Medical Research Archives

ESMED
European Society of Medicine

OPEN ACCESS

Published: October 31, 2022

Citation: Taher S, Chaaya M, et al., 2022. Physical Activity and Memory Function among Older Adults in Lebanon: Differences by Sex and Rural-Urban Living, Medical Research Archives, [online] 10(10). https://doi.org/10.18103/mra.v10i10.3189

DOI
https://doi.org/10.18103/mra.v10i10.3189

ISSN: 2375-1924

RESEARCH ARTICLE

Physical Activity and Memory Function among Older Adults in Lebanon: Differences by Sex and Rural-Urban Living

Sondos Taher[1], Monique Chaaya[1]*, Martine Elbejjani[2], Salim Adib[1], and Khalil El Asmar[1]

[1] Department of Epidemiology and Population Health, American University of Beirut, Beirut, Lebanon

[2] Department of Internal Medicine, American University of Beirut, Beirut, Lebanon

* mchaaya@aub.edu.lb

ABSTRACT

Introduction: The increase in the population of 60 years and above has led to an increase in dementia. Middle East and North Africa region (MENA) has one of the highest prevalence of dementia. One of the factors revealing promising results in reducing the burden of dementia, yet not researched in MENA and in other parts of the world, is physical activity.

Objective: We aimed to assess the association between subjective and objective physical activity, and memory recall of older adults with no dementia in Lebanon. We also investigated the moderating effect of sex and place of residence on this association.

Methods: This is a secondary data analysis of a cross-sectional study conducted in 2013 on a community of 502 older adults 65 years of age and above, selected randomly from two areas, Lebanon's capital, Beirut, and Mount Lebanon. After excluding those who had dementia diagnoses and who did not have data on physical activity, the eligible sample was 459 persons. Physical activity was assessed by three indicators: physical activity perception, walking half a kilometer, and 2-minute step test (2MST). Memory recall, defined as episodic memory, was measured using a 10-word list-learning test with two outcomes: immediate and delayed. Regression models were performed adjusting for cluster effect. Additionally, associations between main exposures and memory recall were stratified by sex and rural/urban residence at the univariate and multivariate levels.

Results: The findings of this study revealed that the three measures of physical activity were significantly associated with higher memory function, at a significance level of 0.05. The data demonstrated that sex and place of residence did not modify the association between physical activity measures and immediate and delayed memory recall.

Conclusion: Physical activity of older adults should be promoted for a variety of health reasons including improvement of memory recall. Further research is needed to determine the long-term impact on the relationship between physical activity and episodic memory.

Keywords: older, adults, episodic memory, memory recall, physical activity, 2MST

Introduction

Of the global dementia cases, 66% are present in developing countries. However, only 10% of research in this field is conducted in that region[1]. According to the World Health Organization (WHO) dementia report, dementia cases will increase by 125% in the Middle East and North Africa region (MENA) by 2050[2], a heavy toll on the region's public health system. Dementia is characterized by a gradual decline in cognitive functions, which manifests itself first in impairment of the episodic memory[3]. Episodic memory refers to memories that we learn, change, and adapt over time. This includes recalling and recollecting information such as the name of the first pet a person owned or house phone number and it is also responsible for learning and recalling recently processed knowledge. Memory can be defined either by duration or by content[7]. Memory impairment causes mild to severe deterioration in the quality of life of older people who become dependent on others to function well. Furthermore, the person experiencing memory decline is prone to depression, anxiety, apathy, social isolation, and cognitive inactivity[4,5].

To date there is no cure to dementia; research is focusing on uncovering risks and protective factors that could be addressed to reduce the risk of cognitive decline or increase the rate of cognitive function[3]. One of the factors revealing promising results in preventing dementia is being physically active. It would be worth exploring the effect of physical activity on episodic memory which is one of the most important indicators of dementia. Additionally, physical activity varies across contexts within the same population (rural vs. urban) and across populations. Physical activity is understudied in this part of the world. In addition, there has been lack of research examining the relationship between physical activity self-perception, physical activity behavior, and cognitions in older adults[8]. The current study provides different measures of physical activity. Of particular interest is self-perception of physical activity which, similar to self-rated health, could be a powerful indicator of cognitive functioning, in addition to walking at least half a kilometer (km) per month and performing the 2-minute step test (2MST). Consequently, these measures could generate a simple way to assess physical activity and cognitive decline.

A systematic review conducted in 2019 revealed nine key risk factors for dementia which include smoking, diabetes, low level of education, depression, midlife obesity, hypertension, high homocysteine levels, atrial fibrillation, and poor social engagement. It also highlighted that reduced risk was constantly associated with engagement in physical activity as well as fish consumption, light alcohol consumption, and use of statin[9]. Most Arab countries are known to have low physical activity due to their sedentary lifestyle. According to surveillance available in 38 countries, it was found that the physical inactivity rate among Arab countries (43.7%) is higher than non-Arab countries (28.6%)[10]. The prevalence of physical activity among Lebanese adults is estimated at 45%[11].

Worldwide, more women are affected by dementia than men. According to U.S. and European reports, two-thirds of clinically diagnosed dementia and Alzheimer's disease (AD) cases are women[12]. Consequently, sex be a moderator for the relationship between physical activity and memory recall. Apolipoprotein E (APOE4) is the greatest risk factor for AD[13]. It has been shown that females' carriers of APOE4 have a 1.5 higher risk for AD than males[14] and present with greater verbal memory decline over time[15]. More research is needed to confirm the role of sex.

Evidence from a systematic review which included studies from numerous countries established variation in dementia prevalence and incidence based on geographical locations. In rural communities, there is an increased risk of AD (OR = 1.50, 90% CI 1.33–1.69), and this risk further increases for early life rural residence (prevalence OR = 2.22, 90% CI 1.19–4.16; incidence OR = 1.64, 90% CI 1.08–2.50) in comparison to urban residence[16]. Moreover, the variation in physical activity levels between rural and urban places of residence is inconsistent across countries. A study conducted in various parts of the United States found that the odds of physical inactivity increased by 43% for those living in rural areas as compared to urban areas[17]. In Malawi, a study reported that the moderate-to-vigorous physical activity is higher in rural areas[18]. It should be noted that educational levels and socioeconomic status play a role in framing the prominence of physical activity among older adults[19].

Methods

Study Design and Data Sources

This is a secondary data analysis of a cross sectional study conducted in 2013 on 502 community older adults, aged 65 years and above, from two areas in Lebanon. The aim of the cross-sectional study was to assess the prevalence of dementia and associated factors. Trained interviewers collected comprehensive data using face-to-face interviews with the elderly participants and their informants. Information collected included socio-demographic characteristics, behavioral risk factors (including physical activity), cognitive performance (including memory recall), care needs, access to care, as well as information on mental, physical and social health. For more details on the original study, refer to Phung et al.[20]

Sampling and Study Population

A representative sample of 502 participants, 65 years and older, was randomly selected from two Lebanese governorates: Beirut, which is the country's capital, and Mount Lebanon. Two districts were selected from Mount Lebanon as it was a large governorate.

The participants in each area were recruited using a multistage cluster sampling strategy with sample size in each area proportional to its actual size in the population. Each selected older person identified one informant to be included in the study. An informant was defined as someone who knew the participant very well or someone who was the main caregiver for participants who needed special care. After excluding those who were diagnosed with dementia based on the 10/66 algorithm and respondents who did not have data on physical activity, the eligible sample size for this study was 459 persons.

Concepts and Measures

Episodic Memory

Memory recall, defined as episodic memory, was measured using a 10-word list-learning test. Word-list learning tests are one of the most common methods used to measure verbal episodic memory[21]. Ten easy and short random words were read aloud to the study participants with a one-second pause after each word. Each participant was asked to recall as many words as he/she could. This process was repeated twice in the exact manner and a score out of 10 was recorded at each of the three trials. An overall average of the 3 immediate trials was also recorded. This word-list memory process represents a measure of the immediate memory recall. After about 20 minutes of being asked different questions and task performance, the participants were asked to recall the 10 word-list, then a score out of 10 was recorded for every participant, measuring the delayed memory recall. Two outcome variables were recorded as continuous variables: immediate memory recall and delayed memory recall. A higher score represents a better memory function; a score of 0 means no words were recalled and a score of 10 indicates all the words were recalled.

Physical Activity

Physical activity was assessed using both subjective and objective measures. The subjective measure included in the study was physical activity perception. It was assessed using one question: "Taking into account both work and leisure, would you say that you are (1)very physically active; (2)fairly physically active; (3)not very physically active; or (4)not at all physically active". The answers were categorized into 'being physically active' if either of the first two options were selected, otherwise the person was categorized in the 'not physically active' group.

Two objective measures of physical activity were considered in the study. Walking half a kilometer in the past month, used as a binary question, and a 2MST. 2MST was assessed by asking the person to walk in their place for 2 minutes. The interviewer counted the number of steps based on the number of times the knee was lifted to the target set on the wall. The participants were allowed to support themselves on a wall, which makes the 2MST suitable to the elderly people[22]. 2MST was used as a continuous variable similarly to the literature[23].

Covariates

The selection of covariates was based on a thorough review of the literature identifying variables associated with both physical activity and episodic memory. The covariates included socio-demographic factors, and health-related characteristics.

The sociodemographic variables included in this study were age, sex, marital status, education level, and geographic area of residence. Age was recorded as a continuous variable, yet for the

purpose of the study the variable was categorized into less than 75 years, between 75 and 84 years, 85 years and older. Marital status was considered as either married or unmarried. Education level attainment was grouped as either low (none or informal education), medium (primary, intermediate, or vocational) or high (secondary or higher). The geographic area was based on categorizing the selected clusters into rural or urban areas. This categorization was based on multiple definitions from prior studies: The 10/66 Dementia Research Group defined rurality as "low population density and traditional agrarian lifestyle"[24] while Project IMAGE defined rural areas as containing villages rather than cities[16]. Based on these definitions, as well as talking to people who know the area well, the clusters were categorized into rural and urban areas.

Health-related characteristics were assessed by asking if participants had ever been diagnosed with diabetes, hypertension, or had a stroke that needed medical attention (variables categorized as 'Yes' or 'No'). While depression was diagnosed using the Geriatric Mental State AGECAT package (GMS) third edition ('depressed' or 'not depressed'). Weight and height variables were used to compute body mass index (BMI), which was categorized as underweight, normal, overweight, or obese based on their sex.

Statistical Analysis

A descriptive analysis was performed to examine the distribution and variability of outcome variables (immediate and delayed recall), exposure variables (physical activity perception, walking half a kilometer, and the 2MST), and covariates (sociodemographic characteristics and health-related factors). The main outcomes, immediate and delayed memory recall, were treated as continuous variables and presented as the mean number of words recalled with their standard deviation, after checking their normality.

Univariate logistic regression was used to assess association between the two binary main exposures (physical health perception and walking half a kilometer in the past month) and the covariates while the two-sample t-test, ANOVA, and Kruskal-Wallis were used to assess the bivariate association between physical activity measured as 2MST and the potential covariates. Non-parametric Kruskal-Wallis was conducted instead of parametric ANOVA when Levene's Test reported a p-value less than 0.05 which indicated that the variances were not homogeneous and the assumptions of ANOVA were not satisfied.

Bivariate association between main exposure variables and co-variates with the outcomes (immediate and delayed memory recall) were performed using simple linear regression, while adjusting for the cluster effect.

At the multivariate level, a multiple linear regression model was performed to assess the adjusted association between memory recall and the main independent variables, accounting for clustering design by governorates. Covariates incorporated in the multiple regression included those that recorded p-values less than 0.2 in the bivariate associations.

Furthermore, associations between main exposure and memory recall were stratified by sex and rural/urban place of residence at the univariate and multivariate levels. Regression coefficients (Betas) and 95 confidence intervals were reported for males and females in rural and urban geographic area separately. Interaction terms were added to the linear regression models to check for statistical significance of the interaction with sex and geographic area.

The threshold for statistical significance was defined at an alpha level of 0.2 at the bivariate level and 5% at the multivariate level. The beta coefficient along with the 95% confidence interval, and R^2 (explained variation) were reported in the regression models. Statistical analysis was conducted using Stata v13, SPSS v.25 and RStudio version 4.0.3 software.

Results

Sample Profile

The distribution of the 459 study participants considered for the study based on baseline sociodemographic factors, health-related characteristics, and physical activity variables of the respondents is reported in Table I below.

Out of the 459 older adult participants, 71.9% perceived themselves as physically active, while a little over half (51.4%) reported to have walked half a kilometer or more during the month prior to the interview. In addition, 450 participants were able to perform the 2MST. The nine participants who had missing data for the 2MST, were not able to conduct the test due to disability or pain. The

average total steps in the two minutes step test for the overall sample was 90.88 +/-41.48 steps.

Bivariate Analysis

Table I presents the crude association of the main exposures and the covariates with the two memory recall variables of interest (immediate and delayed). All demographic factors except for geographic area were associated with both immediate and delayed memory recall at 0.05 level of significance. As for health-related characteristics, diabetes was significantly associated with both immediate and delayed memory recall. BMI was only significantly associated with immediate recall while hypertension was only associated with delayed recall. Both qualitative measures of physical activity (physical activity perception, walking half a kilometer in the past month) were significantly associated with memory recall. Furthermore, the correlation coefficient for 2MST and immediate memory recall indicated a statistically significant weak positive association; however, the same was not seen for delayed memory recall.

Assessing the associations between all covariates and the three main exposures revealed that age, sex, marital status, education, geographic area, diabetes, hypertension and depression were found associated with physical activity perception at 0.05 level of significance. Walking half a kilometer in the past month was significantly associated with all covariates except for geographic location, BMI, and depression variables. The association between the majority of health-related characteristics and 2MST was not statistically significant. Only education level, geographic area, and BMI were statistically significant with p-values less than 0.05(supplemental table I).

Multivariable Analysis

Tables II, III, and IV present the results of the multiple linear regression analysis of immediate and delayed memory recall with the three main exposures (physical activity perception, walking half a kilometer in the past month, and 2MST) while controlling for potential confounders. Potential confounders were covariates that were associated with both recall variables and main exposures with a p value of <0.2.

Controlling for selected potential confounders, perceiving oneself to be physically active is associated with a significant increase in score of immediate memory recall by 0.556 (95% CI: 0.239-0.873) words on average and increase in the score of delayed memory recall by 0.404 (95% CI: 0.024-0.759) words recalled on average in comparison to those who did not perceive themselves to be physically active (Table II). About 20% and 19% of the variability in immediate recall and delayed memory recall respectively are explained by the significant variables in the model.

After adjusting for age, sex, marital status, education level, diabetes, hypertension, and stroke, walking at least half a kilometer in the past month remained significantly associated with both immediate (β = 0.485; 95% CI: 0.234-0.736) and delayed memory recall (β = 0.395; 95% CI: 0.079-0.712) in comparison to the reference group (Table III). Additionally, the significant variables in both models explained 19.68% and 19.28%, respectively, of the variability in words recalled immediately and after 20 minutes.

Table I. Mean and standard deviation (SD) of two memory recall variables (immediate and delayed memory recall) by main exposures of physical activity and covariates among 459 older Lebanese adults (aged 65years+) in two governorates in Lebanon, in 2013.

Variables	Categories	N(%)*	Immediate memory recall		Delayed memory recall	
			Mean(±SD)	p-value[a]	Mean(±SD)	p-value
Age	Bellow 75	312(68.0)	5.66(1.29)	<0.0001	5.52(1.47)	<0.0001
	75-84	120(26.1)	4.81(1.43)		4.56(1.62)	
	85 and above	27(5.9)	4.90(1.22)		4.07(1.36)	
Sex	Male	210(45.8)	5.63(1.33)	0.001	5.49(1.44)	<0.0001
	Female	249(54.2)	5.19(1.39)		4.93(1.66)	
Marital status	Unmarried	163(35.7)	5.09(1.41)	0.001	4.87(1.65)	0.002
	Married	293(64.3)	5.55(1.34)		5.35(1.52)	
Education level	Low	85(18.5)	4.84(1.42)	<0.0001	4.47(1.65)	<0.0001[b]
	Medium	256(55.8)	5.25(1.34)		5.09(1.57)	
	High	118(25.7)	6.10(1.14)		5.92(1.24)	
Geographic area	Rural	123(26.8)	5.56(1.50)	0.117	5.31(1.61)	0.311
	Urban	336(73.2)	5.33(1.33)		5.14(1.58)	
BMI	Normal	80(17.7)	5.28(1.36)	0.028	5.13(1.64)	0.219
	Overweight	253(55.8)	5.55(1.35)		5.30(1.48)	
	Obese	120(26.5)	5.17(1.41)		5.00(1.73)	
Diabetes	No	318(69.6)	5.50(1.37)	0.01	5.29(1.56)	0.028
	Yes	139(30.4)	5.14(1.38)		4.94(1.63)	
Hypertension	No	245(53.7)	5.50(1.41)	0.09	5.33(1.58)	0.045
	Yes	211(46.3)	5.28(1.34)		5.03(1.57)	
Stroke	No	433(94.7)	5.42(1.36)	0.137	5.21(1.57)	0.102
	Yes	24(5.3)	4.87(1.70)		4.67(1.76)	
Depression	No	419(91.3)	5.43(1.34)	0.159	5.22(1.54)	0.230
	Yes	40(8.7)	5.03(1.68)		4.85(1.85)	
Physical activity perception	No	128(28.1)	4.84(1.47)	<0.0001	4.65(1.68)	<0.0001
	Yes	328(71.9)	5.61(1.28)		5.38(1.50)	
Walked half a kilometer in the past month	No	191(48.6)	5.04(1.35)	<0.0001	4.80(1.63)	<0.0001
	Yes	202(51.4)	5.83(1.18)		5.62(1.31)	
2MST	Mean and SD	90.88(41.48)	0.099	0.035	0.079	0.094

**"%" represents valid percentage. [a]p-value based of the t-test and ANOVA, [b]p-value from Kruskal-Wallis test.*

The main exposure 2MST was significantly associated with immediate memory recall after controlling for education level, geographic area and BMI (Table IV). A one step increase on the 2MST while controlling for all other significant covariates resulted in increase of 0.004 mean word recall on the immediate memory recall measure (95% CI: 0.0001-0.008). The model demonstrated that only 13.39% of the variability in immediate memory recall is explained by 2MST, education level, geographic area, and BMI. However, the association between 2MST and delayed memory recall remained insignificant after adjusting for education level.

Table II. Multiple linear regression analysis for immediate and delayed memory recall as the outcomes and physical activity perception as main exposure adjusted for cluster effect, among 459 older Lebanese adults (aged 65years+) in two governorates in Lebanon, in 2013.

Variable	Immediate memory recall			Delayed memory recall		
	Adjusted (β)[a]	95% CI	R^2	Adjusted (β)[b]	95% CI	R^2
Physical activity perception	0.556**	[0.239 - 0.873]	0.1986	0.404*	[0.029 - 0.759]	0.1908

*[a]β was adjusted for age, sex, marital status, education level, geographic area, diabetes, hypertension, and depression. [b]β was adjusted for age, sex, marital status, education level, diabetes, and hypertension. *indicates there was a significance difference between delayed memory recall and physical activity perception at p <0.05. **indicates that there was a significance difference between immediate memory recall and physical activity perception at p <0.01.*

Table III. Multiple linear regression analysis for immediate and delayed memory recall as the outcomes and walked half a kilometer in the past month as main exposure adjusted for cluster effect, among 459 older Lebanese adults (aged 65years+) in two governorates in Lebanon, in 2013.

Variable	Immediate memory recall			Delayed memory recall		
	Adjusted (β)[a]	95% CI	R^2	Adjusted (β)[a]	95% CI	R^2
Walked half a kilometer in the past month	0.485**	[0.234 - 0.736]	0.1968	0.395*	[0.079 - 0.712]	0.1928

*[a]β was adjusted for age, sex, marital status, education level, diabetes, hypertension, and stroke. *indicates that there was a significance difference between delayed memory recall and walking half a kilometer in the past month at p <0.05. **indicates that there was a significance difference between immediate memory recall and walking half a kilometer in the past month at p <0.01.*

Table IV. Multiple linear regression analysis of immediate and delayed memory recall as the outcome and 2MST as main exposure adjusted for cluster effect.

Variable	Immediate memory recall			Delayed memory recall		
	Adjusted (β)[a]	95% CI	R^2	Adjusted (β)[b]	95% CI	R^2
2MST	0.004*	[0.0001 - 0.008]	0.1339	0.004	[-0.0001 – 0.009]	0.1057

*[a]β was adjusted for education level, geographic area, and BMI. [b]β was adjusted for education level. *indicates that there was a significance difference between immediate memory recall and 2MST at p <0.05.*

Stratified Analysis by sex and Rural/Urban Living

Sex and geographic location did not modify the association between physical activity (physical activity perception, walking at least half a kilometer in the past month, 2MST) and both the outcomes, immediate and delayed memory recall. Adjusted regression coefficients of the association between main exposures and memory recall were not different when data were stratified by sex and geographic area. All interaction terms were not statistically significant (Table V).

Table V. Crude and adjusted beta coefficients of memory recall outcome (immediate and delayed memory recall) for main exposures of physical activity, stratified by sex and geographic area, among 459 older Lebanese adults (aged 65years+) in two governorates in Lebanon, in 2013

Table V. Multiple linear regression analysis of immediate and delayed memory recall as the outcome and 2MST as main exposure adjusted for cluster effect, among 459 older Lebanese adults (aged 65years+) in two governorates in Lebanon, in 2013.

Outcome	Exposure	Stratum	Crude (β)	95% CI	Adjusted (β)	95% CI	Interaction term p-value
Immediate memory recall	Physical activity perception	Male	0.695**	[0.277 - 1.112]	0.550*[a]	[0.132 – 0.967]	0.521
		Female	0.763**	[0.401 – 1.126]	0.492*[a]	[0.071 – 0.913]	
		Rural	0.681*	[0.129 – 1.234]	0.558[b]	[-0.008 – 1.125]	0.989
		Urban	0.872**	[0.555 – 1.189]	0.573*[b]	[0.132 – 1.014]	
	Walked half a kilometer in the past month	Male	0.831**	[0.461 – 1.200]	0.594**[c]	[0.289 – 0.899]	0.612
		Female	0.684**	[0.314 – 1.055]	0.437*[c]	[0.074 – 0.801]	
		Rural	0.956**	[0.421 – 1.492]	0.473[d]	[-0.068 – 1.015]	0.468
		Urban	0.732**	[0.448 – 1.016]	0.419**[d]	[0.136 – 0.701]	
	2MST	Male	0.001	[-0.003 - 0.005]	0.001[e]	[-0.004 – 0.006]	0.184
		Female	0.005*	[0.001 - 0.010]	0.006**[e]	[0.002 – 0.010]	
		Rural	0.0002	[-0.004 – 0.008]	0.004[f]	[-0.002 – 0.10]	0.938
		Urban	0.003	[-0.001 – 0.007]	0.004*[f]	[0.0004 – 0.008]	
Delayed memory recall	Physical activity perception	Male	0.522*	[0.062 – 0.882]	0.414[h]	[-0.133 – 0.961]	0.862
		Female	0.798**	[0.364 – 1.231]	0.332[h]	[-0.055 – 0.721]	
		Rural	0.686*	[0.095 – 1.278]	0.468*[i]	[0.024 – 0.911]	0.726
		Urban	0.803**	[0.421 – 1.185]	0.446[i]	[-0.052 – 0.944]	
	Walked half a kilometer in the past month	Male	0.648**	[0.233 – 1.063]	0.323[c]	[-0.078 – 0.725]	0.389
		Female	0.820**	[0.380 – 1.261]	0.468*[c]	[0.006 – 0.930]	
		Rural	0.722*	[0.108 – 1.335]	0.029[d]	[-0.845 – 0.903]	0.572
		Urban	0.854**	[0.520 – 1.189]	0.465*[d]	[0.127 – 0.804]	
	2MST	Male	-0.0004	[-0.006 – 0.005]	0.001[i]	[-0.007 – 0.008]	0.131
		Female	0.005*	[0.001 – 0.009]	0.007*[i]	[0.003 – 0.011]	
		Rural	0.006	[-0.001 – 0.013]	0.008[i]	[-0.001 – 0.016]	0.183
		Urban	0.001	[-0.003 – 0.006]	0.002[i]	[-0.002 – 0.006]	

*[a]beta was adjusted for age, education level, geographic area, diabetes, hypertension, and depression. [b]beta was adjusted for age, sex, education level, diabetes, hypertension, and depression. [c]beta was adjusted for age, marital status, education level, diabetes, hypertension, and stroke. [d]beta was adjusted for age, sex, marital status, education level, diabetes, hypertension, and stroke. [e]beta was adjusted for education level, geographic area, and BMI. [f]beta was adjusted for education level and BMI. [h]beta was adjusted for age, marital status, education level, diabetes, and hypertension. [i]beta was adjusted for age, sex, marital status, education level, diabetes, and hypertension. [i]beta was adjusted for education level. *the association was significant at p <0.05. **indicates that the association was significant at p <0.01.*

Discussion

Findings of this study revealed that the three measures assessing physical activity were significantly associated with higher memory function, an important indicator of cognitive functioning and decline. Perceiving oneself as physically active is significantly associated with better episodic memory, both for the immediate and delayed memory recall. The same trend can be seen when walking half a kilometer at once.

Richard et al. have reported a it's a significant association of walking in the past month with memory performance after accounting for sex, education, and physical and mental health. Additionally, the research revealed a causal link suggesting that recent activity protects and enhances memory[25]. The higher levels of norepinephrine, which promotes alertness, and retrieval of information were detected in participants who walked even on the day of no activity, highlighting the importance of walking on the brain[26]. The 2MST, a practical alternative to 6MWT[23], is reported to be positively associated with immediate memory recall only. The results of this study support the hypothesis which states that older adults who are physically active have higher memory recall function than those who are not, and therefore physical activity and memory are significantly associated. There are several mechanisms that could explain the increase in episodic memory and consequently prevention of dementia. It was found that the function and performance of episodic memory is partially driven by the structure and functions of the brain[27]. Thus, increased brain blood flow resulted in better memory recall. One of the mechanisms to achieve better brain blood flow is by exercising[28]. Improving cerebral blood flow in the left frontal and temporal cortices as well as bilateral medial frontal and anterior cingulate cortices could result in improving various cognitive domains including memory[29].

There are two forms of measurement for physical activity. Commonly scientists use objective measures such as accelerometers which allows for the measurement of frequency, intensity, and duration. It helps in collecting information about physical activity levels and sedentary behavior. On the other hand, a less common instrument is self-reported physical activity which indicates the perception of perceived time spent being active. It involves a complex construct that refers to how numerous aspects of health, both subjective and objective, are combined within the perceptual framework of the individual respondent[30]. Physical activity does not pose a constructive definition but rather is influenced by factors such as the presence of diseases, the existence of a disability, physical function, and the rate of aging[31]. When comparing self-reported physical activity to an accelerometer in adults, it was found that on average the adults reported more physical activity on the questionnaire than recorded on the accelerometer[32]. Thus, although accelerometers are a reliable measure across, they lack reporting about other dimensions of physical activity. This is because they are limited in their ability to measure upper body movement, leisure, household, water activity, and transportation activity such as cycling[33].

Perceived physical activity is especially important in the elderly group as it does not restrain physical activity into one dmension, rather self-reporting physical activity reflects a wholesome life of feeling active. Previous studies of community-dwelling elderly show that elderly persons perceived physical activity as everyday activities[34]. Mainly they described physical activity as any movement such as walking from the living room to the kitchen, practicing hygiene, or performing a hobby like gardening[35]. This is reflected in our study where 71.9% of the participants perceived themselves to be physically active, yet only 51.4% stated to have walked a half a kilometer at once in the past month. Moreover, there is lack of research specifically on the role of physical activity perception in increasing fitness, improving health, and cognitive functioning including memory[36,37]. Several novel findings resulted from our findings. Most importantly, this study, using secondary cross-sectional design, succeeded in providing evidence that physical activity perception is significantly associated with improved memory recall function, also known as episodic memory. With further research establishing causality, physical activity perception can be used by practitioners for elderly as a less costly beneficial tool for detecting the first risk factor to dementia which is deterioration of the episodic memory[5].

The MENA region suffers from a high burden of non-communicable disease (NCD). A key risk factor linked to NCDs is physical inactivity which has reached alarming levels in the MENA region. Globally, this region has the second-highest level of physically inactive populations among WHO regions. For instance, the prevalence of physical inactivity is 82.3% among Syrian adults and 96.1% in Saudi Arabia[38]. Almost 40% of the Lebanese population were reported to have a sedentary lifestyle with no physical activity while 35% reported spending more than 12 hours/day sitting[39]. Many elderly with chronic conditions take their disease as a reason for not exercising.

Although the health condition of a person may restrict their physical activity participation, most NCDs should act as a motivator for the person to perform more physical activity to improve their health status. A person's perception of the impact of physical activity on their health status will influence their engagement in the practice of physical activity. Subsequently, physical activity will lead to improving balance and walking ability, reducing muscle pain, and improving sleep which acts as a facilitator for the continuation of physical activity as well as help in managing numerous types of NCDs[40]. Nonetheless, ministries in Lebanon are facing challenges in regards to prevention and treatment of NCDs -specifically the promotion of physical activity- due to funding, lack of data and research, and lack of laws[41].

Physical activity is critical in the elderly population group as it helps in preventing and/or delaying physical conditions as well as a decline in cognitive functions such as memory. To promote physical activity in an aging population, it is important to know what motivates older people to be active and to optimize engagement[42]. However, studies that focus on factors that influence the pattern of physical activity in the MENA region remain very scarce[43].

A predominant view in the Lebanese culture is that beyond a certain age, the approach to older adult care is watchful thinking while awaiting the ultimate outcome: death. This waiting approach negatively affects the elderly sense of reciprocity and autonomy affecting their physical and mental state. The Permanent National Commission on the Elderly (PNCE), consisting of several ministries, was established in 1999 to address issues of elderly care and ageism in Lebanon. Among its priorities is to conduct studies on elderly needs in Lebanon. However, the Commission is distorted by political interference hindering its productivity[44]. Negative stereotyping of older adults is endemic in the Lebanese culture as well as the lack of awareness campaigns. Besides, it is a big misconception that dementia is a normal part of aging. In fact, it is not and many individuals live their entire life without developing dementia[45]. Therefore, educating the elderly, their family, and caregivers is important to empower them, have a better quality of life, and give them the ability to make decisions regarding their health. Lebanon and the Arab region could dedicate an Annual Elderly Care Awareness week that includes campaigns, talk shows, and documentaries related to the elderly and ageism such as educating programs that discuss the stigma about dementia and the importance of being physically active on a daily basis. Researchers should be given incentives through facilitating grants to pursue research about mental health while keeping data collection and analysis centralized in the MENA region to have the most efficient and comparable results. Moreover, the Lebanese society should embrace and support the elderly community by establishing senior citizen programs and senior transportation systems[46]. According to a systematic review conducted in the MENA region, lack of suitable sports facilities and social support are some of the barriers to physical activity. Some of the common socio-demographic factors negatively associated with physical activity are being a female, being less educated, and being married[40].

Our findings suggest that the association between physical activity and episodic memory is the same between males and females. One of the reasons for not detecting significant differences unlike the majority of the literature could be explained by a study conducted on a sample of elderly in their sixties in Australia[51]. It found that males and females had overlapping motivating factors and context preference for performing physical activity that could also be the case in our sample[51]. On the contrary, it is demonstrated that the effect of resistance training on improving episodic memory approached statistical significance in the female participants[47]. It is said that physical activity enhances the maintenance of endogenous estradiol and testosterone. These two hormones were found to strengthen episodic memory in women[47]. In healthy (no dementia) elderly populations, in both cross-sectional and longitudinal studies, females tend to outperform males on episodic memory tests[48-50].

There are variations in exerted influence on participating in physical activity between urban and rural areas. A study conducted on Lebanese adults reported an inverse association between socioeconomic factors and physical activity level suggesting the negative influence of urbanization[31].

Our study revealed no interaction effect between area of residence and the association between physical activity and episodic memory. Suggesting that physical activity will improve

immediate and delayed memory recall regardless of the rate of urbanization in the area of residence. Our study reveals that a higher prevalence of people living in rural areas perceived themselves to be physically active. The same trend is indicated when considering the 2MST where elderly living in rural areas scored a higher mean number of steps. This finding is inline with other studies[51].

This finding emphasizes the importance of putting more effort into encouraging and supporting older adults living in urban areas to engage in physical activities[52].

Another strategy to mitigate the lack of physical activity facilities in the urban areas is to build sports cities similar to the Aspire Zone in Qatar and Zayed Sports City in the UAE, offering several facilities ranging from sports venues, parks, and open-air activities.

Cognitive studies on elderly population are scarce in the MENA region, although the region, mostly composed of developing countries, has a large number of older adults but most importantly has one of the highest prevalence rate of dementia[53]. Country-specific sociocultural and environmental factors should be considered in the design of interventions that include physical activity as one of its components. Monitoring daily activity using a smartphone or a fitness tracker could help encourage the elderly to indulge in regular physical activity. Elderly individuals need more social support than younger adults to remain physically active[40]. Health professionals can encourage the elderly to participate in group exercises appropriate for their age, skills, and ability. Encouraging physical activity can act as an investment towards reducing medical costs from dementia and other NCDs and improve health status simultaneously.

Study Strengths

The current study included several strengths. To the best of our knowledge, this is the first study in Lebanon and the MENA region that measures the association between physical activity and episodic memory among the elderly in community dwellings. This study has used cross-sectional data from a representative sample of community older adults aged 65 years and above living in Beirut and Mount Lebanon[20] which enhances external validity of the results. In addition, the word list recall test has been extensively used in literature as a measure of episodic memory which facilitated an easy comparison of our results with other studies. It is one of the most common measures to assess episodic memory performance[54]. The 2MST has a good sensitivity and is used to predict physical activity status, aerobic capacity, and VO2 peak[55]. Well-trained interviewers assessed the main exposures, covariates and outcomes. This process assured reduction of information bias. Furthermore, rigorous analysis methods were used for example, multivariate regression models were adjusted for clustering effect which resulted in narrower confidence interval and enhanced precision.

Study Limitations

However, there are few limitations to this study. Cross-sectional studies in nature do not investigate temporality and causality between mental health outcome and physical activity context. The possibility of a good memory function affecting people's engagement in physical activity is very plausible. Conducting prospective studies starting with baseline memory function and physical activity is needed to clarify the direction of the relationship. Moreover, it was challenging to find abundance of studies that measured physical activity in the elderly populations using similar indicators. As well, there is a gap regarding the use of physical activity perception as an indicator of physical health evaluating sex and rural/urban differences[36]. Since physical activity perception is a subjective measure, it is prone to random error that is non-differential as well as measurement bias due to how the person is feeling at the day of the interview which may have influenced their perception. Further, the variable "walking half a kilometer in the past month" was asked to participants as a binary question. This may have resulted in recall bias, however leading to non-differential misclassification by participants. Social desirability bias is another type of information bias given that data were collected by face to face interview. Future studies should include a larger sample size with additional geographic locations to better detect any significant interaction between sex and/or area of residence with the association between physical activity and episodic memory.

Conclusion

In conclusion, subjective and objective physical activity are associated with better episodic memory in elderly with no dementia. Sex and area of residence do not modify the relationship between physical activity and memory recall. This study provides good evidence to strongly recommend addressing the sedentary lifestyle epidemic by creating initiatives to increase movement in the elderly group to ultimately help prevent dementia. Future prospective studies are needed to establish the temporal association of physical activity to memory recall and assess the log term impact of physical activity. Prospective studies could also be used to measure impact of interventions targeting promoting and improving phsycal activity of older adults.

Ethics and consent

The original study was IRB approved. The IRB protocol number that was assigned to the study is FHS.MC.19. The data used for the secondary analysis was deidentified data. Ethical review and approval of this study was also obtained from AUB IRB.

Competing interests

The authors have no competing interests to declare.

References

1. The 10/66 Dementia Research Group. https://1066.alzint.org/. Published 2008. Accessed.
2. Haidari B. Dementia treatment options in the Middle East. https://www.middleeastmedicalportal.com/dementia-treatment-options-in-the-middle-east/#:~:text=Dementia%20statistics&text=The%20projected%20increases%20in%20dementia,increase%20in%20an%20ageing%20population. Published 2020. Accessed.
3. Ye M, Wang L, Xiong J, Zheng G. The effect of mind-body exercise on memory in older adults: a systematic review and meta-analysis. *Aging Clin Exp Res*. 2020.
4. MayoClinic. Triglycerides: Why do they matter? https://www.mayoclinic.org/diseases-conditions/high-blood-cholesterol/in-depth/triglycerides/art-20048186. Published 2020. Accessed.
5. WHO. Dementia. https://www.who.int/news-room/fact-sheets/detail/dementia#:~:text=Worldwide%2C%20around%2050%20million%20people%20have%20dementia%2C%20with%20nearly%2060,is%20between%205%2D8%25. Published 2020. Accessed.
6. King AC, Rejeski WJ, Buchner DM. Physical activity interventions targeting older adults. A critical review and recommendations. *Am J Prev Med*. 1998;15(4):316-333.
7. Camina E, Güell F. The Neuroanatomical, Neurophysiological and Psychological Basis of Memory: Current Models and Their Origins. *Frontiers in Pharmacology*. 2017;8(438).
8. Sales M, Levinger P, Polman R. Relationships between self perceptions and physical activity behaviour, fear of falling, and physical function among older adults. *European Review of Aging and Physical Activity*. 2017;14(1):17.
9. Anstey KJ, Ee N, Eramudugolla R, Jagger C, Peters R. A Systematic Review of Meta-Analyses that Evaluate Risk Factors for Dementia to Evaluate the Quantity, Quality, and Global Representativeness of Evidence. *J Alzheimers Dis*. 2019;70(s1):S165-s186.
10. Kahan D. Adult physical inactivity prevalence in the Muslim world: Analysis of 38 countries. *Prev Med Rep*. 2015;2:71-75.
11. Al-Tannir M, Kobrosly S, Itani T, El-Rajab M, Tannir S. Prevalence of physical activity among Lebanese adults: a cross-sectional study. *J Phys Act Health*. 2009;6(3):315-320.
12. Beam CR, Kaneshiro C, Jang JY, Reynolds CA, Pedersen NL, Gatz M. Differences Between Women and Men in Incidence Rates of Dementia and Alzheimer's Disease. *J Alzheimers Dis*. 2018;64(4):1077-1083.
13. Brouwers N, Sleegers K, Van Broeckhoven C. Molecular genetics of Alzheimer's disease: an update. *Ann Med*. 2008;40(8):562-583.
14. Farrer LA, Cupples LA, Haines JL, et al. Effects of age, sex, and ethnicity on the association between apolipoprotein E genotype and Alzheimer disease. A meta-analysis. APOE and Alzheimer Disease Meta Analysis Consortium. *Jama*. 1997;278(16):1349-1356.
15. Beydoun MA, Boueiz A, Abougergi MS, et al. Sex differences in the association of the apolipoprotein E epsilon 4 allele with incidence of dementia, cognitive impairment, and decline. *Neurobiol Aging*. 2012;33(4):720-731.e724.
16. Russ TC, Batty GD, Hearnshaw GF, Fenton C, Starr JM. Geographical variation in dementia: systematic review with meta-analysis. *Int J Epidemiol*. 2012;41(4):1012-1032.
17. Helgadóttir B, Owen N, W. Dunstan D, Ekblom Ö, Hallgren M, Forsell Y. Changes in physical activity and sedentary behavior associated with an exercise intervention in depressed adults. *Psychology of Sport and Exercise*. 2017;30:10-18.
18. Pratt M, Sallis, J. F., Cain, K. L., Conway, T. L., Palacios-Lopez, A., Zezza, A., Spoon, C., Geremia, C. M., Gaddis, I., Amankwah, A., Friedman, J., & Kilic, T. . Physical activity and sedentary time in a rural adult population in Malawi compared with an age-matched US urban population. *BMJ open sport & exercise medicine*. 2020.
19. Hariharan A. *The correlates of physical activity in rural and urban older adults*, Iowa State University; 2010.
20. Phung KTT, Chaaya M, Prince M, et al. Dementia prevalence, care arrangement, and access to care in Lebanon: A pilot study. *Alzheimers Dement*. 2017;13(12):1317-1326.

21. Tatsumi IF, Watanabe M. Verbal Memory. In: Binder MD, Hirokawa N, Windhorst U, eds. *Encyclopedia of Neuroscience*. Berlin, Heidelberg: Springer Berlin Heidelberg; 2009:4176-4178.
22. Różańska-Kirschke A, Kocur P, Wilk M, Dylewicz P. The Fullerton Fitness Test as an index of fitness in the elderly. *Medical Rehabilitation*. 2006.
23. Alosco ML, Spitznagel MB, Raz N, et al. The 2-minute step test is independently associated with cognitive function in older adults with heart failure. *Aging Clin Exp Res*. 2012;24(5):468-474.
24. Prince M, Ferri CP, Acosta D, et al. The protocols for the 10/66 dementia research group population-based research programme. *BMC Public Health*. 2007;7:165.
25. Richards M, Hardy R, Wadsworth ME. Does active leisure protect cognition? Evidence from a national birth cohort. *Soc Sci Med*. 2003;56(4):785-792.
26. Poehlman ET. Influence of endurance training on energy intake, norepinephrine kinetics, and metabolic rate in older individuals. Poehlman E, Gardner A, Goran M. Metabolism 1992;41 (September):941-8. *Metabolism*. 2005;54(9):1267.
27. Antunes HK, T. DMM. Effects of a physical fitness program on memory and blood viscosity in sedentary elderly men. *Braz J Med Biol Res*. 2015;48(9).
28. Coyle EF. Physical activity as a metabolic stressor. *Am J Clin Nutr*. 2000;72(2 Suppl):512s-520s.
29. Hattori N, Yabe I, Hirata K, et al. Brain regions associated with cognitive impairment in patients with Parkinson disease: quantitative analysis of cerebral blood flow using 123I iodoamphetamine SPECT. *Clin Nucl Med*. 2013;38(5):315-320.
30. Dostálová R, Stillman C, Erickson KI, Slepička P, Mudrák J. The Relationship between Physical Activity, Self-Perceived Health, and Cognitive Function in Older Adults. *Brain Sci*. 2021;11(4).
31. Lohne-Seiler H, Hansen BH, Kolle E, Anderssen SA. Accelerometer-determined physical activity and self-reported health in a population of older adults (65–85 years): a cross-sectional study. *BMC Public Health*. 2014;14(1):284.
32. Colley RC, Butler G, Garriguet D, Prince SA, Roberts KC. Comparison of self-reported and accelerometer-measured physical activity in Canadian adults. *Health Rep*. 2018;29(12):3-15.
33. Cust AE, Smith BJ, Chau J, et al. Validity and repeatability of the EPIC physical activity questionnaire: a validation study using accelerometers as an objective measure. *International Journal of Behavioral Nutrition and Physical Activity*. 2008;5(1):33.
34. Mahrs Träff A, Cedersund E, Nord C. Perceptions of physical activity among elderly residents and professionals in assisted living facilities. *European Review of Aging and Physical Activity*. 2017;14(1):2.
35. Welmer AK, Mörck A, Dahlin-Ivanoff S. Physical activity in people age 80 years and older as a means of counteracting disability, balanced in relation to frailty. *J Aging Phys Act*. 2012;20(3):317-331.
36. Baceviciene M, Jankauskiene R, Emeljanovas A. Self-perception of physical activity and fitness is related to lower psychosomatic health symptoms in adolescents with unhealthy lifestyles. *BMC Public Health*. 2019;19(1):980.
37. Tuakli-Wosornu YA, Rowan M, Gittelsohn J. Perceptions of physical activity, activity preferences and health among a group of adult women in urban Ghana: a pilot study. *Ghana Med J*. 2014;48(1):3-13.
38. Sibai AM, Hwalla N. WHO STEPS chronic diseases risk factor surveillance: American University of Beirut. file:///C:/Users/user/Downloads/WHO_Databook_Lebanon_2010_final%20(1).pdf. Published 2010. Accessed.
39. Sibai AM, Tohme R, Mahfoud Z, Chaaya M. *Non-communicable Diseases and Behavioral Risk Factor Survey*. 2009.
40. Chaabane S, Chaabna K, Doraiswamy S, Mamtani R, Cheema S. Barriers and Facilitators Associated with Physical Activity in the Middle East and North Africa Region: A Systematic Overview. *Int J Environ Res Public Health*. 2021;18(4).
41. WHO. *Regional workshop on developing plans of action for promotion of physical activity and prevention and control of obesity*. 2010.
42. van Uffelen JGZ, Khan A, Burton NW. Gender differences in physical activity motivators and context preferences: a population-based study in people in their sixties. *BMC Public Health*. 2017;17(1):624.

43. Sibai AM, Costanian C, Tohme R, Assaad S, Hwalla N. Physical activity in adults with and without diabetes: from the 'high-risk' approach to the 'population-based' approach of prevention. *BMC Public Health*. 2013;13:1002.
44. DAIH. Lebanon: NGO Report on MIPPAA Progress 2002–2007. http://globalag.igc.org/agingwatch/events/ngos/Lebanon.pdf. Accessed2022.
45. CDC. What Is Dementia? https://www.cdc.gov/aging/dementia/index.html. Published 2019. Accessed.
46. Chemali Z, Chahine LM, Sibai AM. Older adult care in Lebanon: towards stronger and sustainable reforms. *East Mediterr Health J*. 2008;14(6):1466-1476.
47. Barha CK, Davis JC, Falck RS, Nagamatsu LS, Liu-Ambrose T. Sex differences in exercise efficacy to improve cognition: A systematic review and meta-analysis of randomized controlled trials in older humans. *Front Neuroendocrinol*. 2017;46:71-85.
48. Lundervold AJ, Wollschläger D, Wehling E. Age and sex related changes in episodic memory function in middle aged and older adults. *Scand J Psychol*. 2014;55(3):225-232.
49. Sunderaraman P, Blumen HM, DeMatteo D, Apa ZL, Cosentino S. Task demand influences relationships among sex, clustering strategy, and recall: 16-word versus 9-word list learning tests. *Cogn Behav Neurol*. 2013;26(2):78-84.
50. Pauls F, Petermann F, Lepach AC. Gender differences in episodic memory and visual working memory including the effects of age. *Memory*. 2013;21(7):857-874.
51. Taylor D. Physical activity is medicine for older adults. *Postgraduate Medical Journal*. 2014;90(1059):26-32.
52. Fahs I, Khalife Z, Malaeb D, Iskandarani M, Salameh P. The Prevalence and Awareness of Cardiovascular Diseases Risk Factors among the Lebanese Population: A Prospective Study Comparing Urban to Rural Populations. *Cardiol Res Pract*. 2017;2017:3530902.
53. Guerchet M, Prince M, Albanese E, Prina M. *Numbers of people with dementia around the world*. Alzheimer's Disease International2017.
54. UCSF. Memory. https://memory.ucsf.edu/symptoms/memory. Published 2021. Accessed.
55. Guedes M, Lopes J, Andrade A, Guedes T, Ribeiro J, Cortez L. Validation of the two minute step test for diagnosis of the functional capacity of hypertensive elderly persons. *SciEo Brazil*. 2015.

SUPPLEMENTARY MATERIAL

Supplemental Table I. The distribution of 459 older adults by covariates and main exposures.

Covariates	Categories	Physical activity perception		Walked half a kilometer		2MST	
		N(%)	p-value[a]	N(%)	p-value[a]	Mean(±SD)	p-value[b]
Age	Bellow 75	244(78.46)	-	160(59.26)	-	87.42(37.75)	
	75-84	67(56.30)	<0.0001	33(33.33)	<0.0001	101.47(49.16)	0.052
	85 and above	17(65.38)	0.13	9(37.50)	0.044	85.71(40.81)	
Sex	Male	159(76.44)	-	120(67.42)	-	89.10(37.28)	-
	Female	169(68.15)	0.049	82(38.14)	<0.0001	92.37(44.71)	0.398
Marital status	Unmarried	108(66.26)	-	53(37.06)	-	94.47(45.62)	-
	Married	219(75)	0.047	148(59.44)	<0.0001	88.04(38.11)	0.131
Education level	Low	53(63.86)	-	29(40.28)	-	106.45(55.16)	
	Medium	175(68.63)	0.421	96(44.86)	0.498	86.50(37.59)	0.004
	High	100(84.75)	0.001	77(71.96)	<0.0001	89.21(35.46)	
Geographic area	Rural	76(62.81)	-	52(53.06)	-	107.25(43.08)	-
	Urban	252(75.22)	0.010	150(50.85)	0.704	84.86(39.26)	<0.0001
BMI	Normal	55(69.62)	-	33(47.14)	-	105.81(44.50)	
	Overweight	195(77.08)	0.072	130(59.36)	0.071	85.32(34.59)	<0.0001
	Obese	73(61.86)	0.261	35(35.35)	0.125	93.11(49.76)	
Diabetes	No	240(75.71)	-	155(56.99)	-	91.40(41.74)	-
	Yes	88(63.31)	0.007	47(38.84)	0.001	88.21(39.42)	0.450
Hypertension	No	187(76.95)	-	120(55.81)	-	93.68(44.60)	-
	Yes	138(65.71)	0.008	80(45.71)	0.048	87.68(37.45)	0.126
Stroke	No	315(72.92)	-	198(52.80)	-	90.91(41.92)	-
	Yes	13(54.17)	0.052	4(22.22)	0.018	80.25(34.38)	0.257
Depression	No	308(73.86)	-	187(51.23)	-	90.09(39.24)	-
	Yes	20(51.28)	0.004	15(53.57)	0.811	99.17(60.30)	0.362

[a]p-value based of the logistic regression, [b]p-value based on t-test and Kruskal-Wallis.