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A case-control study addressing the association between elevated body mass index and risk of multiple sclerosis

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Abstract

Aim: Obesity is an important risk factor of multiple sclerosis particularly in younger age. Many studies reported an association between elevated body mass index (BMI) and development of MS especially in teenagers and adolescents. As obesity is a major health problem in Saudi Arabia, an elevated risk of multiple sclerosis is expected. This study aimed to evaluate the association between elevated body mass index and multiple sclerosis. Material and Method: This case-control study included 231 participants aged ≥17 years old, of them 77 cases were multiple sclerosis and 154 controls. Patients previously diagnosed with MS or had no medical records were excluded. Controls had no MS or any related neurological symptoms and selected from outpatients' clinics. Data were collected from hospital records regarding demographics and BMI. Results: The majority of the participants aged 21-40 years old. About 30% of them were 21-30 years old and 35% were 31-40 years old. Regarding BMI categorization of the respondents 51.5% had an elevated BMI, while 112 (48.5%) had a normal BMI. Findings of the binary logistic regression model showed an increased risk of multiple sclerosis by 2.3 times among participants with an elevated BMI than those with normal BMI (p value = 0.005, OR: 2.28, 95% CI=1.289 to 4.019). Discussion: As multiple sclerosis has been linked to genetic factors, an assessment of the presence of such association in different populations are meaningful. The cross-sectional approach is defective in the assessment of association, thus a retrospective analytical approach with the case-control study was the most appropriate design. Conclusions: There was a significant association between BMI and the occurrence of multiple sclerosis, the risk is doubled among overweight or obese people in Saudi Arabia in comparison to normal or underweight people.

Keywords

Obesity; Neurological Diseases; Adult; Overweight; Case-Control Study

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Introduction

Multiple sclerosis (MS) is defined as an autoimmune inflammatory disorder of the Central Nervous System (CNS). Pathologically MS characterized by myelin destruction (demyelination), mononuclear cells perivascular infiltration, axonal damage and multiple plaques formation in both of the spinal cord and the brain [1-3]. It has been considered as a progressive and chronic inflammatory disease that mostly attributed to environmental and genetic risk factors [1,4].

MS is considered the second prominent reason of neurological disability in both children and adolescent as stated by World Health Organization (multiple sclerosis resources in the world, 2008). Women most commonly affected than men with female/male ratio 4:3 in Saudi Arabia [5]. Several studies reported the prevalence of MS in different populations, in Kuwait (2000) a prevalence of 14.77/100,000 was reported, while in Turkey a high prevalence of 101.4/100,000 was found [6]. In the US, the prevalence of MS ranged from 47.2/100,000 in Texas to 109.5/100,000 population in Ohio. MS can affect any age, but it commonly affects young adults. The disease usually begins at an age of 20 years up to 50 years, with the mean age of 30 years. MS can occur in early childhood and can develop after 60 years of age with more severe clinical presentation in children and adolescent. The disease characterized by relapsing-remitting course in about 85% of affected patients. Furthermore, the remissions and exacerbations most commonly are unpredictable [7]. Disability may develop in about 60% of patients with MS and most of them may need ambulatory support [7-9]. MS can be progressive without relapsing phase in about 5 – 15 % of cases, in which the disease gradually worsens from the onset and become very progressive [10,11].

Obesity is considered an essential risk factor of MS especially in young age [12,13]. Many studies reported the association between elevated body mass index (BMI) and development of MS especially in teenagers and adolescents [12-15]. However, none of them was conducted in Saudi Arabia and those studies were found to show positive results supporting the association between elevated BMI and higher risks of developing MS. In Saudi Arabia, the prevalence of obesity is remarkably high, with 82% of the general population were overweight or obese in Riyadh city [16]. This case-control study aimed to assess the association between elevated body mass index and multiple sclerosis in Saudi Arabia.

Material and Method

This was a case-control study conducted in King Abdulaziz University Hospital (KAUH) with a total number of 77 patients with MS aged 17–64 years. For each case, two controls were randomly selected from the outpatient department at KAUH, matched by age (5-year age group) and gender. A total sample size of 231 study participants was calculated using StatCal in Epi-info (version 7) and included MS cases and non-MS controls. This study included cases aged ≥17 years old with newly confirmed diagnosis of MS. The exclusion criteria included patients previously diagnosed with MS or those who did not have documented BMI records. Controls were outpatient attendants who had no MS or any related neurological symptoms. Controls who were relatives of any studied case were excluded from the study to rule out the risk associated with the genetic effect. The authors explained information to the participants which included the objectives of the study, the right to refuse or withdrawal from participation, and the confidentiality of information provided. The Written consents were obtained from adult study participants, while parents provided consents for patients aged less than 18 years old. Data were collected from hospital records regarding age, gender, and BMI calculated in kg/m^2. The statistical analysis was conducted using Statistical Package of Social Science (SPSS), version 23. The descriptive statistics were calculated and presented in tables and figures, while odds ratios were assessed for the association between MS and BMI with 95% confidence interval. Associations with p-value less than 0.05 were assessed as statistically significant.

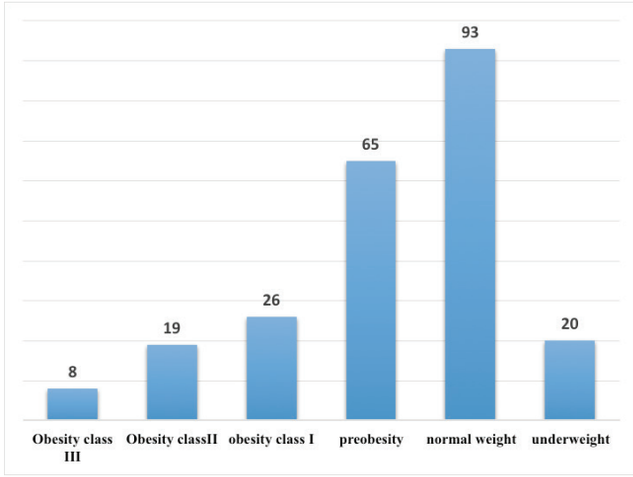
Results

The total number of the study respondents was 231 with age ranged from 17 to 72 years old, of them 168 (72.7%) were females and 63 (27.3%) were males. The respondents were divided into six age groups; two thirds of them were in the age groups of 21-40 years old. About 30% were 21-30 years old and 35% were 31-40 years old. Regarding the BMI categorization of the respondents, 119 (51.5%) were categorized as having an elevated BMI, while 112 (48.5%) had a normal BMI (Table/Figure 1). The BMI of the respondents was also categorized into six groups according to the WHO classification. Approximately 9% of the respondents were underweight, while 28.1% were categorized in the pre-obesity phase (overweight) and 23% were obese as (Table/Figure 2).

Table 1. Demographic characteristics of the respondents, (n = 231):

Variables	Frequency	Percent (%)
Gender:		
Male	63	27.3
Female	168	72.7
Age:		
≤ 20 years old	8	3.5
21 - 30 years old	70	30.3
31 - 40 years old	81	35.1
41 - 50 years old	36	15.6
51 - 60 years old	33	14.3
≥ 61 years old	3	1.3
Body mass index (BMI):		
Elevated	119	51.5
Not elevated	112	48.5
Diagnosis with multiple sclerosis (MS):		
Not diseased	154	66.7
Diseased	77	33.3

Cross tabulation, using Chi-Square test, between demographic characteristics of the respondents and occurrence of MS revealed significant association between BMI and occurrence of MS. As the cases and controls were matched in age and gender, no significant associations were reported for these factors in relation to occurrence of multiple sclerosis (*p*-value = 0.996 and 0.559, respectively) as shown in Table/Figure 3.



Table/Figure 2. Body mass index grades of the respondents, (n =231)

The association between demographic characteristics and BMI of the respondents were significant with age (*p*-value = 0.004), while gender showed no significant association with BMI (Table/Figure 4). Results of the binary logistic regression model showed an increased risk of MS in participants with elevated BMI in comparison to those with normal BMI (Table/Figure 5). The elevated BMI compared to normal BMI have 2.3 times greater risk of developing multiple sclerosis (*p-value* = 0.005, OR: 2.276, 95% CI=1.289 to 4.019).

Table 3. Cross tabulation between demographic characteristics of the respondents and diagnosis with multiple sclerosis, (n = 321):

Variables	Diagnosis with multiple sclerosis		P value
	Not diseased	Diseased	
Gender:			
Male	42	21	0.559
Female	112	56	
Age:			
≤ 20 years old	6	2	
21 - 30 years old	47	23	
31 - 40 years old	54	27	0.996
41 - 50 years old	24	12	
51 - 60 years old	21	12	
≥ 61 years old	2	1	
Body mass index (BMI):			
Elevated	69	50	0.003
Not elevated	85	27	

Discussion

Several reports highlighted the association between elevated body mass index (BMI) and development of MS [12-15], however, no study reported this association in Saudi Arabia. As MS has been linked to genetic factors [17], an assessment of the presence of such association in different populations is meaningful. The cross-sectional approach is defective in the assessment of association, thus a retrospective analytical approach with case-control study was the most appropriate design.

Results of our study showed a significant association between BMI and occurrence of MS. Findings of logistic regression modeling found 2.3 times greater risk of developing MS in people with the elevated BMI compared with those with normal BMI.

Table 4. Cross tabulation between demographic characteristics of the respondents and body mass index, (n = 321):

Variables	Body mass index (BMI)		P value
	Elevated	Not elevated	
Gender:			
Male	33	30	0.495
Female	86	82	
Age:			
≤ 20 years old	4	4	
21 - 30 years old	23	47	
31 - 40 years old	49	32	0.004
41 - 50 years old	20	16	
51 - 60 years old	20	13	
≥ 61 years old	3	0	

Table 5. Binary logistic regression between demographic characteristics of the respondents and diagnosis with multiple sclerosis, (n = 231).

Variables	Reference group	P value	Odd Ratio (OR)	95% C.I. for OR	
				Lower	Upper
Elevated BMI	Normal BMI	0.005	2.276	1.289	4.019

Thus, elevated BMI can be considered as a risk factor of MS among adults in Saudi Arabia. Similarly, a population-based case-control study by Hedström *et al.* concluded that adults with BMI > 27 have two times greater risk of developing MS [14]. Another study by Mokry *et al.* reported that elevated BMI increases the risk of developing MS (OR: 1.41, 95% CI=1.20 to 1.66) [18]. Manouchehrinia *et al.* concluded in their study that; elevated BMI more than 30 can increase risk of MS in smokers by 1.5 times [19]. Our findings showed no significant association between each gender and age with the occurrence of MS. A systematic review and meta-analysis conducted by Heydarpour *et al.* found that MS is more common among females in Saudi Arabia (female: male ratio = 4:3) [6]. Gianfrancesco *et al.* reported twofold times increase in the risk of MS among people with elevated BMI. Additionally, they reported the increased risk of MS among females after controlling the environmental and genetic factors [20]. Regulations to decrease the obesity especially among females and to increase the awareness of multiple sclerosis among both patients and doctors might be needed. Hedström *et al.* concluded in their study that prevention of obesity in adolescent may reduce the risk of developing MS [21].

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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