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Muscle Mass Is Associated with Depression in Adolescents and Young Adults

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Abstract

Background and Aims: The study aims to explore the association between body composition and depression in adolescents and young adults. **Methods:** A random cluster sampling method was used to select 41 age-matched individuals (aged 11 - 30) as a non-depressive control group. The Department of Psychology at the Affiliated Hospital of Youjiang Medical University for Nationalities recruited 27 depressive patients within the same age range. Bioelectrical impedance analysis measured body composition, while SCL-90, SAS, and SDS were employed for depression diagnosis. Logistic regression analysis was conducted to assess the relationship between body composition and depression scores. **Results:** The Depression Group exhibited higher levels of fat mass ($p < 0.001$) and lower levels of muscle mass ($p < 0.001$) compared to the control group. Regression analysis indicated a negative correlation ($p < 0.05$) between muscular mass index, age, and depression scores. Binary Logistic regression analysis demonstrated that skeletal muscle mass index (OR: 0.304, $p < 0.035$), age (OR: 0.304, $p < 0.035$), and the likelihood of depression were elevated. **Conclusion:** Depression is associated with age, gender, and muscle mass in adolescents and young people. Proper exercise and a healthy diet can increase muscle mass, thereby reducing fat mass and, as a result, reducing the prevalence of depression.

Keywords

Teenagers and Youth, Depression, Body Composition, Muscle Mass, Fat Mass

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1. Introduction

Depression is a common mental health disorder with harmful effects on physical and mental health, often leading to suicide. It is characterized by feelings of sadness, loss of interest or pleasure, low self-worth, poor sleep and/or appetite, fatigue, and difficulty concentrating. Depression is a major global mental health issue [1]. Depression affects about 264 million individuals globally, making it a significant concern, particularly among the younger generation. A comprehensive meta-analysis found that the prevalence of the condition was 2.8% in children under the age of 13 and 5.6% in adolescents aged 13 to 18 [2]. The rate increases dramatically during adolescence [3]. By age 19, 20% to 25% of adolescents suffer from melancholy [4]. Genetic and other biological reasons suggest that serious depression begins between adolescence and middle age. About 40% of patients have their first episode before 20. The average onset age was 25 [5]. According to recent data, depression is the third leading cause of the global disease burden [6]. Given the rising prevalence of depression and its detrimental effects on health, researchers are urged to identify depression risk factors [7]. This results in more effective interventions to combat depression.

According to a meta-analysis of clinical short-term exercise studies, Muscle-strengthening exercises increase skeletal muscle mass or strength [8] [9], and bone mineral density, enhance daily activities and cardiac metabolism [10], and alleviate depressive or anxious symptoms [11] [12]. Strength training could be a mitigating factor against depression. More than three decades of research have verified the clinical validity of the health benefits of muscle-strengthening exercise.

A significant public health issue is abnormal or excessive accumulation of body fat [13]. As a risk factor for cardiovascular disease, type II diabetes, certain malignancies, and a shorter life expectancy overall, obesity is a significant public health concern [14]. Luppino *et al*. found a link between obesity and depression. Elevated body fat percentage was associated with 55% greater odds of melancholy and 58% higher odds of depression [15].

Depression lowers life quality by affecting physical and mental health. Clinicians struggle to prevent, identify, diagnose, and treat the condition due to its varied and unexpected symptoms. This study explores the association between body composition and depression in adolescents and young adults to give a theoretical basis for prevention and treatment.

2. Population and Experimental Design Research

At the time of recruitment, all participants in a cross-sectional study conducted in Guangxi Province in southwestern China were apprised of the study procedure and provided informed consent. Participants were questioned and evaluated by qualified researchers. Inclusion criteria: age between 11 and 30; first appointment; not taking antidepressants; informed consent signed. Exclusion criteria for both groups were lifetime or current depression, taking antidepres-

sants, and not signifying informed assent. Furthermore, exclusion criteria for both groups were younger than 11 years or older than 30 years, and pregnancy. The entire initiative is overseen by the Medical Ethics Committee of the Youjiang Medical University for Nationalities of Ethnic Medicine, following state and school regulations governing medical ethics. Number 2022053001 for the moral review.

According to the inclusion and exclusion criteria, the Department of Psychology at the Affiliated Hospital of Youjiang Medical University for Nationalities included a total of 27 patients with depression aged 11 to 30 years. A random cluster sampling method was used to select 41 age-matched subjects ranging in age from 11 to 30 years as the non-depression control group from a population of healthy individuals with no history of severe physical diseases or antidepressant use.

3. Method

Before the investigation, all evaluators received uniform training, the measuring instruments were calibrated, and the measurement was conducted following the standard operating procedures.

3.1. Height and Weight Measurement

The height (cm) and weight (kg) of the subjects were measured to one decimal place using a height meter and weight scale, respectively. The body mass index (BMI) is determined by dividing a person's weight in kilograms by their height in square meters (kg/m^2).

Body composition determination

The total body muscle mass (kg), total fat mass (kg), body moisture (kg), upper and lower limb muscle mass (kg), and basal metabolic rate (KJ) were determined using a body composition analyzer (Japan TANITA, MC-180) utilizing the bioelectrical impedance method (BIA). The totality of the muscle mass of the upper and lower limbs is limb muscle mass (ASM). Calculate skeletal muscle mass index (SMI) by dividing skeletal muscle mass (g) by the square of height (m).

Diagnosis of depression

The questionnaire for this study consisted of three parts.

First, we used the Depression Self-Rating Scale (SDS) as a widely used symptom measurement tool to assess the level of depressive symptoms by reflecting the subjective feelings of psychiatric patients. It was written by William W. K. Zung in 1965 [16]. It contains 4 components with a total of 20 items. Including mental-emotional symptoms, physical, and psychomotor disorders, and psychological disorders. There are 10 positive scores and 10 reverse scores (with*). Participants rated each item on a 4-point scale based on the frequency of symptoms over the past 7 days: 1 occasionally, 2 sometimes, 3 frequently, and 4 consistently. The total score of the question is added sequentially from the original

score and multiplied by 1.25 to calculate the final standard score. A higher score means more severe depressive symptoms. The cut-off for SDS scores is defined as no depression (<49), mild (50 - 59), moderate (60 - 69), or severe (>70) [17]. The Chinese version of SDS was used in this survey with good reliability. Its validity has been confirmed in previous studies.

The Self-Anxiety Rating Scale (SAS), a popular symptom measurement tool, was employed in the second portion to examine psychiatric helpers' subjective anxiety symptoms. The 1971 W.K. Zung report includes 20 elements in four categories: mixed anxiety and autonomic function, autonomic malfunction, motor tension, and anxiety. The project lists 15 positive and 5 reverse scores (*). Based on 7-day symptom frequency, participants assessed each item on a Likert 4-point scale: never or very little, occasionally, most, or all. The total question score is added sequentially from the original score and multiplied by 1.25 to calculate the standard score. Severe anxiety symptoms increase with the score. The SAS standard score cut-off is no anxiety (<49), mild (50 - 59), moderate (60 - 69), and severe (70+) [17]. The survey employs SAS Chinese, which is reliable and valid.

We also assessed research participants' psychological well-being using the SCL-90 questionnaire. The SCL-90 is a common mental health assessment tool. It is a 90-item multidimensional questionnaire that screens for many psychological issues. Somatization (SOM), obsessive-compulsive disorder (OC), interpersonal sensitivity (IS), depression (DEP), anxiety (ANX), hostility (HOS), phobic anxiety (PHOB), paranoid ideation (PAR), and psychosis (PSY) are nine regularly used subscales that describe symptoms. A higher score on the Likert five-point scale (1 - 5) indicates more symptoms. 1 - 2 is typical [18]. Its major objective is to determine if and how serious a psychological ailment is. Clinics utilise it as a screening scale for psychiatry and counselling.

3.2. Statistical Methods

The analysis of data is performed using SPSS 26.0 statistical software. The Kolmogorov-Smirnov test was used to determine whether or not the samples followed a normal distribution. For measures with a normal distribution, the mean standard deviation ($x \pm s$) is used for description; otherwise, the median (M) and interquartile range (P25-P75) are employed. If the data have a normal distribution, the independent sample t-test is used to compare numerical indicators; otherwise, the Wilcoxon rank sum test is employed. If the distribution is normal, the Pearson correlation test is used; otherwise, the Spearman correlation test is employed. The enumeration data are expressed as frequency and rate, and the chi-square test is used to compare the rate of advancement. The relationship between the age-related depression diagnostic score scale and body composition was explored using linear regression, and the risk factors for depression were analyzed using binary logistic regression, with $p < 0.05$. Significant statistical difference.

4. Results

4.1. Population Baseline Data

Randomly selected for this study were 41 young, healthy volunteers and 27 despondent participants, including 44 females and 24 males. The average age of men was (19.75 ± 5.81) years, the average age of women was (18.73 ± 5.605) years, and the average age of the entire population was (19.09 ± 5.656) years. In comparison to males, women had a significantly lower muscle mass, basal metabolic rate, and bone mass ($p < 0.001$) and a significantly higher fat mass ($p < 0.001$) (Table 1). Among the depressive patients, 23 (33.82%, 23/68) were male and 4 (5.88%) were female. 33.82% (23 out of 68) of males and 5.88% (4 out of 68) of females had minimal muscle mass.

4.2. Comparison of Body Composition between the Depression Group and the Non-Depressed Group

To determine whether differences in age, sex, weight, height, body water, muscle mass, fat mass, bone mass, and basal metabolism were statistically significant between depressed and non-depressed individuals. In a comparison between the depression group and the non-depression group, the depression group was younger, had less body water, and had less muscle mass ($p < 0.01$, Table 2).

Table 1. Population baseline data.

	n	Age (year)	BMI (kg/m^2)	Muscle mass (kg)	Fat mass (kg)	Basal metabolism (KJ)	Bone mass (kg)
Male	24	19.75 ± 5.81	19.772 ± 2.341	42.758 ± 7.133	6.579 ± 3.452	1404.83 ± 137.251	2.346 ± 0.404
Female	44	18.73 ± 5.605	19.336 ± 2.682	33.136 ± 3.071***	11.530 ± 4.691***	1206.70 ± 164.399***	1.970 ± 0.278***
Total	68	19.09 ± 5.656	19.374 ± 2.550	36.532 ± 6.707	9.782 ± 4.888	1276.63 ± 181.414	2.103 ± 0.372

Compared to Male *$p \leq 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 2. Comparison of body composition between the depression group and the non-depressed group.

Variable	Non-depression group	Depression group	P Value
N (%)	41 (60.29%)	27 (39.71%)	—
Age (years)	20.78 ± 5.96	16.52 ± 4.052	0.007**
Weight (kg)	48.502 ± 8.51	48.29 ± 8.61	0.99
Height (cm)	157.96 ± 8.90	157.37 ± 8.61	0.957
Muscle mass (kg)	18.10 ± 3.93	16.77 ± 2.87	0.002**
BMI (kg/m^2)	19.31 ± 2.15	19.48 ± 3.10	0.329
Fat mass (kg)	8.84 ± 3.85	11.219 ± 5.94	0.261
Bone mass (kg)	2.10 ± 0.40	2.100 ± 0.329	0.249
Body moisture (kg)	27.89 ± 5.43	26.611 ± 4.032	0.009**
Energy metabolism (KJ)	1257.20 ± 187.01	1453.87 ± 211.93	0.285

*$p \leq 0.05$, **$p < 0.01$.

4.3. Factors Influencing Adolescents' Anxiety and Depression Levels

We utilized linear regression analysis to examine the demographic factors that could influence SDS, SCL-90, and SAS scores. Skeletal muscle mass index (SMI) ($\beta = -0.554$; $p = 0.006$), and age ($\beta = -0.291$; $p = 0.016$) were negatively correlated with the total score of the SDS (Table 3(a)). Skeletal muscle mass index (SMI) ($\beta = -0.437$; $p = 0.035$), age ($\beta = -0.325$; $p = 0.007$) negatively correlated with SCL-90 total score (Table 3(b)), and skeletal muscle mass index (SMI) ($\beta = -0.5$; $p = 0.017$), age ($\beta = -0.332$; $p = 0.008$) negatively correlated with SAS total score (Table 3(c)) ($p < 0.05$). Thus, SMI and age are the primary determinants of anxiety and depression scale scores. The higher the cumulative scores of depression and anxiety, the greater the likelihood of depression, or the greater the severity of depression, the younger the age and the lower the SMI. The positive correlation between body water and body mass index (BMI) and anxiety and melancholy scores was not statistically significant.

Table 3. (a) Skeletal muscle mass index and age are predictors influencing SDS scores on the depression scale; (b) Skeletal muscle mass index and age were predictors of SCL-90 score; (c) Skeletal muscle mass index and age are predictors of anxiety SAS score.

(a)

Variable	B	Standard error	β	t	p	95.0% *CI* of Exp (B)		Partial correlation
Age(years)	−1.547	0.626	−0.291	−2.471	0.016	−2.798	−0.295	−0.299
SMI(kg/m^2)	−17.464	6.449	−0.554	−2.708	0.009	−30.355	−4.574	−0.325
BMI(kg/m^2)	2.473	1.607	0.209	1.539	0.129	−0.739	5.685	0.192
Body Moisture(kg)	2.056	1.176	0.340	1.748	0.085	−0.296	4.408	0.217
Content	91.241	32.012		2.85	0.006	27.25	155.232	

(b)

Variable	B	Standard error	β	t	p	95.0% *CI* of Exp (B)		Partial correlation
Age (years)	−0.070	0.025	−0.325	−2.780	0.007	−0.120	−0.020	−0.333
SMI (kg/m^2)	−0.557	0.258	−0.437	−2.156	0.035	−1.073	−0.041	−0.264
BMI (kg/m^2)	0.123	0.064	0.257	1.908	0.061	−0.006	0.251	0.235
Body Moisture (kg)	0.044	0.047	0.180	0.935	0.353	−0.050	0.138	0.118
Content	3.789	1.282		2.955	0.004	1.226	6.353	

(c)

Variable	B	Standard error	β	t	p	95.0% *CI* of Exp (B)		Partial correlation
Age (years)	−1.512	0.554	−0.322	−2.73	0.008	−2.619	−0.405	−0.328
SMI (kg/m^2)	−13.947	5.706	−0.500	−2.444	0.017	−25.354	−2.540	−0.296
BMI (kg/m^2)	2.098	1.422	0.201	1.475	0.145	−0.745	4.940	0.184
Body Moisture (kg)	1.787	1.041	0.334	1.716	0.091	−0.294	3.868	0.213
Content	76.470	28.328		2.699	0.009	19.844	133.096	

4.4. Analysis of Independent Influencing Factors of Depression

Age, skeletal muscle mass index (SMI), body hydration, body mass index (BMI), and age were included as independent variables in the analysis of depression. The results of binary logistic regression revealed that both SMI (*OR*: 0.304, $p < 0.05$) and age (*OR*: 0.853, $p < 0.05$) influenced depression. SMI and age have a substantial negative effect on whether a person has depression. The elder the age, the greater the SMI, and the lower the likelihood of depression. No statistical difference existed between body water, body mass index (BMI), and depression (Table 4).

5. Discussion

Our findings demonstrate the independence between depression and body composition in adolescents and young adults. This study provides additional support for the correlation between body composition and common mental health with biopsychosocial characteristics among adolescents and young adults. Our research emphasizes the potential usefulness of individual body composition for assessing the physical and mental health changes associated with growth in young and middle-aged populations.

Increasing numbers of epidemiological studies indicate that the advent of depression frequently occurs during adolescence. There is evidence that the cumulative probability increases from approximately 5% in early adolescence to 20% in late adolescence [2] [19]. Our results indicate that age has a negative correlation with the depression rating scale, *i.e.*, the younger the individual, the greater the likelihood of depression. This is consistent with previous scientific findings. Some studies suggest that the overall incidence of depression and the peak increase in new cases of depression occur between the ages of 15 and 18, Middle and late adolescence (15 - 18 years) may be a crucial period of depression susceptibility, as the higher the rate of depression, the greater the risk of depressive episodes, and the gender disparity in depression increases drastically during this time [20]. In addition, a substantial proportion of adolescents with subthreshold symptoms are undiagnosed and untreated [20]. Future adversity risk increases the importance of effective prevention and early treatment for those affected [21].

In the geriatric, reduced muscle mass and impaired muscle function are common

Table 4. Analysis of independent influencing factors of depression.

Variable	B	Standard error	Wald	*p*	OR	OR 95% *CI*	
Age (years)	−0.159	0.057	7.693	0.006	0.853	0.762	0.954
BMI (kg/m^2)	0.181	0.141	1.654	0.198	1.198	0.910	1.578
SMI (kg/m^2)	−1.192	0.567	4.424	0.035	0.304	0.100	0.922
Body Moisture (kg)	0.115	0.100	1.320	0.251	1.122	0.922	1.367
Content	4.207	2.655	2.511	0.113	67.186		

[22]. According to the current literature, skeletal muscle mass loss and common mental disorders share pathophysiological pathways [23] [24]. In South Korea, adolescents also demonstrated a decline in muscle mass. Due to the social pressure to pursue the attractive ideal of a slim body, a great number of adolescents have imposed stringent dietary restrictions on themselves. In addition, Korean students lack physical activity as a result of the rigorous college preparatory system. They predominantly sit, attend, and study. Reduced skeletal muscle mass may contribute to depressive symptoms in adolescents for these reasons [24]. Consistent with prior research, our findings demonstrated that the lower the muscle mass of adolescents and young adults, the greater the risk of depression. Depression is an independent risk factor for diminished muscle mass. Studies on adults have demonstrated a negative correlation between body muscle mass and depression. The relationship between physical activity and melancholy should be supported. First, muscle-strengthening exercise can increase muscle strength and muscle strength has always been considered a component of health indicators and exercise to enhance physical function and quality of life [25] [26]. Reduce despondency. Second, food disorders are linked to diminished muscle mass and depressive episodes. The prevalence of depression is substantially increased in patients with sarcopenia, characterized by reduced muscle mass, according to studies [27]. Muscle-strengthening exercise would be a preventative treatment for depression, according to a study of German adults aged 18 and older (N = 23,635) [25] [26]. A recent meta-analysis of 14 systematic reviews and 27 prospective cohort studies revealed significant evidence that regular aerobic exercise can reduce the incidence of depression and the severity of depressive symptoms in patients with major depression (US Department of Health and Human Services, 2018). Regular physical activity is a key modifiable non-drug method for preventing and treating a variety of common mental health disorders, such as depression, anxiety, and cognitive impairment, according to studies (US Department of Health and Human Services, 2018). The World Health Organization's Global Recommendations on Physical Activity for Health provide recommendations for comprehensive health and wellbeing (including mental health) [28].

The findings of this investigation suggest multiple avenues for future research. First, it provides a theoretical foundation for future research to explore the correlation between muscle mass and depression in young and middle-aged people in southwest China. Additionally, it enriches the research on the correlation between muscle mass and depression in young and middle-aged Asians. Future longitudinal studies should examine the causal relationship between depression and muscle mass in young and middle-aged individuals, as well as potential biological regulatory mechanisms, such as muscle mitochondrial dysfunction, chronic low-grade inflammation, or elevated leptin secretion, and psychosocial factors that may influence the ability to cope with the psychological and physical health consequences of decreased muscle mass.

In addition to providing guidance and opportunities for comprehensive health treatment in clinical practice, the results of this study also provide these benefits [29]. Regular assessments for depression should be performed on young people to evaluate the mental health issues associated with multiple body composition changes and the potential risk of physical health decline in young people. There is a need for a straightforward and reliable method of assessing body composition in depressed young adults. Young adults with depression may have preexisting depressive symptoms (such as psychomotor disorders, malnutrition, etc.) compared to young adults without these biological and psychological issues.

Although this study offers the opportunity to investigate the relationship between body composition and depression in young adults and has several advantages, there are still some limitations to consider. We used cross-sectional data that reflect the status of depressed patients' body composition at a given time Second, depression measurement is limited to the SAS score table, SDS score table, and SCL-90 score table, which may be biased and have limited specificity. The magnitude of the depression sample may impede statistical analysis and make it more difficult to establish an association. In addition, the diagnosis must be further interpreted because it is retrospective and lacks biological hormone data.

6. Conclusion

The findings of this study indicate that age and muscle mass are independent risk factors for depression in adolescents and young adults, as they are negatively correlated with depression scores. It demonstrates a correlation between muscle mass and depression in adolescents and young adults, highlighting the need to increase muscle mass and decrease the prevalence of depression.

Declarations

Authors Contributions

Ziyang Fang contributed to data analyses, interpretation, and drafting of the manuscript. Xin Zhang contributed to data analyses and interpretation. Jinting Wei designed the study, acquisition of data, and contributed to the interpretation of the analyses. Guangwu Huang, Yi Wei, Yinling Zhao, Yiying Pan, Yuanying Su and Ying Li contributed to the acquisition of data and drafting of the manuscript. All authors made substantial contributions to critically revising the manuscript. All authors approved the final version of the manuscript.

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Availability of Data and Materials

Due to ethical restrictions, the data cannot be made publicly available. The data-

sets used during the current study are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Participants provided written informed consent and the study was approved by the Medical Ethics Committee of the Right River School of Ethnic Medicine Ethics Committee.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

BMI Body mass index

SMI Muscle mass index

SAS Self-Anxiety Rating Scale

SDS Depression Self-Rating Scale