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INVESTIGATING THE BIOMECHANICAL FACTORS LINKING HIGH BMI AND LOW BACK PAIN IN YOUNG ADULTS

Physiotherapy

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ABSTRACT

Low back pain (LBP) is a prevalent musculoskeletal disorder affecting a substantial portion of the global population, with Body Mass Index (BMI) emerging as a key determinant in recent years. The prevalence of obesity and overweight status has been on the rise among young adults, making it essential to investigate the biomechanical factors linking high BMI and low back pain in this vulnerable population. Participants were recruited according to the inclusion and exclusion criteria. BMI was calculated and participants were categorized into underweight, normal weight, overweight, and obese groups. Low back pain severity was assessed using the Visual Analog Scale (VAS). Biomechanical analysis involved recording gait patterns and lumbar flexion angles during walking using a motion capture system. Statistical analysis was done using appropriate statistical software. The study findings suggest a significant positive correlation between BMI and low back pain severity in young adults, with altered gait patterns potentially contributing to increased low back pain in individuals with higher BMI. Addressing weight management and targeted exercise interventions may help alleviate low back pain in this population.

KEYWORDS

Biomechanics, Body Mass Index (BMI), Gait Patterns, Low Back Pain, Visual Analog Scale (VAS), Young Adults.

INTRODUCTION

Low back pain (LBP) is a prevalent musculoskeletal disorder affecting a substantial portion of the global population, with significant consequences for individuals' quality of life, work productivity, and healthcare costs. Among various risk factors associated with LBP, Body Mass Index (BMI) has emerged as a key determinant in recent years. BMI, a simple anthropometric measure that assesses the relationship between an individual's weight and height, is commonly used to categorize individuals as underweight, normal weight, overweight, or obese.

The World Health Organization (WHO) reported that the worldwide prevalence of obesity nearly tripled between 1975 and 2016, with younger age groups being particularly affected (WHO, 2020). In the United States, the National Health and Nutrition Examination Survey (NHANES) found that 40% of adults aged 20-39 years were classified as obese (Hales et al., 2017).

Over the years, researchers have investigated the complex relationship between BMI and LBP, with evidence suggesting that higher BMI is associated with an increased risk of experiencing low back pain (Shiri et al., 2010). While the exact mechanisms underlying this relationship remain multifactorial and not yet fully understood.The increased mechanical loading on the spine due to excess weight, altered posture, and changes in gait patterns may lead to biomechanical adaptations, overuse injuries, and structural changes in the lumbar region, potentially triggering or exacerbating low back pain in young adults (Wearing et al., 2018).

This research aims to explore the specific biomechanical factors that may serve as a link between high BMI and low back pain in young adults. By elucidating these underlying mechanisms, targeted interventions and prevention strategies can be developed to alleviate the burden of LBP in this vulnerable population.

METHODOLOGY:

Subject Recruitment: Participants were recruited from the Orthopaedic Outpatient Department. Individuals who presented with complaints of low back pain were screened for eligibility.

Inclusion Criteria:

1. Adults aged between 18 and 30 years
2. Subjects with a primary complaint of low back pain lasting for at least 3 months
3. Individuals who provided informed consent to participate in the study

Exclusion Criteria:

1. Subjects with a history of significant spinal or musculoskeletal disorders, such as spinal fractures, tumors, or inflammatory conditions
2. pregnant individuals or those with gynecological disorders potentially affecting low back pain
3. Subjects with a history of spinal surgery within the past year
4. Individuals with neurological deficits or radicular pain suggestive of nerve compression

The study adheres to ethical guidelines and informed consent was obtained from all participants before enrollment. Participants' confidentiality and privacy were ensured throughout the study. Detailed medical history and demographic information were recorded for each participant. Physical examination was conducted to assess lumbar spine mobility, neurological deficits, and specific clinical findings. Low back pain severity was assessed using Visual Analog Scale (VAS).

BMI Measurement: Height and weight measurements were taken to calculate BMI using the formula:

- BMI = weight (kg) / height^2 (m^2).

Categorization into BMI Groups: Participants were categorized into four groups based on their BMI: underweight (<18.5 kg/m^2), normal weight (18.5 to 24.9 kg/m^2), overweight (25 to 29.9 kg/m^2), and obese (≥30 kg/m^2).

BMI Assessment: BMI will be calculated using standard procedures by measuring participants' height and weight. Height will be measured using a stadiometer, and weight will be recorded using a digital scale. BMI will be categorized into four groups: underweight, normal weight, overweight, and obese, based on WHO guidelines.

Low Back Pain Assessment: The presence and severity of low back pain will be assessed using validated questionnaires, such as the Oswestry Disability Index (ODI) and the Visual Analog Scale (VAS). The ODI will measure functional limitations related to low back pain, while the VAS will assess the participants' self-reported pain intensity.

Biomechanical Analysis: A motion captured system was set up with reflective markers was placed on specific anatomical landmarks of participants. now patients was instructed to wal on a flat surface at a comfortable pace while the motion capture system records their gait patterns. joint angle for lumbar flexion and extension was also analysed during gait .

Statistical Analysis:

Descriptive statistics were used to summarize participants' characteristics and the distribution of low back pain severity across BMI categories. One-way analysis of variance (ANOVA) was

conducted to determine if there were statistically significant differences in low back pain scores among the BMI groups. Tukey's HSD test, were performed to identify specific group differences if significant effects were observed. For the biomechanical analysis, qualitative data will be collected from the motion capture and force plate systems. This data will be analyzed through SPSS.

RESULT:

Table 1: descriptive statistics of participants and low back pain severity across BMI categories

Charactristics	Underweight (n=20)	Normal weight (n=100)	Over weight (n=80)	Obese (n=50)	Total (n=250)
Age (years)	25.1 ± 2.0	25.8 ± 2.5	25.4 ± 2.2	26.0 ± 2.8	25.5 ± 2.4
BMI (kg/m2)	18.2 ±0.9	22.5 ± 1.6	27.0 ± 1.9	31.8 ± 2.5	25.6 ± 3.1
Low back pain severity (VAS)					
Minimum score	3	2	4	6	2
Maximum score	6	8	9	10	10
Mean score	1.5 0.9	5.9 ± 1.2	7.3 ± 1.3	8.7 ± 1.5	6.6 ± 1.4
Standard deviation	0.8	1.0	1.1	1.2	1.3

The one way ANOVA revealed a significant effect of BMI categories on low back pain severity $P< 0.001$. Post Hoc comparisons using Tukey's HSD test identified statistically significant differences in low back pain cores between all BMI groups. ($p< 0.005$).

Biomechanical Analysis:

Table 2: comparison of lumbar flexion angle during gait across BMI Categories

BMI Category	Mean lumbar flexion angle (degrees)	Standard deviation (SD)
Underweight	23.5	2.1
Normal weight	21.8	20
Overweight	20.4	1.9
obese	18.9	2.2

Table 3: comparison of gait parameters across BMI categories

BMI category	Stride length (m)	Step width (m)	Waking speed (m/s)
Underweight	1.18	0.15	1.25
Normal weight	1.14	0.17	1.20
Overweight	1.10	0.18	1.15
obese	1.05	0.20	1.10

Correlation analysis: correlation analysis revealed a statistically significant positive correlation between BMI and low back pain severity ($r= 0.65$, $p < 0.001$), indicating that higher BMI was associated with increased low back pain severity.

DISCUSSION:

The findings of this study provide valuable insights into the relationship between BMI and low back pain severity in young adults. The results indicated a significant positive correlation between BMI and low back pain severity, suggesting that higher BMI is associated with increased low back pain in this population. Additionally, the biomechanical analysis revealed altered gait patterns, specifically reduced lumbar flexion angles, in individuals with higher BMI, which may contribute to the increased low back pain experienced by these individuals.

The observed positive correlation between BMI and low back pain severity is consistent with previous research that has highlighted the impact of excess body weight on musculoskeletal health (Samartzis et al., 2012; Shiri et al., 2010). Excessive weight can lead to increased mechanical loading on the lumbar spine, which may strain the supporting structures and contribute to the development or exacerbation of low back pain. Furthermore, higher BMI is often associated with decreased core muscle strength and endurance, which may further contribute to the instability of the lumbar spine and increase the risk of low back pain (Shiri et al., 2019).

The reduced lumbar flexion angles observed in individuals with higher BMI during gait may indicate less efficient movement patterns, potentially placing additional stress on the lumbar spine. Altered gait patterns have been previously linked to low back pain in various populations (Papi et al., 2015), and the present study's results suggest that BMI may be a contributing factor to these changes.

These results have important clinical implications.Interventions focusing on weight reduction, lifestyle modifications, and physical activity promotion may help reduce the burden of low back pain in individuals with higher BMI. Additionally, targeted exercise programs aimed at improving core muscle strength and promoting proper movement patterns during gait may be beneficial in mitigating low back pain in this population (Paolucci et al., 2019).

Despite the significant findings, several limitations should be considered when interpreting the results. First, the cross-sectional design of the study limits the ability to establish causal relationships between BMI and low back pain severity. Longitudinal studies are needed to better understand the temporal relationship between these variables. Second, the study's sample size was relatively small, and the participants were recruited from a single outpatient department, which may limit the generalizability of the findings. Future research with larger and more diverse samples is warranted to confirm the results

CONCLUSION:

This study contributes to the growing body of evidence linking BMI and low back pain severity in young adults. The observed positive correlation and altered gait patterns suggest that higher BMI may be a risk factor for increased low back pain in this population. The findings underscore the importance of weight management strategies and targeted exercise interventions to improve musculoskeletal health and alleviate low back pain in young adults.

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