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Association Between Weight-Adjusted Waist Index and Depressive Symptoms in Older Adults

Yaşlı Bireylerde Ağırlıkla Düzeltilmiş Bel Çevresi İndeksi ile Depresif Semptomlar Arasındaki İlişki

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Association Between Weight-Adjusted Waist Index and Depressive Symptoms in Older Adults

ABSTRACT

Objective: Depression is a common and disabling condition in older adults. Identifying simple, non-invasive predictors of depression risk is essential for early intervention. The Weight-Adjusted Waist Index (WWI), a novel anthropometric marker of central adiposity, may be associated with depressive symptoms in older populations. This study aims to investigate the association between WWI and depressive symptoms in adults aged 65 years and older.

Material and Method: This retrospective cross-sectional study included 150 patients aged ≥65 years attending a geriatrics outpatient clinic. Sociodemographic, functional, cognitive, nutritional, and anthropometric data were collected. Depressive symptoms were assessed using the Yesavage Geriatric Depression Scale (GDS), with scores ≥5 indicating depression. WWI was calculated as waist circumference (cm) divided by the square root of weight (kg). Binary logistic regression analysis was performed to identify factors independently associated with depressive symptoms.

Results: Depressive symptoms were present in 53 participants (35.3%). Patients with depressive symptoms had significantly higher WWI values (11.68 ± 0.73 vs. 11.28 ± 0.66, *p<0.001*). In the final regression model, female gender (OR: 3.17; 95% CI: 1.21–8.32; *p=0.019*), lower Standardized Mini-Mental State Examination (SMMSE) score (OR: 0.84; 95% CI: 0.75–0.95; *p=0.005*), higher WWI (OR: 1.66; 95% CI: 0.91–3.02; *p=0.097*), and lower MNA-SF score (OR: 0.76; 95% CI: 0.60–0.97; *p=0.027*) were associated with depressive symptoms.

Conclusion: Higher WWI may be linked to depressive symptoms in older adults. WWI could serve as a simple, non-invasive tool to help identify individuals at increased risk of depression. Longitudinal studies are needed to confirm these findings.

Keywords: Depression, Older adults, Weight-Adjusted Waist Index.

ÖZET

Amaç: Depresyon, yaşlı bireylerde yaygın ve işlevselliği bozan bir durumdur. Depresyon riskini öngörebilecek basit ve invaziv olmayan belirteçlerin tanımlanması, erken müdahale açısından büyük önem taşır. Ağırlıkla Düzeltilmiş Bel Çevresi İndeksi (WWI), santral obezitenin yeni bir antropometrik göstergesi olup yaşlı bireylerde depresif semptomlarla ilişkili olabilir. Bu çalışmanın amacı, WWI ile depresif semptomlar arasındaki ilişkiyi 65 yaş ve üzeri bireylerde incelemektir.

Gereç ve Yöntem: Bu retrospektif kesitsel çalışmaya, geriatri polikliniğine başvuran 65 yaş ve üzeri 150 hasta dâhil edilmiştir. Sosyodemografik, fonksiyonel, bilişsel, beslenme durumu ve antropometrik veriler toplanmıştır. Depresif semptomlar, Yesevage Geriatrik Depresyon Ölçeği (GDÖ) kullanılarak değerlendirilmiş; GDÖ skoru ≥5 olanlar depresyon olarak kabul edilmiştir. WWI, bel çevresinin (cm) vücut ağırlığının (kg) karekköküne bölünmesiyle hesaplanmıştır. Depresif semptomlarla bağımsız olarak ilişkili faktörleri belirlemek için ikili lojistik regresyon analizi uygulanmıştır.

Bulgular: Katılımcıların 53'ünde (%35,3) depresif semptomlar tespit edilmiştir. Depresif semptomları olan hastaların WWI değerleri anlamlı olarak daha yüksekti (11,68 ± 0,73 vs. 11,28 ± 0,66, *p<0,001*). Nihai regresyon modelinde; kadın olmak (OR: 3,17; %95 GA: 1,21–8,32; *p=0,019*), daha düşük Standardize Mini-Mental Durum Muayenesi (SMMSE) skoru (OR: 0,84; %95 GA: 0,75–0,95; *p=0,005*), daha yüksek WWI (OR: 1,66; %95 GA: 0,91–3,02; *p=0,097*) ve daha düşük MNA-SF skoru (OR: 0,76; %95 GA: 0,60–0,97; *p=0,027*) depresif semptomlarla ilişkili bulundu.

Sonuç: Yüksek WWI, yaşlı bireylerde depresif semptomlarla ilişkili olabilir. WWI, depresyon riski yüksek bireyleri belirlemek için kullanılabilecek basit ve invaziv olmayan bir araç olabilir. Bu bulguların doğrulanması için ileriye dönük çalışmalara ihtiyaç vardır.

Anahtar Sözcükler: Ağırlıkla Düzeltilmiş Bel Çevresi İndeksi, Depresyon, Yaşlı bireyler.

Introduction

Depression is one of the most common and disabling mental health conditions in older adults, affecting up to 20% of individuals aged 65 and above and often going underdiagnosed due to atypical presentations and overlapping symptoms with physical illnesses (1). Identifying novel, non-invasive biomarkers that may aid in early detection and risk stratification is critical for improving outcomes in this vulnerable population.

Traditional anthropometric measures such as Body Mass Index (BMI) have limitations in older adults, as they do not distinguish between fat and muscle mass and may underestimate the health risks associated with central adiposity. In contrast, the Weight-Adjusted Waist Index (WWI), calculated as waist circumference (cm) divided by the square root of body weight (kg), has emerged as a promising indicator that independently captures central fat accumulation regardless of overall body size (2). WWI has been shown to reflect fat and muscle mass in opposite directions, increasing with adiposity and decreasing with muscle mass, which is particularly relevant in aging populations prone to both sarcopenia and visceral fat accumulation.

Recent studies have begun to investigate the relationship between WWI and mental health outcomes. In several large-scale cross-sectional and cohort studies, higher WWI values were found to be significantly associated with elevated depressive symptoms, independent of confounding factors such as BMI and comorbidities (3-5). Additionally, hospitalized older patients with higher WWI values were more likely to exhibit depressive symptoms, supporting the utility of WWI in clinical geriatric settings (6). A recent study by Wang et al. further proposed that depressive symptoms may mediate the relationship between WWI and cognitive decline, highlighting the importance of understanding WWI's broader implications in geriatric mental and cognitive health (7).

Despite growing evidence, most studies to date have been conducted in Asian or US populations, with limited data available from diverse older adult populations in different sociocultural contexts. Furthermore, many existing studies rely on secondary data from population health surveys, with few specifically targeting individuals aged 65 and older as a primary focus.

The aim of this study is to investigate the association between WWI and depression in older adults aged 65 years and above in a clinical cohort. By examining this relationship in a population with distinct demographic and lifestyle characteristics, the study seeks to validate previous findings and contribute to the growing body of evidence on WWI as a practical, non-invasive screening tool for mental health risk in older adults.

Material and Method

Study Design and Participants

A retrospective screening was conducted on patients who consecutively applied to the Geriatrics outpatient clinic, and 150 patients aged 65 years and older were included. Exclusion criteria were acute illness, severe cognitive impairment, and incomplete data of anthropometric measurements.

Data Collection

Sociodemographic data, including age, gender, and education duration (categorized as ≤5 years or >5 years), were collected. Comprehensive geriatric assessments were noted, including measures of functionality, cognition, nutrition, comorbidity, and anthropometry. Activities of Daily Living (ADL) were assessed using the Katz Index, with scores ranging from 0 (completely dependent) to 6 (completely independent) (8,9). Instrumental Activities of Daily Living (IADL) were evaluated using the Lawton–Brody scale, ranging from 0 to 8 (10,11). Cognitive status was assessed with the Standardized Mini-Mental State Examination (SMMSE) (12). Frailty was assessed using the Clinical Frailty Scale (CFS, Version 2.0) (13,14) and nutritional status was evaluated using the Mini Nutritional Assessment-Short Form (MNA-SF) (15,16). Handgrip strength was measured using a calibrated handheld dynamometer (T.K.K.5401; Takei Scientific Instruments), with the highest value of three attempts from the dominant hand recorded. Comorbidities were assessed using the Charlson Comorbidity Index, which assigns weighted scores to a range of chronic diseases such as heart disease, diabetes, chronic pulmonary disease, malignancies, and others. The cumulative score reflects the overall

comorbidity burden, with higher scores indicating increased risk of mortality and more severe disease burden (17).

The study was conducted in compliance with the Declaration of Helsinki. Informed consent was not required, as the study was retrospective in design. Ethical approval was obtained from the Ankara Bilkent City Hospital Clinical Research Ethics committee with the reference number of TABED 2-25-1219.

Assessment of Depressive Symptoms

Depressive symptoms were evaluated using the Yesavage Geriatric Depression Scale (GDS) short form (18,19). A GDS score of 5 or higher was considered indicative of clinically relevant depressive symptoms.

Anthropometric Measurements

Height, weight, and waist circumference were measured using standard techniques. Body Mass Index (BMI) was calculated as weight (kg) divided by height squared (m^2). WWI was calculated by dividing waist circumference (cm) by the square root of weight (kg) (2).

Statistical Analysis

All analyses were performed using SPSS software (version 27.0, IBM Corp.). Normally distributed variables were presented as mean ± standard deviation, while non-normally distributed variables were reported as median (interquartile range). Categorical variables were presented as frequencies and percentages. Differences between groups (depressed vs. non-depressed) were compared using the t-test or Mann–Whitney U test for continuous variables and the chi-square test for categorical variables.

To identify factors independently associated with depressive symptoms, a multivariable logistic regression analysis with backward stepwise likelihood ratio method was performed. Variables included in the initial model were age, gender, education duration, ADL, IADL, SMMSE score, WWI, BMI, MNA-SF score, handgrip strength, CFS score, and Charlson Comorbidity Index. Odds ratios (OR) and 95% confidence intervals (CI) were reported. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test, and model performance was evaluated by Nagelkerke R^2 values. A p value <0.05 was considered statistically significant.

Table I. Patient Characteristics Based on Depressive Symptoms

	Depression (n=53)	No Depression (n=97)	*p*
Age	74 (70-79)	71 (68-78)	***0.020***
Gender Female Male	 45 (84.9%) 8 (15.1%)	 49 (50.5%) 48 (49.5%)	***<0.001***
Education duration ≤5 years >5 years	 49 (92.5%) 4 (7.5%)	 59 (60.8%) 38 (39.2%)	***<0.001***
ADL	5 (4-6)	6 (6-6)	***<0.001***
IADL	8 (4-8)	8 (8-8)	***<0.001***
CFS	4 (3-5)	3 (2-3)	***<0.001***
GDS	6 (5-8)	1 (1-3)	***<0.001***
SMMSE	24 (21-27)	28 (26-30)	***<0.001***
MNA-SF	12 (10-14)	14 (13-14)	***<0.001***
Handgrip strength (kg)	18.53 ± 6.52	24.15 ± 7.51	***<0.001***
Charlson comorbidity index	5 (3-6)	4 (3-5)	***0.040***
Height (cm)	156.6 ± 8.7	162.3 ± 8.5	***<0.001***
Weight (kg)	77.6 ± 14.8	77.3 ± 12.4	*0.910*
BMI (kg/m2)	29.7 (27.7-34.7)	28.3 (25.9-32.4)	***0.020***
Waist circumference (cm)	102.4 ± 10.8	98.9 ± 10.0	*0.052*
WWI	11.68 ± 0.73	11.28 ± 0.66	***<0.001***

ADL: Katz Index of Independence in Activities of Daily Living, IADL: Lawton-Brody Instrumental Activities of Daily Living, CFS: Clinical Frailty Scale, GDS: Yesevage Geriatric Depression Scale, SMMSE: Standardized Mini Mental State Examination, MNA-SF: Mini Nutritional Assessment Short Form, WWI: Weight-adjusted waist index

Results

A total of 150 patients aged 65 years and older (62.7% women) were included in the study. The median age of the study population was 73 years (68-78). Baseline characteristics of participants according to depressive symptom status are presented in Table I. Compared to those without depressive symptoms, participants with depressive symptoms were significantly older, and more likely to be women. Lower education duration (≤5 years) was significantly more common in the depression group (*p<0.001*). Functional and cognitive assessments revealed that participants with depressive symptoms had lower scores in ADL and IADL, lower SMMSE scores, and higher CFS scores. Nutritional assessment showed that participants with depressive symptoms had

lower MNA-SF scores and weaker handgrip strength. Anthropometric measurements revealed that although body weight and waist circumference were similar between groups, BMI was significantly higher in individuals with depressive symptoms (median 29.7 vs. 28.3 kg/m^2, *p=0.02*). Importantly, the WWI was significantly higher in participants with depressive symptoms compared to those without (11.68±0.73 vs. 11.28±0.66, *p<0.001*).

Table II. Logistic Regression Analysis of the Independent Factors Associated with depressive symptoms

Odds Ratio		Depression		
		95% CI	p-value	
Model 9 Nagelkerke R^2=0.388	Gender (female)	3.17	1.21-8.32	0.019
	SMMSE	0.84	0.75-0.95	0.005
	WWI	1.66	0.91-3.02	0.097
	MNA-SF	0.76	0.60-0.97	0.027

SMMSE: Standardized Mini-Mental State Examination, WWI: Weight-adjusted waist index, MNA-SF: Mini Nutritional Assessment Short Form, (Only the final step is presented due to the utilization of the backward method.)

In the logistic regression analysis using a backward stepwise likelihood ratio method, several variables were initially entered into the model, including age, gender, education duration, ADL, IADL, SMMSE score, WWI, BMI, MNA-SF score, handgrip strength, CFS score, and Charlson comorbidity index.

In the final model (Step 9), several factors were independently associated with depressive symptoms. Female gender was significantly associated with increased odds of depression (OR: 3.17; 95% CI: 1.21-8.32; *p=0.019*). Lower SMMSE scores were also linked to higher likelihood of depressive symptoms (OR: 0.84; 95% CI: 0.75-0.95; *p=0.005*). Although the association between higher WWI and depressive symptoms did not reach statistical significance (OR: 1.66; 95% CI: 0.91-3.02; *p=0.097*), it demonstrated a meaningful trend. Additionally, lower MNA-SF scores remained significantly associated with depressive symptoms (OR: 0.76; 95% CI: 0.60-0.97; *p=0.027*). The final model showed good fit according to the Hosmer–Lemeshow goodness-of-fit test (*p=0.656*) (Table II).

Discussion

In this cross-sectional study, we examined the association between the WWI and depressive symptoms among older adults aged 65 years and above. Our findings revealed that higher WWI values were associated with a greater likelihood of depressive symptoms, although the association did not reach conventional statistical significance. Additionally, female gender, lower cognitive performance as measured by the SMMSE, and poorer nutritional status were independently associated with depressive symptoms.

Our results are consistent with previous studies demonstrating a relationship between higher WWI and increased depressive symptoms. Li et al. and Shen et al. both reported significant associations between WWI and depression in large, nationally representative cohorts from the United States, independent of traditional obesity indices such as BMI (3,4). Similarly, Zeng et al. confirmed this association in a longitudinal study among middle-aged and older Chinese adults, suggesting that WWI may serve as a stable predictor of depressive symptomatology over time (5). These findings, together with our results, reinforce the emerging evidence that WWI may capture central adiposity and its related metabolic and inflammatory pathways, which could contribute to depression risk.

The biological plausibility linking WWI and depression may be explained through several mechanisms. Central adiposity, more accurately reflected by WWI than BMI, is associated with systemic inflammation, dysregulation of the hypothalamic-pituitary-adrenal axis, and altered neurotransmitter activity, all of which have been implicated in the pathophysiology of depression (2). Notably, WWI reflects fat and muscle mass changes in opposite directions, making it particularly relevant in geriatric populations where sarcopenia and visceral fat accumulation often coexist.

Interestingly, in our study, although the association between WWI and depressive symptoms was clinically meaningful, it did not reach statistical significance (*p=0.097*). Several factors may explain this finding. Our sample size was relatively modest compared to the larger population-based studies such as NHANES analyses (3,4). Furthermore, sociocultural differences in body composition and perception of weight status in older Turkish adults compared

to US and Chinese populations may influence the observed associations. Nevertheless, the direction and strength of the association in our study align with previous findings and suggest that WWI is a promising anthropometric marker worthy of further exploration in diverse populations.

Our findings regarding the association of female gender and depression are consistent with prior research indicating that older women are at higher risk of depression than men (1). Additionally, cognitive impairment and poor nutritional status were independently linked to depression, echoing findings from previous studies that emphasized the interconnected nature of physical, nutritional, and mental health in late life (7,20).

Beyond depression, previous studies have also linked higher WWI values to adverse cognitive outcomes (7,21) and even suicidal ideation (22), further supporting the clinical relevance of WWI as a holistic health risk indicator. In particular, mediation analyses have suggested that depression may serve as an intermediary between WWI and cognitive decline, highlighting the need for early identification and intervention in individuals with elevated WWI. In addition to the anthropometric, nutritional, and cognitive associations explored in this study, a broad range of psychosocial and biological factors contribute to depressive symptoms in older adults. Common risk factors include chronic medical conditions, multimorbidity, physical disability, sensory impairment, poor social support, bereavement, low socioeconomic status, and loneliness (1). Cognitive decline and frailty have also been consistently associated with increased depression risk, as reflected in our findings through lower SMMSE scores and MNA-SF scores among those with depressive symptoms (23).

On the other hand, several protective factors can buffer against depression in this age group. These include strong family and social networks, higher educational attainment, regular physical activity, engagement in meaningful activities, and adequate nutritional status (24). Early identification and intervention through comprehensive geriatric assessment, promotion of social connectedness, and integrated physical and mental health care models are essential in preventing and mitigating depressive symptoms in older populations (25-27). These broader contextual factors should be considered when interpreting the association between WWI and depressive symptoms, as they may mediate or moderate this relationship.

This study has several strengths. It is among the few investigations specifically focusing on the association between WWI and depressive symptoms in a clinical cohort of adults aged 65 years and older. Comprehensive geriatric assessments, including validated measures of cognitive function, nutritional status, physical performance, and depression, strengthen the robustness of our findings.

However, certain limitations should be considered. The cross-sectional design prevents the establishment of causality between WWI and depressive symptoms. The sample size, while adequate for preliminary investigation, may limit the generalizability and statistical power, particularly regarding associations that approached but did not reach conventional significance thresholds. Furthermore, unmeasured confounding factors such as inflammatory markers, physical activity levels, and psychosocial variables were not assessed and may have influenced the observed relationships. Finally, the study population was drawn from a single center, which may limit the external generalizability to broader populations.

Conclusion

Our findings contribute to the growing evidence suggesting that WWI is associated with depressive symptoms in older adults. Although further longitudinal and interventional studies are needed, WWI may offer a simple, non-invasive screening tool to identify individuals at increased risk for depression, enabling earlier interventions aimed at improving mental and physical health outcomes in the aging population.

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