort, especially in the spinal region and lower extremities. The underlying mechanisms remain ambiguous; however, factors such as biomechanical alterations, changes in pain perception, and low-grade inflammation associated with obesity have been suggested as potential contributors.[11, 12] Numerous studies have documented diminished muscle strength in the lower limbs when adjusted for body mass, particularly during activities that necessitate movement or the propulsion of body weight, thereby indicating probable deficits in functional strength. Additionally, there is growing evidence of balance impairments in obese children, which may be related to sensory deficits and/or relative muscle weakness. Furthermore, children with obesity exhibit deviations in gait, postural misalignments in the spine and lower limbs, motor skill challenges, increased fatigue, and heightened perceived exertion. The evidence regarding the effects of childhood obesity on flexibility and bone health remains less definitive.[13]

Conclusion

Obesity and overweight represent significant global health challenges that particularly impact children and adolescents. Excess weight during these formative years can profoundly affect the health and overall well-being of young individuals, potentially leading to chronic health issues such as musculoskeletal pain and dysfunction of bones and joints in adulthood.

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