

# A research on relationship between ABO blood groups and body mass index among Turkish seafarers

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## ABSTRACT

**Background:** The present study aims to investigate and to reveal the relationship between ABO blood groups and body mass index (BMI) and obesity among Turkish seafarers by using the health examination reports data obtained from 2009 to 2016.

**Materials and methods:** The data on age, gender, weight, height and blood groups obtained from 298,247 medical examination reports of Turkish seafarers were used with the official permission of Directorate General of Health for Border and Coastal Areas. Only 116,871 reports included blood group data. Regression and analysis of variance (ANOVA) tests were performed to survey relationship between variables. The results of the study were compared with other studies in the related literature.

**Results:** It has been revealed that AB Rh (–) group was associated the highest mean BMI value (mean: 25.952).

**Conclusions:** It is suggested that seafarers with AB Rh (–) blood group, who have the highest mean BMI value, should pay special attention to their weight.

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**Key words:** obesity, Turkish seafarers, blood groups

## INTRODUCTION

Obesity that is defined by World Health Organisation (WHO) as abnormal and excessive fat accumulation [1] has become an epidemic due to changing eating habits and inactive life style [2]. According to WHO Fact Sheet, there were more than 1.9 billion adults (18 years and older) and 41 million children (5 years and younger) who were overweight in 2014 [3]. This shows that obesity and overweight has become a serious problem in the world.

It has been reported that obesity is an important risk factor for some types of diseases, such as metabolic syndrome, type 2 diabetes, cardiovascular diseases and cancer [4–6]. Especially, metabolic syndrome is widespread and complicated disorder directly related to obesity [7]. In addition to its influence on health, obesity might be a safety issue for occupational area especially on board at sea due to the fact that it may be difficult for overweight persons to carry out safety tasks in emergency situations, such as escaping from ships and getting on a lifeboat [8]. In this respect, the seafarers should be fit so as to overcome risky situations be-

cause fatal accidents and injury rates in maritime industry are higher than in other industries such as construction industry and manufacturing industry [9]. But this situation does not seem very possible because seafarers usually spend a long time on board [10] where their movement areas are limited and the convenience provided by technological devices on board have reduced the demand for muscle power, so they tend to put on weight.

In 1997, the practicable system for classification of overweight and obesity (as shown in Table 1) was first introduced in the report prepared by WHO [11]. After that, it has been adopted internationally [12]. This system was named as body mass index (BMI). The weight in kilograms divided by the square of the height in meters equal to BMI. The BMI calculation formula is shown below:

$$\text{BMI} = \frac{\text{Weight}}{(\text{Height})^2}$$

In related literature, there are certain studies on seafarers' health with different focal points such as psychosocial [13], cardiovascular [10, 14], diet and nutrition [6, 15], stress

**Table 1.** Classification of body mass according to body mass index (BMI)

Classification	BMI	Risk of co-morbidities
Underweight	< 18.5	Low
Normal weight	18.5–24.9	Average
Overweight	25.0–29.9	Increased
Obesity class I	30.0–34.9	Moderate
Obesity class II	35.0–39.9	Severe
Obesity class III	≥ 40.0	Very severe

[16], etc. Besides, there are also studies on obesity and BMI among seafarers [8, 17, 18], but there is no study that examines relationship between blood groups and obesity among seafarers. In this respect, this study attempts to find out whether there is relationship between ABO blood groups and obesity among Turkish seafarers.

Previously, there were attempts to disclose a possible relationship between ABO blood groups and various diseases in related literature. The potential relationship between ABO blood groups and various diseases, such as ischaemic heart disease, coronary artery disease [19, 20, 21], cancer [22, 23], cardiovascular diseases [24], etc., have been investigated by many researchers for a last two decades. These studies have shown the strong relationship between blood groups and such diseases. This relationship contributes to diagnosis of the disease and supports the possible preventive measures to decrease the incidence [2].

Additionally, several studies on relationship between ABO blood group and obesity has been also performed on different communities and subjects. Behera et al. [2] found that the blood group AB and Rh (-) was associated with the highest number of obese subjects. Sukalingam and Ganesan [25] and Qunq and Abdel Hamid [26] revealed that the patients with blood group B were more susceptible to be obese compared to those with the other blood groups. Ainee et al. [27] and Krishnakanth et al. [28] found higher incidence of obesity among the children with blood group O as compared to children with the other blood groups. On the other hand, Jafari et al. [29] and Mascie-Taylor and Lasker [30] revealed that there was no relationship between blood groups and BMI. Table 2 shows the details of these studies [2, 25–36].

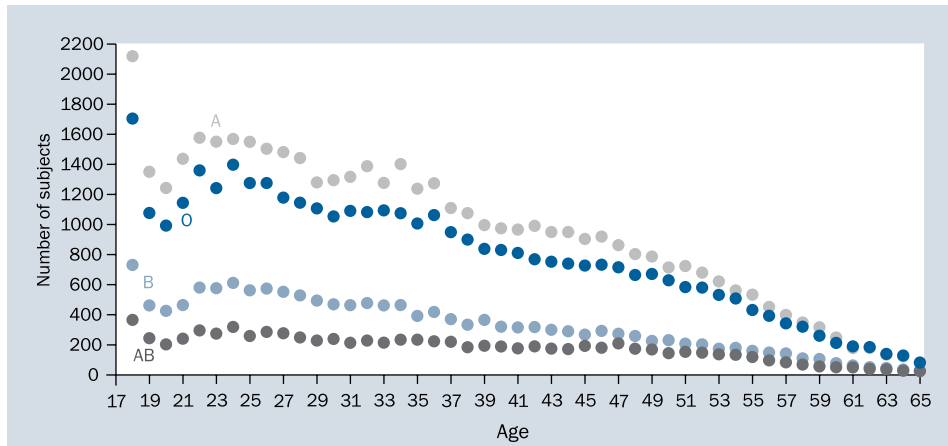
The aim of the study is to compare current BMI status of the Turkish seafarers with previous study conducted by Nas and Fişkin [17] and to determine the relationship between ABO blood groups and BMI among Turkish seafarers by comparing the results with other studies in related literature.

## MATERIALS AND METHODS

This study was conducted to compare the BMI and obesity among Turkish seafarers in regard to blood groups A, B, AB and O. The medical examination reports that ought to be taken every 2 years by Turkish seafarers and contain data such as age, height, weight and blood group were used for this purpose. The data was officially requested from the Republic of Turkey Ministry of Health Directorate General of Health for Border and Coastal Areas and a total of 298,247 medical examination reports of Turkish seafarers

**Table 2.** Details of studies in related literature

Blood group (more susceptible to obesity)	Studies that revealed the relationship between blood groups and obesity			Studies that revealed no relationship between blood groups and obesity		
	References	Subject size	Region	References	Subject size	Region
A	Idzeliene and Razbadauskas [31]	207	Lithuania	Jafari et al. [29]	50045	Iran
B	Sukalingam and Ganesan [25]	990	Malaysia	Mascie-Taylor and Lasker [30] Chuemere et al. [35]	14000	UK
	Qunq and Abdel Hamid [26]	151	Malaysia		2620	Nigeria
	Ganesan and Gani [32]	890	India		201	Nigeria
	Chandra and Gupta [34]	23320	India			
	Mmom and Chuemere [36]	201	Nigeria			
AB	Behera et al. [2]	100	India			
O	Ainee et al. [27]	149	Pakistan			
	Krishnakanth et al. [28]	143	India			
	Abdollahi et al. [33]	2920	Iran			
	Mmom and Chuemere [36]	201	Nigeria			
Rh(+)	Ganesan and Gani [32]	890	India	Idzeliene and Razbadauskas [31] Mascie-Taylor and Lasker [30]	207	Lithuania
	Behera et al. [2]	100	India		14000	UK
Rh(-)						



**Figure 1.** Numbers of subjects by blood group and age

were obtained. Unfortunately, only male seafarers' data were included in the sample because of very few data of female seafarers and resulting high standard deviation. In the sample, only 116,871 medical reports of Turkish male seafarers, detailed in Figure 1, contained data on blood groups. These reports were analysed by statistical programme SPSS 22 [37] and the analysis of variance (ANOVA) and regression tests were conducted. As shown in Figure 1, the distribution of the analysed data by age group is well above the number required for comparison and is satisfactory.

### RESULTS

In this study, a total of 116,871 valid data out of 298,247 medical examination reports were analysed. The distribution of the seafarers by year and gender is shown in Table 3. The ratio of woman seafarers among the Turkish seafarers is only 3%. As shown in Table 3, each year approximately a total of 37,000 seafarers received a medical examination report.

The distribution of blood groups by weight classification is shown in Table 4. As seen in the Table 4, groups AB Rh (+) and AB Rh (-) were associated with the highest percentage (13.7% and 13.6%, respectively) and B Rh (+) and B Rh (-)

**Table 3.** Distribution of the seafarers by year and gender

Years	Gender of seafarers		Total
	Male	Female	
2009	34309	969	35278
2010	35946	881	36827
2011	36669	1046	37715
2012	36693	1138	37831
2013	37584	1277	38861
2014	35768	1184	36952
2015	37893	1494	39387
2016	33977	1419	35396
<b>Total</b>	<b>288839</b>	<b>9408</b>	<b>298247</b>

with the lowest percentage (11.6% and 11.3%, respectively) of obese subjects.

This study has investigated whether there are significant differences between ABO blood groups and BMI among the Turkish male seafarers. For this aim, analysis of variance (ANOVA) was performed. The analysis results indicated that

**Table 4.** Distribution of blood groups by weight classification

		Blood groups										
		A Rh (+)	A Rh (-)	B Rh (+)	B Rh (-)	AB Rh (+)	AB Rh (-)	O Rh (+)	O Rh (-)	Rh (+)	Rh (-)	Total
Normal	f	21012	2540	7255	1012	3917	449	16866	2473	49050	6474	54243
	%	47.9%	45.8%	49.0%	51.0%	47.6%	44.8%	47.2%	47.2%	47.8%	47.0%	
Overweight	f	17427	2260	5838	747	3194	417	14008	2056	40467	5480	45510
	%	39.7%	40.8%	39.4%	37.7%	38.8%	41.6%	39.2%	39.3%	39.4%	39.8%	
Obese	f	5460	743	1714	224	1125	136	4838	706	13137	1809	14946
	%	12.4%	13.4%	11.6%	11.3%	13.7%	13.6%	13.5%	13.5%	12.8%	13.1%	
Total		43899	5543	14807	1983	8236	1002	35712	5235	101132	13567	114699

**Table 5.** Mean values of blood groups

	Blood groups										Total
	A Rh (+)	A Rh (-)	B Rh (+)	B Rh (-)	AB Rh (+)	AB Rh (-)	O Rh (+)	O Rh (-)	Rh (+)	Rh (-)	
Mean BMI	25.497	25.668	25.382	25.227	25.576	25.952	25.605	25.662	25.53	25.63	25.536
Mean ages	33.55	34.10	33.08	33.17	34.55	35.15	33.80	34.22	33.65	34.09	33.70
f	43899	5543	14807	1983	8236	1002	35712	5235	103021	13804	116417
%	37.8	4.7	12.8	1.7	7.0	0.8	30.7	4.5	100	100	100

BMI – body mass index

**Table 6.** Analysis of variance for mean values of body mass index (BMI) and blood groups

		Blood groups							
		F = 10.266; p = 0.000 (Equal variance not assumed – Dunnett C)							
		A Rh (+)	A Rh (-)	B Rh (+)	B Rh (-)	AB Rh (+)	AB Rh (-)	O Rh (+)	O Rh (-)
Mean BMI	Differences								
	o	-	A Rh (+)	-	-	A Rh (+)	A Rh (+)	-	-
	-	o	A Rh (-)	A Rh (-)	-	-	-	-	-
	B Rh (+)	B Rh (+)	o	-	B Rh (+)	B Rh (+)	B Rh (+)	B Rh (+)	
	-	B Rh (-)	-	o	B Rh (-)	B Rh (-)	B Rh (-)	B Rh (-)	
	-	-	AB Rh (+)	AB Rh (+)	o	-	-	-	
	AB Rh (-)	-	AB Rh (-)	AB Rh (-)	-	o	-	-	
	O Rh (+)	-	O Rh (+)	O Rh (+)	-	-	o	-	
	-	-	O Rh (-)	O Rh (-)	-	-	-	o	

seafarers with blood group AB Rh (-) had the highest mean BMI value (mean: 25.952), followed by group A Rh (-) (mean: 25.668) while those with group B Rh (-) represented the lowest mean value (mean: 25.227) (Table 5).

The results of ANOVA test of the mean values of BMI and blood groups are shown in Table 6. The test revealed that there are significant differences between blood groups and mean values of BMI (F = 10.266, p = 0.000). It stands out that group B Rh (+) and group B Rh (-) are significantly different from all other groups except A Rh (+) for B Rh (-). Besides that, the differences between all groups are shared in detail in Table 6.

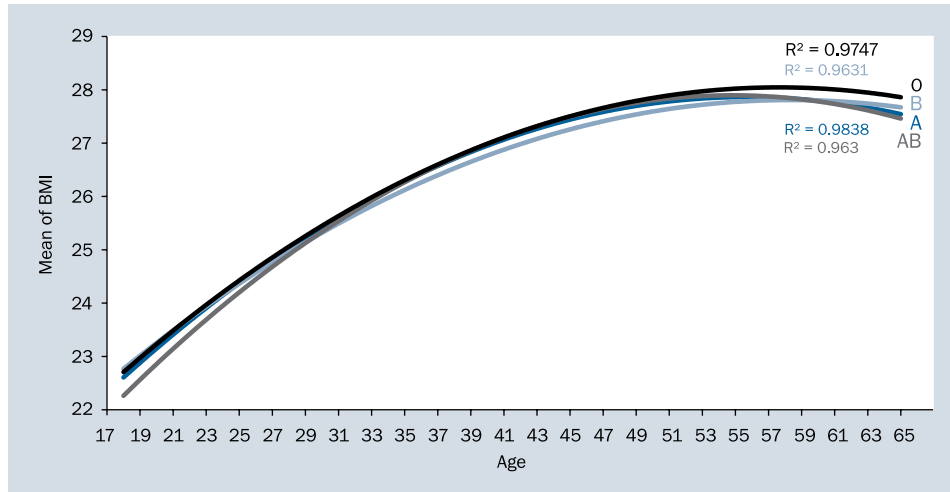
The study also investigated whether there is a relationship between blood groups and BMI mean values according to ages of Turkish male seafarers. According to regression results, while seafarers get older, their BMI values rise progressively for all blood groups and for all Rh factors. As seen in Figure 2 and Figure 3, group O and Rh (-) is the more susceptible to overweight in older age.

## DISCUSSION

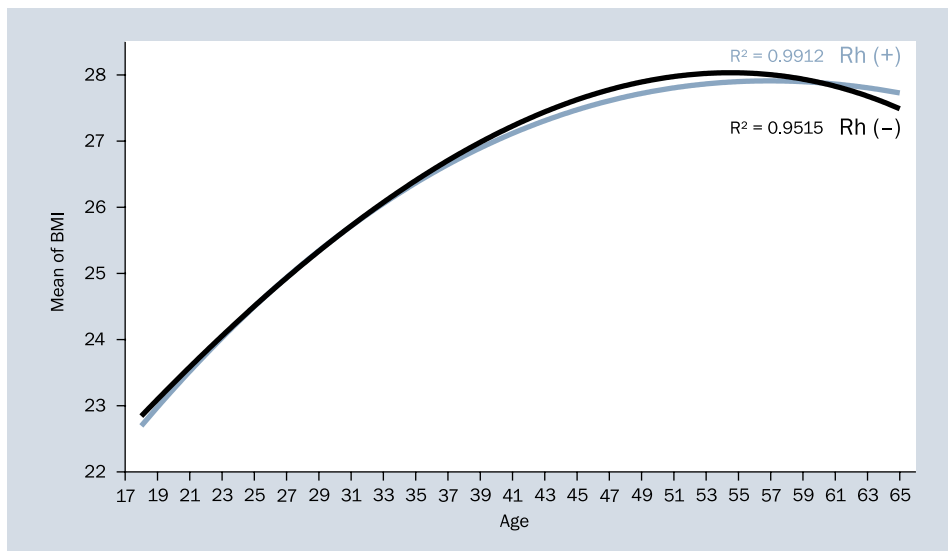
This study is crucial because any similar study has not been conducted so far. These types of studies are applied especially in the field of health and medicine industry. In this respect, being applied to a profession group like seafarers is increasing the importance of the study.

The study conducted by Ganesan and Gani [32] revealed that there were significant differences between healthy and obese nursing homes patients in B and Rh (+) blood groups' prevalence among a total of 890 subjects. Sukalingam and Ganesan [25] also revealed the same results for a total of 990 subjects who were patients of private clinics. Qunq and Abdel Hamid [26] found high incidence of overweight in subjects with group B compared to other blood groups within 151 staff and student participants. Krishnakanth et al. [28] found out that the overweight was most prevalent in those with group O among a total of 143 students. Other study on related issue was conducted by Idzeliene and Razbadauskas [31]. The results of the study including 207 students demonstrated the correlation between the blood group and BMI and it was concluded that the obesity was the greatest among group A subjects. In this study, the analysis results indicated that group AB Rh (-) was associated with the highest mean BMI value and there were significant differences between blood groups and mean BMI values in Turkish male seafarers. Especially, group B Rh (+) and group B Rh (-) are significantly different from all other blood groups. This study also revealed that there are no significant differences between Rh groups.

On the other hand, obesity and overweight continues to be a major risk for Turkish male seafarers. The study conducted by Nas and Fişkin [17] disclosed that more than



**Figure 2.** Regression curve of relationship between the means of body mass index (BMI) and blood groups by ages



**Figure 3.** Regression curve of relationship between mean values of body mass index (BMI) and Rh groups by ages

half of Turkish male seafarers (52.1%) were overweight and obese based on 2009–2012 data. Similarly, this study also revealed the same results based on 2013–2016 data. The results showed that 53.27% of them were still within the limits of obesity and overweight.

The specialty and originality of this study, distinguishing it from other studies, is the large number of subjects. The number of subjects is important in such studies. The more subjects, the greater the reliability of the results. A total of 116,871 valid data within 298,247 medical examination reports of Turkish seafarers were analysed in this studies.

**LIMITATIONS OF THE STUDY**

Otherwise, the study has some limitation. The obtained data may include more than one measurement that belongs

to the same seafarer because the medical examination is renewed every 2 years. And also only male seafarers’ data were included in the sampling because of very few data of female seafarers and resulting high standard deviation.

**CONCLUSIONS**

As detailed in the introduction of the study, there are many studies in related literature that examine the relationship between ABO blood group and diseases such as obesity, cancer hypertension, diabetes, etc. Some of these studies have identified the relationship, while others have suggested that there is no relationship between the blood group and such diseases. This study found that there were significant differences between the blood groups with regards to obesity and overweight. Besides, the study also

disclosed that more than half of Turkish male seafarers are still overweight and obese. It is suggested that seafarers with AB Rh (-) blood group, who have the highest mean BMI value, should pay special attention to their weight.

Consequently, it is also necessary to mention that the sample size of our study is substantially large and that its results may be extended easily to the general population of Turkish seafarers.

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