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Effect of obesity on balance: A literature review

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***Abstract*---**To assess studies that look into whether obesity has an effect on balance. The goal of this review was to look at the latest studies on the impact of obesity on balance. A high lipid accumulation or extra fat mass level is classified as obesity. Obesity is a complicated disease that develops as a consequence of an interaction between genetic, environmental, and behavioural factors, and it is now more common than malnutrition. Obesity is linked to a number of medical issues, including cardiovascular disease, diabetes, tumours, respiratory difficulties, and severe orthopaedic ailments which reduce the QOL. Obesity is also linked to postural instability, which is defined as the ability to keep or recover the centre of mass with reference to the support base. Computerized bibliographic databases were used to find journal papers published between 2011 and 2021. Systematic reviews and cross-sectional studies with high levels of evidence were included. There was a total of 30 studies chosen. Following the analysis of the studies, it was discovered that obesity had a negative impact on balance. According to previous research, bodyweight is a powerful predictor of postural equilibrium. Increased postural sway was linked to a higher body mass index (BMI). These effects were seen in static balance, perturbed balance, and dynamic balance settings.

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There is evidence in the literature showing a substantial correlation between obesity and balance problems.

***Keywords*---**obesity, overweight, body mass index, balance, postural balance.

Introduction

Obesity has now become a severe and inescapable worry for people of all generations (Mangalam et al.,2021). Obesity is associated with an excessive or inappropriate fat build-up that poses a health concern. A BMI of 25 or above is considered to be overweight, while a BMI of 30 or greater is classified as obese. In 2017, nearly 4 million individuals died as a direct result of being overweight and obese, according to the global burden of sickness report. Overweight and obesity rates in adults and children continue to rise. Between 1975 and 2016, the global prevalence of obesity in adolescents & children aged 5 to 19 years increased by more than fourfold, from 4% to 18%. The large bulk of overweight or obese children lives in developing countries, where the rate of growth is 30 per cent faster than in industrialized nations.

Obesity is a global crisis and one of the leading intermediary risks of chronic noncommunicable diseases. As per the WHO, obesity is one of the most widespread, though under-reported, societal problems for both developing and developed nations. As per the WHO World Health Statistics Survey 2012, one out of every 6 individuals in the world is obese or overweight, and as a result, 2.8 million deaths worldwide each year. India with 1.2 billion citizens, is the world's second-largest populous country. And it is currently experiencing a rapid epidemiological transformation. Obesity is connected to a higher risk of atherosclerosis vascular complications, coronary artery disease, colon cancer, hypercholesterolemia, high blood pressure, gallbladder disease, metabolic disorders, as well as a higher death rate (Jinal Sagar et al., 2020). Weight gain is influenced by a sedentary lifestyle, a poor diet, and psychosocial (Essraa A et al.,2020).

Obesity results in excessively elevated lordotic curvature, weight shifting problems, and improper biomechanics. Postural instability results from these changed biomechanics, which leads to a lack of balancing capacity. As a result, Obesity has been linked to a higher risk of falling, as well as injuries and disabilities caused by falls (Rajib Mondal et al.,2021). Postural equilibrium is required for us to function normally in our daily lives. The ability to manage the centre of mass inside the base of support, which serves to maintain the body in balance, is characterized as equilibrium (Afaf Emara et al.,2020) Balance can be defined as the process that maintains the center of gravity within the body's support base and requires constant adjustments that are provided by muscular activity and joint positioning. Balance is described as the process of maintaining the body's center of gravity within its support base, which necessitates regular modifications given by muscle activity and joint alignment (Nazia et al 2021). Another health issue associated with obesity affects people of all ages, particularly in underdeveloped nations, is balance instability. The precise

coordination of signals into the central nervous system from the visual, auditory and somatosensory systems for static or moving equilibrium can maintain balance and postural stability. Any factor that pushes the body out of equilibrium, generating postural sway, puts a person out of balance (Firas S. et al.,2017).

Obesity causes everyday activity limits by increasing the bulk of body segments and changing body proportions. In both eyes open and closed settings during silent standing, obesity is linked to postural instability (Wael Maktouf et al., 2020). It alters the way the body moves due to anthropometric alterations. Bending, kneeling, stooping, lifting, and carrying are all challenging tasks for people with a larger waist circumference and body mass. Problems with these fundamental physical skills hinder one's ability to maintain strength and mobility, as well as execute essential daily activities (Hannah C et al., 2012).

A variety of kinetic and kinematics anomalies appear to interfere with appropriate musculoskeletal function as a result of weight gain, according to studies. These physical modifications result in decreased balance, aberrant gait patterns, and increasing muscle weakness, which are the top three risk factors for falls in seniors. Obesity-related decreased balance, falls, injuries and disability are more common in older obese people, and young adult obese people are no exception (Dutil M et al.,2013). Obese young adults have also been reported to have poor posture, balance, and stride (Son SM et al.,2016 & Sarkar A et al.,2011).

When compared to females of normal weight, being overweight increases the load on the bones, surrounding structures, and joints, altering biomechanics and causing abnormal weight distribution, resulting in impairment of the female locomotor system, an increased risk of falling, and a loss of interest in the activity (Anees S. et al., 2017). Bodyweight is thought to be a good predictor of maintaining postural balance (PB), and becoming overweight is thought to be a significant factor to have fallen. As a result, a high BMI is linked to higher postural sway in obese people (Dutil M et al.,2013), particularly in the anteroposterior (AP) and medial-lateral (ML) directions for males and females, as well as the occurrence of falls in adults. When compared to other anthropometric metrics, waist circumference had the strongest link between stabilometric parameters and fall outcomes (Thatiane et al., 2020).

Obese patients had a faster swaying speed and a wider sway range when standing erect than normal-weight individuals, according to Dutil et al. Obese people spend little time in unstable regions and the distance between them was greater, according to Dutil et al, meaning that even if their sensory system was intact, they spent less time in these zones, managing balance is challenging. Because postural instability or balance control impairments have been established as risk factors for falling, the researchers' findings indicate that fat was another significant contributor (Suryasa et al., 2021).

Obese older people have a greater ability to fall, according to Fjeldstad et al., and the distribution of adipose tissue could have been a key contributor to balancing issues. Being overweight can have an impact on postural regulation, as evidenced by postural sway and motor reaction time (Afaf Emara et al.,2020). After reducing

weight, obese and morbidly obese men's postural control (i.e., COP swaying speed and extent of anteroposterior and lateral displacement) enhanced, according to some researchers (Camila Pereira et al.,2017). In the adult population (aged 24–61 years), Hue et al. found a substantial link between increased body weight and poorer postural stability (Jae Joon et al.,2020). Obesity has an effect on older people's postural control and has been reported in conflicting ways in the literature. According to Pereira et al., BMI and fat mass had no effect on older persons' balance, although other authors found that obesity adds to age-related postural control degradation and increases the chance of falling (Wael Maktouf et al.,2020). Studies on the impacts of obesity, as well as the association between weight and balance, were included in the review. The objective of this paper is to go over the existing studies on the influence of obesity on balance.

Materials and Methods

This is a literature review study, and we used articles that were found in search engines like PubMed and Google Scholar. A total of 30 publications were gathered and included in the study. Articles addressing the impact of obesity on balance were sought. We used the following keywords to search the Medline database for this study: obesity, balance, Postural control, biomechanics, and connection. The articles were chosen from the years 2011 to 2021. The abstracts of the publications were chosen, and their reference links were also checked for articles that met our inclusion criteria, and a few of them were included in our study.

Analysis of the Articles Reviewed

Characteristics of the Included Studies

AUTHORS	OBJECTIVE	METHODS	RESULT
1. Jeetendra yogi et al., 2015	Obesity's impact on dynamic and static body balance was investigated in this observational research.	There were 200 individuals in total, 100 of each gender, who were separated into three groups. On the basis of BMI, there are three categories: 1) normal, 2) overweight, and 3) obese. To assess dynamic, and static lower, upper body balance, the dynamic gait index test, one-leg stand test, and MFRT were employed.	The static upper body balance of normal and overweight patients did not differ significantly in the test. There had been a substantial difference ($p<0.05$) among obese & overweight subjects, as well as between normal and obese ones. Similar results ($p<0.001$) were reported for static lower body balance. The findings revealed a substantial difference in Dynamic balance between overweight and normal individuals ($p<0.001$), obese & overweight subjects

			(p<0.001), & obese and normal subjects (p<0.001).
2. Essraa A at al., 2020	This study examines the impact of obesity in children on Saudi children's musculoskeletal flexibility and balance	A convenience sample of 150 children was used to obtain a representative sample of Saudi elementary school students for the study. Total 90 students in primary school, ages 6 to 11, 47 of normal weight and 43 of obesity. To check for balance, the Biodex balancing system was employed. The weight-bearing ankle lunge test was used to measure calf muscular flexibility, while the chest expansion test used to assess chest flexibility.	In children with obesity, at all stability levels, all stability metrics have worsened severely (P≤.05). In terms of musculoskeletal flexibility, children with obesity had a shorter weight-bearing lunge test distance (P=.01). There would be no distinction between the two groups in the chest expansion test.
3. Jinal et al., 2020	The effects of static as well as dynamic balancing on obesity grades were investigated in this study.	In this investigation, 60 samples were obtained, 20 from each of the three groups (obesity in grades 1, 2, and 3), and each group was subjected to both static & dynamic assessments. Static balance was achieved through a single-limb stance, whereas to achieve dynamic equilibrium, the TUG test was employed.	According to a study, when BMI rises, the chance of postural impairments rises as well, with obese women in grades 3 had a greater risk of instability than obese women in grades 1 & 2.
4. Anees et al., 2017	The goal of the study was to see how obesity affected teenage females' balance control.	A total 60 adolescent females, ranging in age from 15 to 19, were chosen from the faculty of physical therapy. Group A consisted of 30 subjects with normal weight, while group B consisted of 30 obese subjects. Balance is tested using the	Group B mean ML, AP, and OA scores were substantially higher (P<.05) than group A. In compared to the non-obese group, obese exhibit poor postural control, according to the study. Obesity seems to has a deleterious impact on

		Biodex balance system.	postural balance in young adult obese females, according to findings.
5. Aparna et al., 2011	Obesity's impacts on young people's gait metrics such as foot angle and step breadth and balance were investigated.	A total of 60 male and female subjects were gathered. A control group of 30 people (non-obesity, BMI <25) and an experimental group of 30 people (obese, BMI 30>) were chosen. The FRT was utilized for balance testing, and the footprint method was employed to measure gait metrics.	Obesity has a negative effect on a person's balance. In both genders, the degree of toe-out was greater in the obese group. When comparing males in obese and normal BMI categories, the Step Width measurement was higher in obese males than in normal BMI males, but it was statistically insignificant when comparing females in both groups.
6. J. A. do Nascimento et al., 2017	The goal of this study was to assess the dynamic and static balance of obese young people with normal BMI throughout various dynamic and static postural circumstances.	To determine the dynamic and static balance in 25 sedentary people, a cross-sectional investigation was carried out. The participants were split into two groups: 15 in the obese group and 10 in the normal weight group. Visual inspection was used to assess postural stability, while the Balance System (biodex) & Timed Up and Go Test (TUG) was used to assess balance.	Obese patients had a risk of falling, larger ML dynamic displacement, and TUGT & mean time to conduct the limits of stability test ($P<0.05$), but in static balance, there were no substantial differences between unipedal and bipedal activity. The disadvantage that young fat people present occurs in dynamic tasks, resulting in loss of balance and a rise in the time required to execute tasks.
7. Andrezza et al., 2012	The goal of this study was to assess the effects of overload on postural alterations in the lower limbs and spine, as well as general praxis and balance in obese or overweight school	The study included Thirty-four participants (27 girls and 7 boys) who had been diagnosed as overweight or obese based on their baby BMI (BMI). The Fonseca psychomotor battery was utilized to assess	The findings revealed posture modifications in both groups. Obese patients were dyspraxic, while overweight participants with eupraxic psychomotor profiles had dissociation of lower and upper limbs.

	children ages 6 to 12 years.	praxis and global balance, while a Kendall-based evaluation form was employed to assess posture.	The findings suggest that obesity and overweight in children can affect posture, balance, and general praxis.
8. Thatiane Lopes et al., 2020	The objective of this study would be to see how obesity affected static PB and the incidence of fall in asymptomatic people and those beyond the age of 40.	The postural balance was measured using a force platform of 624 people stratified into quartiles for BMI, waist-to-height, waist-to-hip ratio, and fat body mass as a percentage without and with vision.	Obesity and static PB were shown to have mild to moderate bivariate correlations, which after adjustment became non-significant. Using percent FBM, they discovered substantial disparities between the first and fourth quartiles. After adjustment, the odds ratio values for all obesity indices became non-significant, indicating that obesity wasn't linked with the incidence of falls.
9. Pallavi Sharma et al., 2021	The goal of this study was to evaluate dynamic and static balance in obese and overweight children who have flat feet and those who do not.	A total 1165 children from 11 schools were examined, with 87 being determined to be obese between the ages of 6 -12 years. The balance error scoring system (BESS) and the stork balancing stand test (SBST) were used to assess children's static balance, while the modified bass test (MBTDB) and the four-square step test (FSST) of dynamic balance were used to assess their dynamic balance.	Obese children with and without flat feet, as well as overweight children with flatfoot, had substantial changes in static balance, but obese children with flatfoot had significant changes in dynamic balance. When comparing within and between groups, In the SBST, there was no discernible change (P = 0.0657). In comparison to overweight children with flatfoot, obese with flatfoot showed worse dynamic and static balance.
10. Sung Min Son., 2016	The objectives of this paper were to see if obesity is linked to a lack of postural control in young people, and if	The total sway distance and center of gravity (COG) velocity were assessed on hard or soft flooring with eyes open or closed in	On soft & hard floors with eyes close, the obese group's total sway distance and COG velocity were significantly higher

	this is impacted by the sensorial dysfunction or anterior pelvic tilt angle.	research including 12 normal-weight and 12 obese participants.	than the normal-weight groups. On soft and hard floors with eyes open, total sway distance & COG velocity was not substantially different in the two groups.
11. HU Mi et al., 2021	The study's objective was to look into the features of static and dynamic balance in children between the ages of 8 to 10 years old, as well as to give a reference for avoiding injury caused by physical activities in overweight children and choosing physical activity facilities.	One-legged hops were used to choose 100 normal children and 100 obese children as subjects, with a male to female ratio of 1:1 in each group. The static balance was assessed by the IIM-BAL-100 balance tester. The balance-check dynamic balance tester was used to measure the dynamic balance.	While standing among eyes closed, there were no substantial difference in static balance scores across groups, the interaction between the two factors, or gender identities. When standing on one foot with eyes open, there was a substantial difference in the static balance index between the gender & groups. All of the dynamic balance indicators exhibit a substantial difference between the groups in case of dynamic balance ability.
12. Mohammadreza Rezaeipour et al, 2018	By monitoring the centre of pressure velocity, the researchers were able to assess the influence of different BMI groups on the postural control of older females in a normal posture.	The participants in this study were 77 inactive females over the age of 65 yrs. old (67.7 ± 3.5), Based on their BMI, all participants were divided into 3 groups: obese, overweight, & normal. The force platform measured postural stability in static condition on a foam mat with closed (CE) eyes and open (OE) in the mediolateral (ML) & anteroposterior (AP) directions.	During the CE and OE conditions, Obese females swayed in the AP direction far faster than normal-weight females. Under OE and CE, females with normal weight had higher COP velocities than obese in the ML direction. The study concluded that in the AP direction, obesity had a negative effect on postural control. Obese females, on the other hand, were more stable along the ML direction due to the extension of the support base than

			normal-weight females.
13. Rajib et al., 2021	The goal of this study was to look at the effects of obesity on young individuals' gait and balance.	A total of 60 normal-weight and obese young adults (aged 20–40 years) in Dhaka participated in the study. The footprint technique for step length, foot angle, and step breadth, is used to assess the Spatio-temporal gait variables and the FRT used for forwarding balance assessment.	Obesity is significantly connected with gait and balance among young adults in Bangladesh, according to research. Study findings are Lower forward balance, higher foot angle, lower step length, and higher step width was in the obese group, compared with normal-weight.
14. Hannah C. Del Porto et al.,2012	The objectives of this paper was to look through the existing study on the impact of obesity on balance.	Studies examining the biomechanical impacts of obesity, the link between weight reduction and balance, and the relative efficacy of weight loss as a balancing treatment were included in the review. Where particular information was available, the aging population was highlighted, since they are at a higher risk of falling and the injuries that come with it.	There is evidence in the literature showing a substantial correlation between obesity and balance problems. This meta-analysis backs up the benefit of weight reduction as a treatment for improving balance in obese patients.
15. Abishek sasidharanet al.,2014	The objective of this research was to see if there is a correlation between balance and obesity in school-aged children.	The study enlisted five hundred school-going youngsters, they were chosen at random and had an age of 10.20 ± 1.51 years. The Paediatric Reach Test (PRT) had been used to determine the balance, while the BMI was utilized to establish a level of obesity.	The researchers discovered a link between BMI and school-age children's balance problems (R=0.45), which was more pronounced above the BMI threshold of >22 kg/m2. Balance impairment in school children is linked to a high BMI above a particular threshold.
16. Jae Joon Lee et al., 2020	The goal of this study was to see if BMI-based overweight is linked to impaired balance	The body mass index of 317 individuals was used to categorize them. The BBS, TUG test, and Short Physical	The results of three clinical balance evaluation methods revealed a strong link between BMI and

	and if instabilities have any links to the primary risk factors for falls.	Performance Battery were used to measure clinical balance. A dynamometer was used to assess each person's knee extensor strength. InBody posturography was used to calculate total sway distance in four different circumstances.	balance. The obese group had lower strength of extensor muscles of the knee and a longer overall sway distance. Obesity affects the senior population's ability to balance, and it's linked to lower-limb weakness and postural instability.
17. Afaf Emara et al., 2020	In this study, researchers looked at dynamic and static computerised dynamic posturography (CDP) examinations in healthy individuals based on their BMI.	The individuals were separated into two groups: control (15) and study, which was further divided into three subgroups based on BMI: underweight (15), overweight (15), and obese (15). They looked at dynamic computerized posturography (CDP) static and dynamic tests examinations in healthy persons according to their BMI classification.	The sensory organisation exam and the rhythmic weight shift test found a significant difference between the research groups in the different scores reported, suggesting that a higher BMI has an impact on the various sensory systems necessary for balance regulation as well as the motor technique employed to keep one's balance. The vestibular system was used more frequently to maintain balance in obese older participants. Visual dependency in maintaining balance decreased as BMI increased.
18. Patrícia Azevedo Garcia et al., 2021	To see if obesity is linked to poor postural control and the dread of tripping in older people.	201 older people were classified as normal weight by BMI, obese, or overweight in the study. Postural Control was tested on unsteady and steady surfaces with or without visual cues, as well as with and without eyes closed, using the Biodex Balance System platform. The Falls Efficacy Scale and a	On a stable surface, the researchers discovered no substantial differences ($p > 0.05$) between the three groups in body oscillations. Obese elderly people experienced higher body oscillations than people of normal weight in all three visual circumstances. Obese older individuals

		binary question were used to measure the fear of falling.	experienced greater mediolateral oscillations with visual input, as well as global oscillations and gradual instability.
19. Normand Teasdale et al.,2013	This paper seeks to convey the current knowledge from the latest research demonstrating the negative effects of obesity and the positive effects of losing weight on balance ability, as well as the accuracy and speed of upper-limb goal-directed motions conducted from a standing position.	Obesity impacts the efficiency of everyday actions such as walking, standing, or holding an object while standing, in addition to metabolic difficulties. This article aims to provide an up-to-date summary of recent research findings demonstrating the positive effects of weight reduction and negative effects of obesity on velocity, postural stability, and accuracy of upper-limb goal-directed motions.	Obese people may have less plantar sole sensitivity, according to certain studies. As a result of their research, they can establish that being overweight has a deleterious impact on motor function, when standing, losing weight improves stability and upper-limb speed-accuracy performance.
20. Maxime Dutil et al., 2012	The purpose of this research was if being overweight is linked to a loss of postural stability in elder females.	This study comprised 45 older women ranging in age from 65 to 80, who were separated into three groups: 15 overweight, 15 obese, and 15 normal-weight participants. Balance control was evaluated by the use of a force platform. The ground reaction forces were used to estimate the mediolateral (ML) and anteroposterior (AP) values of the center of pressure.	According to the findings, obesity has a detrimental influence on an older woman's capacity to use proprioceptive information efficiently for posture maintenance. The findings suggest that obesity in older women might be a contributing factor since postural instability or balance control deficiencies have been identified as risk factors for falling.
21. Firas S. Azzeh et al., 2017	The objective of this study was to see how obese affected dynamic stability in young Saudi males.	The participants in this study were 704 young adult males (ages of 18 to 35). The obesity-induced balance was assessed using a Biodex Balance System	OSI values increased considerably ($p<0.001$) when BMI increased in the overall sample. BMI and OSI had an adjusted association of 0.487 ($p<0.001$). The

		with a movable platform & the overall stability index (OSI) was used as a dynamic balance indicator.	study concluded that for the selected young boys, Obesity affects dynamic equilibrium in a substantial way.
22. David Perez-Cruzado et al., 2021	The study's goal was to determine the variations in the balance between those with intellectual disabilities those who were not obese and those who were.	A total of 549 intellectually disabled persons were evaluated, according to their BMI, the individuals were divided into 2 groups: non-obese or obese. Semi-Static and static balance tests were administered to all individuals.	Non-obese and obese with intellectual disabilities had significantly different static balances. Only one static balancing test, in the young adult men's group, revealed significant variations in the analyses when gender and age range were taken into account. Women, both middle-aged adults and older people, showed no significant differences.
23. Mojdeh Pajoutan et al., 2017	The purpose of this study was how obesity impaired postural control during a standard lifting activity.	Twelve young males, 6 non-obese & obese conducted 3 repetitions of 6 lifts (6 reps per minute) at two directions (0° and 45° from the sagittal plane) and two different loads (10% and 25% of capacity)	According to the findings, when the lifting load is equivalent to capacity, obesity, as defined by BMI, has no effect on postural control in young males.
24. Leonardo Vidal Andreato et al., 2020	To conduct a comprehensive evaluation of the effects of overweight-or obesity and age on foot sensibility, as well as its link to equilibrium and postural stability	Up until December 2018, PubMed, Web of Science databases, Cochrane Library, SPORTDiscus, and Scopus, were used to search for articles. The researchers looked into randomized controlled and non-randomized trials, as well as cross-sectional research that looked at balance and foot sensitivity in adult people and the elderly. There were 152 studies found in all, with 14 of them being included.	The effect of growing older on foot sensitivity was negative. In the majority of studies, reduced feet sensibility were linked to poor balance and/or postural control. Plantar sensitivity was found to be linked to obesity, with obese people having lesser sensitivity and worse postural stability.
25. Wael Maktouf	To determine the	The 6-minute walk test,	The findings of the 6-

et al., 2020	impact of obesity in the effect of exercise on balance control, physical and functional capabilities, and to examine the efficiency of a PA programme on these capacities in older persons.	the time up and go, and the Tinetti test, were performed on six obese, 7 overweight, and 6 normal-weight older persons. Postural control was tested both static and dynamically (forward leaning). All of these tests were repeated four months later, with just the obese and overweight groups taking part in a PA program.	minute walk test, the time up and go test, Tinetti test, quiet standing, and forward lean tests demonstrated that the obese group had a lower physical capacity and dynamic and static postural control than the normal weight group before PA. The obese group's results on silent standing, physical, and functional assessments improved after PA.
26. José M. Cancela Carral et al., 2019	The goal of this study was to give empirical data on the link between equilibrium and BMI, while also accounting for the quantity of physical exercise done as a covariate.	They grouped 160 older adults into three BMI categories: normal weight, overweight, and obese. Using the Yale Physical Activity Questionnaire, they categorized the subjects as inactive or active. Dynamic and static balancing measurements were performed using the TUG Test and the force platform respectively.	Inactive overweight and inactive normal adults had statistically significant relationships between dynamic and static balance and BMI. In Active and inactive obese people, they found moderately fair and strong significant relationships between dynamic/static balance and BMI.
27. Christopher W. Frames et al., 2018	The purpose of this study is to see whether obesity influenced equilibrium in society senior citizens and if it might be seen as a fall risk factor.	A full geriatric examination and assessment of fall history were given to the subjects at random. The standing postural balance of 98 obese individuals was tested using an inertial measuring device positioned on the sternum and a force plate. Participants' fall history was tracked for two years, and fallers were defined as those who seemed to have at least one fall the year before.	The data suggest that elevated BMI is another contributing factor for falls in the geriatric and that it could be a valuable fall risk indicator. According to the study, obese fallers had considerably larger sway ranges and areas.

28. Aline B. Herrera-Rangel et al., 2014	The objective of this study was to see how the BMI affected the incidence of falls in individuals with diabetics who were getting primary care.	The information was gathered from 134 people, none of whom had sought medical care for balance or sensory issues. They reported falls, filled out a questionnaire on balance complaints, and had a sensory exam. They reported falls again after a six month follow-up, and patients were split into two categories based upon the number of falls they incurred in the previous year: falls (N = 42) and No-falls (N = 92).	The falling were linked to age, gender, and BMI. The frequency of falls and balance in people with diabetes may be affected by a BMI of ≥35, which may be independent of age.
29. Camila Pereira et al., 2018	The objective of this research was to see how fat mass and BMI affected balancing force platform measures in older people.	Based on their BMI, the individuals were separated into four groups: obesity, pre-obesity, normal weight, and low weight. The fat mass of older persons was used to separate them into two categories: high-fat mass & low-fat mass. On a force platform, all of the groups tested one-legged stance balance three times. The domain parameters for the COP were calculated using the mean of all experiments.	The results of the analysis of variance indicated no significant associations between sexes and groups for all COP parameters. Regardless of BMI or fat mass characteristics, only for gender difference in COP metrics was a significant impact ($P<0.05$) found. Women were more balanced than men in general. Finally, older people's balance during a one-leg stance test does not appear to be affected by their BMI or fat mass.
30. Heba M Youssr M El-Basatiny et al.,2014	The objective of this report was to assess postural stability in Saudi girls of various BMIs.	Sixty Saudi girls, ranging in age from 12 to 17years, took part in the study, and participants were placed into 3 groups for the research: (overweight, obese, and healthy weight). The Biodex Stability System	All of the females in the research were in one of the two stability categories, mean AP stability scores were higher than ML stability ratings. Obese females at stability levels 1 and 12 had significantly lower ML scores than

		was utilized to measure dynamic postural balance. During bilateral stand at the platform with open eyes, anteroposterior, overall stability, and mediolateral indices were measured. On the BSS, measurements were taken on a totally very unstable surface and a firm surface.	overweight girls, all stability indicators considerably deteriorated in obese girls at stability level 1. This implies that obesity and overweight have a negative impact on the dynamic balance of Saudi girls.

Discussion

The study's purpose was to discover if obesity had any effects on balance. We used a total of 30 cross-sectional studies and systematic reviews for this study, and after analyzing them, I discovered that obesity had a negative impact on balance. Although it's worth noting that obesity is a major predictor of falling and that becoming overweight is thought to be a risk factor for falling (Dutil M et al., 2013). The dynamic process of maintaining equilibrium in the body's position is referred to as balance. Equilibrium refers to a state in which the body whether at rest or in a constant state of motion. When the body's COM or COG is kept on top of the BOS, the balance is at its best. A complex combination of numerous inherent and external elements is required to maintain balance (Jinal S.et al.,2020).

Obesity is a multifaceted disease, with various interactions between genes and the environment contributing to its development. Obesity lowers muscular fatigue resistance and reduces relative muscular strength. Motor delays and insufficient corrective torque may result from these restrictions. As a result, it contributes to an inability to provide an acceptable reaction to a disturbance that enables postural control to be maintained (Pallavi S et al.,2017). Jinal S. et al. (2020) looked at how obese women's balance differed depending on their obesity level. They came to the conclusion that both dynamic and static balance is more influenced now in grades 2 and 3 than that in grades 1 and 2. This is due to the fact that it alters the way the body moves by altering the anthropometry of the body, interfering with the integration of joints and muscles. Maintaining postural stability necessitates more attentional resources. This may result in a loss of balance, which is used to maintain stability in many tasks.

Body weight gain can produce alterations in body shape and attitude, which can lead to changes in the position of the centre of gravity (COG), according to Del Porto H et al (2012). Due to increased bulk, it slips anteriorly to the base of support (BOS), making it difficult to maintain balance. As a result, obesity and balance are linked. As the BMI rises, the bodily structure changes, affecting equilibrium. In numerous studies, excessive fat build-up, as noted by the high BMI, resulted in the loss of equilibrium. This result could be linked to the torque created by the ankle joint, which is proportional to the gap between the centre of

mass (COM) and the ankle joint. This gap is connected to the amount of corrected ankle torque needed to maintain good equilibrium, and obese people with a longer gap required more corrective ankle torque to maintain a normal stance than skinny people (Firas S. et al.,2016). As a result of the excessive fat storage, impaired balance is the end result.

Dutil M. et al. (2013) examine the influence of obesity on balance in community-dwelling elderly women of obese, overweight, and normal body weight. Obesity has a deleterious influence on older women's capacity to use proprioceptive input for postural stability, according to the research. Obesity disrupts the correct interaction of physical joints and muscles, causing major changes in movement patterns. The lumbar spine's lordotic curvature is abnormally elevated when there is excess adiposity in the abdomen area. This possible change leads to the development of incorrect biomechanics, as well as a disruption in the body's appropriate weight shifting (Son SM. Et al.,2016). Finally, disordered weight shifting and changed biomechanics result in postural instability, which leads to poor balancing capability and arrhythmic gait (Rajib M. et al.,2021).

Conclusion

The normal individual's balancing function is affected by increased body weight. There is a decrease in equilibrium when the BMI rises. Obesity's increasing prevalence over time may have an impact on obese people's daily activities and injury rates. Obesity has an adverse effect on balance, based on the conclusions of the research. They should engage in pragmatic weight loss, balancing exercises, and gait rehabilitation programs.

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