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Impact of Obesity and Cardiovascular Parameters on Spine and Gait Problems in Postmenopausal Women. A Cross-Sectional Study

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Abstract

Background: Obesity defined as BMI of more than 40 kg/m2 is a major health concern which is attributed to a range of complications such as cardio metabolic diseases, DM, and metabolic disorders affecting the skeletal structures. Some of these health problems must be linked to hormonal problems and older age, which is why postmenopausal women are more at risk. Learning about how severe obesity affects their health and movement is informative in the development of strategies for management of their conditions; they need a better lifestyle.

Objective: The present research is aimed at assessing the influence of obesity and CV parameters on the spine and gait problem in the PMW**.**

Methods: It is important to note that this is a cross-sectional study, in which quantitative data from 120 participants was collected, and checked for obesity-related health conditions, FGA scores and physical activity.

Results: The analysis exposes poorer peripheral artery disease, cardiovascular diseases, and diabetes mellitus health people suffering from severe obesity. Furthermore, the sedentary behavior and Functional mobility also diminished in this population**.**

Conclusion: Based on this, this study found that persons with severe obesity experience aggravated health and functional deficits. Investigations have shown that this population has a greater prevalence of peripheral artery disease, cardiovascular diseases, and diabetes mellitus with reduced physical activity levels and impaired mobility. Such findings highlight the dire necessity for proper and individualized interventions for patients which would include the management of weight, increments in physical activity levels, and the like.

Key words: BMI, women after the menopausal period, cardiovascular diseases, diabetes mellitus, functional mobility, gait analysis – spatiotemporal parameters,

Introduction

A woman's menopause is a significant and natural stage of life development. Women go through social, psychological, and physical changes throughout menopause. [1].The term "menopause" refers to a woman's stage of life when her menstrual cycle ends and her ability to reproduce falls. It is not a sickness to be considered; rather, it is a normal physiological shift that occurs in women. If menopause is substituted for age 50, then every year over 47 million women (about twice the population of New York) experience menopause; by 2030, there may be 1.2 billion post-menopausal women worldwide, with an average age of about 60.[2]

The World Health Organization (WHO, 1996) noted that premenopausal was frequently used imprecisely by researchers, either to refer to the year or two just prior to menopause or, as was advised, to include the whole reproductive period up to the FMP. Other crucial phases identified by the World Health Organization (WHO) comprised the postmenopausal transition (i.e., the time frame immediately preceding the FMP when endocrinological, biological, and clinical signs of impending menopause begin, as well as the first year following menopause); and the perimenopause (i.e., the time frame just before the FMP, when menstrual cycle variability is typically increased).[3]

Obesity currently classified as the fifth most common primary cause of death worldwide, obesity and its associated disorders have become serious health problems. Obesity is defined by the World Health Organization (WHO) as "abnormal or excessive fat accumulation that may impair health," and it is further explained that "an energy imbalance between calories consumed and calories expended is the fundamental cause of obesity and overweight" A straightforward index used to place humans into one of three categories—"underweight," "overweight," or "obese"—the "Body Mass Index" (BMI) is calculated as [(weight in kg)/ (height in m2). [4]

People who are obese have slower walking speeds, wider steps, and more variations in their mediolateral center of mass (COM) displacement as compared to people of normal weight.[5]

Numerous studies have demonstrated the detrimental effects of obesity on the musculoskeletal system. It has also been observed that obese people produce noticeably larger plantar pressures when standing and walking and that their foot and lower limb biomechanics change during walking in comparison to non-obese people. Musculoskeletal pain and suffering have also been linked to the requirement for overweight and obese people to maintain their extra body mass over time.[6]

Globally, obesity-related comorbidities are on the rise, and there is a favorable correlation between obesity and cardiovascular disease (CVD). Because of aberrant estrogenic signaling, elevated activation of aldosterone and mineralocorticoid receptors, and elevated levels of androgens, women are more susceptible to ischemic heart disease and heart failure. Understanding non-traditional risk factors that are specific to women, such as weight gain during pregnancy, preeclampsia, gestational diabetes, and menopause, is essential to lowering the prevalence of CVD. Globally, cardiovascular disease (CVD) is the primary cause of death for postmenopausal women. Conventional risk factors for CVD include advanced age, smoking, sedentary lifestyle, poor diet, high blood pressure, and early CVD.[7]

Nonetheless, women have lower overall outcomes and a higher overall incidence of CVD in all its forms than men. Women, for instance, are more likely to pass away in the year after a heart attack. It's also clear that as people age, sex differences are smaller. Menopause-induced sex hormone reduction adds to older women's elevated risk of cardiovascular disease (CVD); nevertheless, hormone replacement treatment by itself does not offer protection against CVD, especially in later postmenopausal women. Furthermore, while rates of CVD mortality have been falling for the past 20 years, younger women's death has reduced the least.[8]

More postmenopausal women die from coronary vascular disease (CVD) worldwide than from breast or gynecologic cancer combined. CVD is the major cause of death for these women. Conventional risk factors for cardiovascular disease (CVD) include age, smoking, body mass index, poor diet, diabetes mellitus, dyslipidemia, high blood pressure, and a family history of early CVD. The loss of sex hormones brought on by menopause raises the risk of CVD in elderly women. Hormone replacement therapy, however, particularly in later postmenopausal women, does not provide protection against CVD on its own. The purpose of this study is to ascertain if, in postmenopausal women without a history of cardiovascular illness, being overweight or obese is independently correlated with myocardial flow reserve (MFR). In this cohort, elevated body mass index (BMI) is systematically linked to higher cardiovascular mortality.[9]

Globally, the prevalence of obesity-related comorbidities is rising, and there is a significant correlation between obesity and cardiovascular disease (CVD). Due to elevated testosterone levels, aberrant estrogenic signaling, and greater activation of aldosterone and mineralocorticoid receptors, women are more susceptible to ischemic heart disease and heart failure. Understanding nontraditional risk factors specific to women, such as weight gain during pregnancy, preeclampsia, gestational diabetes, and menopause, is essential to lowering the prevalence of CVD. Globally, cardiovascular disease (CVD) is the primary cause of death for postmenopausal women. Conventional risk factors for CVD include advanced age, smoking, sedentary lifestyle, poor diet, high blood pressure, and early onset of the disease.[10]

An elevation in pulse wave velocity (PWV), a measure of arterial stiffness, is Strongly associated with a higher risk of death in older women from CVD, Whether or not they are obese. Younger Women may be protected against CVD. Because of greater arterial flexibility, as seen by the higher PWV of men compared to premenopausal women of similar age. It can be deduced that atherosclerosis is the likely factor underlying the sex differences in CVD mortality because higher PWV is a strong predictor of atherosclerotic disease compared to other common indices of CVD risk. This is especially true since atherosclerosis is the primary cause of ischemic heart disease, which has heart attacks and strokes as its main outcomes a minimum of 12 months of amenorrhea, abstinence from smoking, and no current use of hormone treatment or phytoestrogens were requirements for Participation.[11]

Methodology and Data Analysis

It was cross sectional study. Sample size was 120 women. Written consent were taken from the women before data collection and data was collected from Al Hafeez specialist clinic. All patient were well informed about scales. Functional gait assessment scale, 6 minute walk test, figure of 8 walk test and postural analysis grid chart. Only female were allowed to participate in this study. The participants which full fill inclusion criteria were Postmenopausal women, obese and cardiovascular related women. And our research sample consisted of all women between the ages of 41 and 60. A minimum of 12 months of amenorrhea, abstinence from smoking, and no current use of hormone treatment or phytoestrogens were requirements for participation and The study excluded women with heart surgery, heart transplants, cancer patients, non-Black or White women, women with missing menopausal age, those who had a hysterectomy before age 55, women with missing BMI or weight, underweight women, women with missing data on heart Failure incidence, and women with prevalent heart failure.

Data will be evaluated and analyzed with SPSS version 20, Microsoft Excel 2018. The quantitative data will be presented in the form of descriptive statistics, mean $\pm$S. D and qualitative data will be presented by percentage, frequency and bar charts or pie charts. Collection data will be stored in Microsoft Excel.

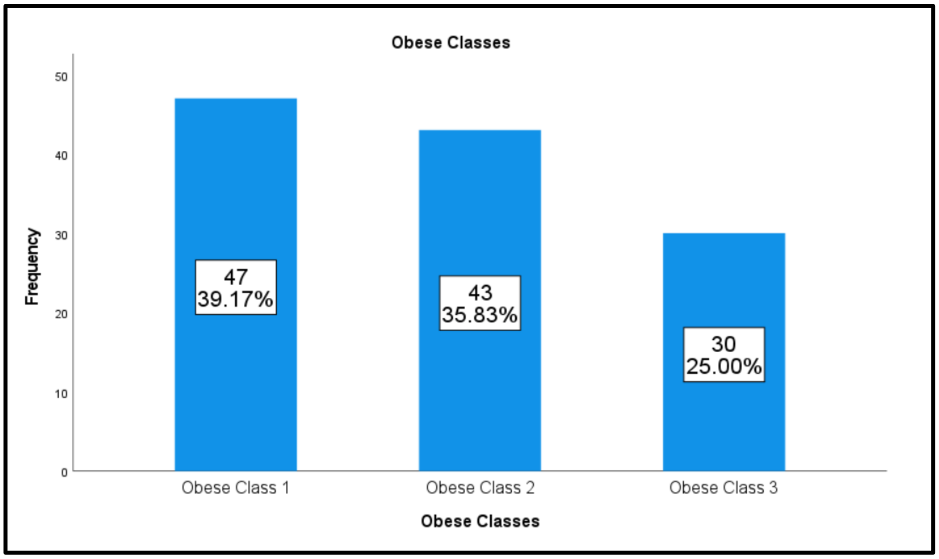
Results

Frequency Distribution of demographics

The frequency distribution of demographics among the study population shows that 39.2% of individuals belong to Obese Class 1, 35.8% to Obese Class 2, and 25.0% to Obese Class 3. Regarding cardiac diseases, 36.7% have Coronary Artery Disease, 49.2% have Peripheral Artery Disease, and 14.2% have experienced a stroke. Diabetes Mellitus is present in 76.7% of the population, with 23.3% not affected. Smoking status distribution reveals that 44.2% have never smoked, 45.0% are current smokers, and 10.8% are former smokers. Hypertension is prevalent in 60.8% of the individuals, while 39.2% do not have hypertension. Physical activity levels show that 20.0% engage in less than 1 hour per week, 37.5% engage in 1-2 hours per week, 38.3% engage in 3-4 hours per week, and 4.2% engage in more than 4 hours per week. Hormonal changes are reported by 39.2% of the population, with 60.8% not experiencing any hormonal changes. This data provides a comprehensive overview of the distribution of key health and lifestyle factors among the study participants.

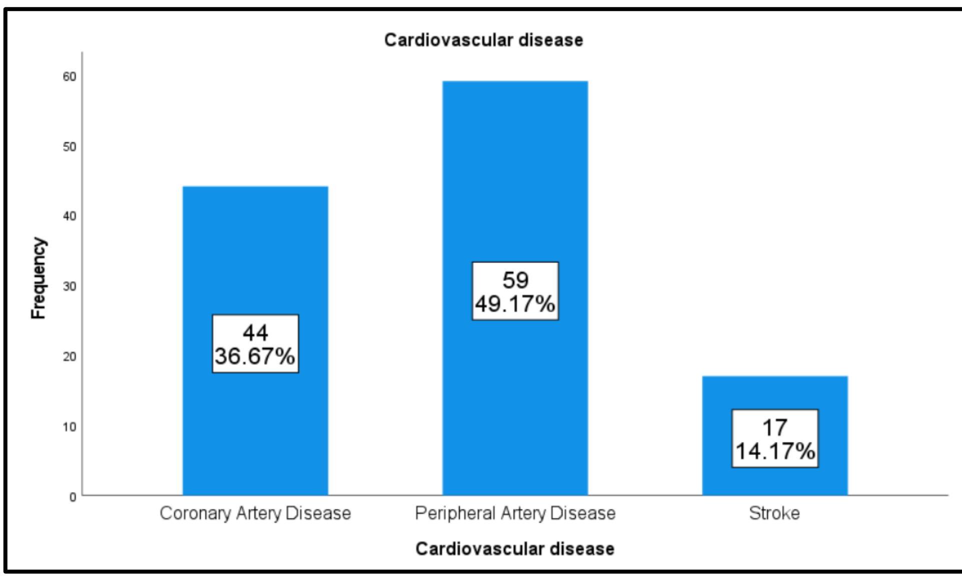
Frequency Distribution of demographics

		N	%
Obesity Class	Obese Class 1	47	(39.2%)
	Obese Class 2	43	(35.8%)
	Obese Class 3	30	(25.0%)
Cardiac disease	Coronary Artery Disease	44	(36.7%)
	Peripheral Artery Disease	59	(49.2%)
	Stroke	17	(14.2%)
Diabetes Mellitus	Yes	92	(76.7%)
	No	28	(23.3%)
Smoking	Never	53	(44.2%)
	Former	54	(45.0%)
	Current	13	(10.8%)
Hypertension	Yes	73	(60.8%)
	No	47	(39.2%)
Physical Activity	<1 hour/week	24	(20.0%)
	1-2 hours/week	45	(37.5%)
	3-4hours/week	46	(38.3%)
	>4 hours/week	5	(4.2%)
Hormonal Changes	Yes	47	(39.2%)
	No	73	(60.8%)



Frequency Distribution of Obesity classes

Bar chart show frequency distribution of obesity classes which show 39.2% of individuals belong to Obese Class 1, 35.8% to Obese Class 2, and 25.0% to Obese Class 3.



Frequency Distribution of Cardiovascular disease

Bar chart show frequency distribution of cardiac diseases, 36.7% have Coronary Artery Disease, 49.2% have Peripheral Artery Disease, and 14.2% have experienced a stroke.

Distribution of three types of cardiac diseases across different classes of obesity

Cardiac disease	Obese Classes						Total	
	Obese Class 1		Obese Class 2		Obese Class 3			
	N	%	N	%	N	%	N	%
Coronary Artery Disease	15	(31.9%)	19	(44.2%)	10	(33.3%)	44	(36.7%)
Peripheral Artery Disease	22	(46.8%)	18	(41.9%)	19	(63.3%)	59	(49.2%)
Stroke	10	(21.3%)	6	(14.0%)	1	(3.3%)	17	(14.2%)

The data presents the distribution of three types of cardiac diseases across different classes of obesity. In Obese Class 1, Coronary Artery Disease (CAD) is observed in 31.9% of cases (15 over

47), Peripheral Artery Disease (PAD) in 46.8% (22 over 47), and Stroke in 21.3% (10 over7). Moving to Obese Class 2, CAD occurs in 44.2% (19 over 43), PAD in 41.9% (18 over 3), and Stroke in 14.0% (6 over 43). In Obese Class 3, CAD is seen in 33.3% (10 over 30), PAD in 63.3% (19 over 30), and Stroke in 3.3% (1 over 30). Across all obesity classes, the total percentages indicate that 36.7% (44 over 120) have CAD, 49.2% (59 over 120) have PAD, and 14.2% (17 over 120) have experienced a Stroke

Functional mobility of individuals across different classes of obesity

	Obese Class 1		Obese Class 2		Obese Class 3	
	Mena ±SD N=47	P value	Mena ±SD N=43	P value	Mena ±SD N=30	P value
Functional gait assessment	21.680±2.743	.261	21.046±3.518	.956	16.366±1.731	.011
6 minute walk test (meters)	110.531±14.972	.110	105.232±17.591	.856	81.833±8.658	.011
Figure 8 walk test times (seconds)	17.893±2.097	.011	18.581±2.206	.021	17.900±2.139	.082
Figure 8 walk test Steps	16.489±2.030	.010	17.558±1.053	.003	17.400±1.248	.287

The study assessed the functional mobility of individuals across different classes of obesity using various gait assessment tests. The Functional Gait Assessment (FGA) scores were compared among the three obesity classes, revealing significant differences (p = .011). Specifically, Obese Class 3 individuals demonstrated lower FGA scores (M = 16.366, SD = 1.731) compared to Obese Class 1 (M = 21.680, SD = 2.743) and Class 2 (M = 21.046, SD = 3.518), where the differences were not statistically significant (p = .261 and p = .956, respectively). Similarly, the 6-minute walk test showed significant differences in distances covered (p = .021), with Obese Class 3 individuals walking shorter distances (M = 81.833 meters, SD = 8.658) compared to Class 1 (M = 110.531 meters, SD = 14.972) and Class 2 (M = 105.232 meters, SD = 17.591). Moreover, the Figure 8 walk test revealed significant differences in completion times (p = .001) and steps taken (p = .001) among the obesity classes. Specifically, individuals in Obese Class 1 completed the test in the shortest time (M = 17.893 seconds, SD = 2.097) and with the fewest steps (M = 16.489, SD = 2.030) compared to Class 2 and Class 3. These findings suggest that as the severity of obesity increases, functional mobility, as assessed by these gait tests, tends to deteriorate. The implications of these findings underscore the importance of tailored interventions targeting mobility and gait improvement among individuals with severe obesity to enhance their overall functional independence and quality of life.

Table of Correlation

	Pearson Correlation	P value
Obese Class - Body mass Index (BMI) (kg/m2)	.957	.000
Obese Class – Cardiac disease	-.122	.183
Obese Class - Diabetes mellitus	-.076	.411
Obese Class – Smoking	.117	.203
Obese Class – Hypertension	-.007	.936
Obese Class – Physical activity hours/week	.058	.528

Obese Class – Hormonal changes	.007	.936
Obese Class – Height (m)	-.417	.000
Obese Class - Weight (kg)	-.409	.000
Obese Class - Waist circumference (wc) (cm)	.434	.000
Obese Class - Hip circumference (HC)(cm)	-.216	.018
Obese Class - Body adiposity index (BAI) (%)	.348	.000
Obese Class – Functional gait assessment	-.551	.000
Obese Class – SIX MWT	-.577	.000
Obese Class – Posture	-.133	.149
Obese Class - Figure8 walk test times	.022	.814
Obese Class - Figure8 walk test Steps	.248	.006

The Pearson correlation coefficients and corresponding p-values for various health and physical metrics in relation to Obese Class are summarized in the provided table. The results indicate a very strong positive correlation between Obese Class and Body Mass Index (BMI) (r = .957, p = .000), suggesting that higher BMI values are closely associated with higher obesity classification. In contrast, a slight negative correlation with cardiac disease (r = -.122, p = .183) and diabetes mellitus (r = -.076, p = .411) was observed, though these associations were not statistically significant. Smoking exhibited a weak positive correlation (r = .117, p = .203) but also lacked significance. Interestingly, hypertension showed a negligible correlation (r = -.007, p = .936), indicating no meaningful relationship.

Physical activity hours per week (r = .058, p = .528) and hormonal changes (r = .007, p = .936) also demonstrated very weak and non-significant correlations. Conversely, height was moderately negatively correlated (r = -.417, p = .000), suggesting taller individuals might have a lower obesity classification. Weight (r = -.409, p = .000) and waist circumference (r = .434, p = .000) showed moderate correlations, indicating their relevance in obesity classification. Hip circumference had a weak negative correlation (r = -.216, p = .018), whereas Body Adiposity Index (BAI) had a moderate positive correlation (r = .348, p = .000).

Functional gait assessment (r = -.551, p = .000) and the Six-Minute Walk Test (SIX MWT) (r = -.577, p = .000) both showed strong negative correlations, highlighting the impact of obesity on physical performance and mobility. Posture presented a slight negative correlation (r = -.133, p = .149) without statistical significance. The Figure-8 walk test times (r = .022, p = .814) and steps (r = .248, p = .006) indicated minor relationships, with steps showing a weak but significant positive correlation. Overall, these correlations highlight various aspects of how obesity classification relates to physical health and performance metrics.

Discussion

This is true because, postmenopausal women are at relatively higher risk for obesity, cardiovascular diseases, and general frailty resulting from early menopause which greatly impacts the musculoskeletal system. The current study was a cross-sectional research which aimed at identifying the relationship between Obesity and Cardiovascular disease on Spine and gait difficulties in the context of the population under review. These connections to one degree or another are rather important to comprehend in order to know how an appropriate preventive action may contribute to the improvement of postmenopausal women’s quality of life. This study confirmed the existence of a positive significant relationship between obesity and spine disorders as highlighted in female postmenopausal clients. Self-reported symptoms linked to the medical conditions including DD, S, and VF were found to be higher among the obesity, particularly those with high BMI. Such conclusions are in agreement with prior literature concerning the effect of obesity as a cause of diminished spinal well-being, thereby warranting intervention endeavors aimed towards the modification of obesity-related weight status among such population. Regarding the distribution of the population by Obesity class, it is worthwhile to note that Obesity Class 1 and Obesity Class 2 were observed to have captured the highest percentage share with 39%. 2% and 35. 8% respectively whereas the Obesity Class 3 got the lowest proportion of 25 percent of the total prescription rate. 0% only. This as postulated by Stokes et al is predicted to be an across study characteristic insofar as the prevalence of moderate obesity is more prominent than the rate of severe obesity among the population at large.[12]

The various classes of obesity also affect the degrees of CAD, PAD, and stroke that show the prevalence of cardiovascular diseases. However, PAD is found much more frequently in Obesity Class 3 patients, 63. 3% suffering from it, while CAD and stroke are almost equal, 21. Singh et al also suggested that these findings are in accordance with data regarding the findings of significant obesity increasing the probability of PAD development, according to published literature.[13] Based on the research on obesity and cardiovascular diseases it is recommended that all obesity people must be made to be checked often for early signals of this diseases because of the high risks of this diseases.

Diabetes Mellitus is present at an alarming rate in practically all classes of obesity with a tiny difference, higher numbers are seen at Obesity Classes 2 and 3. Meigs et al recommended that this factor agrees with the accepted periods between obesity and diabetes more especially type 2 diabetes where higher BMI is a known risk factor.[14]

The results showed that diabetes is very common in the obese population, highlighting the need for routine checks on the blood sugar level among this population.

Performing the functional mobility tests that include the 10 MWT, 6MWD and the stair climbing test, there are differences across obesity classes. The 6-Minute Walk Test-Normative and Figure 8 Walk Test Times depict noticeable differences with Obese Class differences performing poorly than Class 1 & 2. These outcomes suggest the changes in PA and mobility restrictions due to severe obesity supporting existing knowledge indicating that higher BMI prognosticates reduced physical function.[15]

As it can be seen therefore, across the different obesity classes, the number of participants who practice 1-4 hours of physical activity per week is relatively higher. On the contrary, a pretty high percentage of patients belonging to Obese Class 3 still reports minimal levels of weekly physical exercise, which would not exceed 1 hour a week. Severely obese individuals lack the necessary Physical Activity; Physical inactivity is a well-known chronic disease risk factor. [16]

While Adopt healthy lifestyles that include exercise it developed in phase II; exercise intervention in obese subjects should undergo specific structured exercise programs which will in turn enhance their health and functional status.

Smoking distribution indicate majority of the participants are either Never or Ex-smokers but there is a gradual rise in the smoking with Obesity Class 3. This type of development raises concerns particularly when it is considering the increased vulnerabilities of smokers with severe obesity. [17] Smoking habits should be targeted for the eradication and for this, health campaigns should incorporate cessation programs targeting the obese population due to the risks above highlighted.

It is pertinent to note that the relationship between hypertension and obesity is consistent across the defined classes; that is, hypertension prevalence is higher in the increased proportion of the studied population for each class of obesity. Such conclusion is in compliance with the conclusions made in other research that there exists a relation between obesity and hypertension as the increase in BMI results into increase in the level of blood pressure[18]. It can be said that the important prevention activity may involve the use of exercise and diet in combination with antihypertensive medications in the obese to exclude cardiovascular events.

Limitations and Recommendations
This study has several limitations that must be acknowledged. The cross-sectional design restricts the ability to establish causality between obesity, cardiovascular parameters, and spine and gait problems in postmenopausal women (PMW). With a sample size of 120 participants, the generalizability of the findings to the broader population may be limited. Further research with larger and more diverse populations, utilizing longitudinal designs, is recommended to better understand the causal relationships and long-term effects of severe obesity on health and mobility in PMW.

Conclusion
Obesity significantly affects functional mobility in postmenopausal women, with increasing severity of obesity correlating with poorer performance in gait and walking tests. Specifically, women in Obese Class 3 shown reduced functional gait assessment scores, shorter distances covered in the 6-minute walk test, and greater difficulty in the figure 8 walk test both in terms of time and steps. Both cardiovascular disease and obesity significantly affect functional mobility in postmenopausal women, but their impacts vary. Cardiovascular conditions show less variability in functional mobility scores.

Ethical Consideration:
Written informed consent (attached) will be taken from all the patients. All information and data collection will be kept confidential. Participants will remain anonymous throughout the study.

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