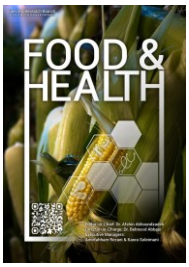

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A Report on the Anthropometric and Health Characteristics of Foreign Students at SRBIAU in 2023-2024

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ABSTRACT

This study aims to assess the anthropometric and health characteristics of foreign students at the Science and Research Branch of Islamic Azad University in Tehran, Iran, during the 2023-2024 period. A total of 400 non-Iranian students participated in this cross-sectional study. Anthropometric measurements, including weight, height, BMI, waist circumference, and body composition, were taken using standardized equipment. Physical activity levels, blood pressure, fasting blood sugar, and heart rate were also assessed. The results revealed a significant prevalence of overweight and obesity (21.75%), particularly among females (31.93%), and high rates of hypertension and prediabetes. The study found a high proportion of sedentary individuals (70.6%), which is a key contributor to the observed health risks. These findings highlight the importance of addressing obesity-related health issues, particularly in the context of non-communicable diseases (NCDs), and their economic impact. This data is crucial for the development of targeted health policies, such as medical tourism and insurance adjustments for individuals at higher health risks. The study concludes that proactive measures are essential to prevent and manage the health conditions prevalent in this population.

1. Introduction

Diseases associated with overweight and underweight are serious concerns expanding through the world and affecting the lives of a large proportion of people (1). The World Health Organization (WHO) reported that overall, about 13% of the world's adult population (11% of men and 15% of women) were obese in 2016, and its prevalence nearly tripled between 1975 and 2016 (2). The global prevalence of underweight among adults is about 8.1-9.9%. Research has stated that being underweight or obese comes with remarkable medical and economic expenses annually (3). According to a global report, 44% of diabetes cases, 23% of ischemic heart disease patients, and 7-41% of certain cancers are attributed to overweight and obesity (4). Therefore, preventing and controlling abnormal body weight is essential to avoid its negative health and economic impacts (5).

Being overweight and underweight can increase the risk of health problems. The health risks of being underweight are threatening, but nowadays, being overweight is the main problem in the world (6). Being underweight increases the risk of mortality, osteoporosis, fracture, Cardiovascular Disease (CVD), eye disorders, depression, anxiety, anorexia nervosa, Obsessive-Compulsive Disorder (OCD), multiple sclerosis, chronic inflammation, and asthma (7, 8). Obesity considerably increases the risk of several Non-Communicable Diseases (NCDs), including CVD (mainly heart disease and stroke), Type 2 Diabetes Mellitus (T2DM), High Blood Pressure (HBP), musculoskeletal disorders (especially osteoarthritis – a highly disabling degenerative disease of the joints), and certain types of cancers, including endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon. In addition to these, obesity can also lead to various psychological problems, physical disabilities, and several other complications, including depression and sleep apnea, resulting in high morbidity and mortality among obese patients (9).

All the mentioned problems and diseases impose an enormous economic burden on society and individuals. Many patients travel to other countries to receive health care, called

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"Medical Tourism" (10). Different motivational factors engage people to experience medical tourism, including lowering waiting times, decreasing costs, having higher quality service, and being accessible for services that can be illegal in their country or for which the individual is not eligible (11-14).

Medical tourism provides remarkable economic benefits to host countries. Iran has a low cost of services, modern technologies and equipment, and higher medical standards compared to neighboring, which can be recognized as one of the medical tourism destinations in the region. As previously stated, obesity and a high body mass index (BMI) (> 30 kg/m²) are associated with various health risks, including cancer, type 2 diabetes (D2M), high blood pressure (HBP), and cardiovascular diseases (CVD). These health risks increase the likelihood of medical complications, leading to higher treatment costs compared to individuals with a normal weight. Consequently, it is reasonable to consider that individuals with higher health risks, such as those with obesity, may face higher travel insurance costs due to the increased potential for medical expenses.

Thus, we aimed to report and analyze the anthropometric information of students who approached one of the Electronic Health and Statistics Surveillance Research Center of the Science and Research Branch of Islamic Azad University in Tehran and assessed their physical activity and health status. Moreover, this analysis can be used to investigate the risk of diseases in the target group, assuming that the higher the risk of diseases in the target group, the more medical expenditures and insurance costs can be contemplated.

2. Materials and methods

2.1. Study design

This cross-sectional study recruited 400 non-Iranian students who visited the Electronic Health and Statistics Surveillance Research Center of the Science and Research Branch of Islamic Azad University from February 2023 to February 2024. In the current study, a convenience sampling method was employed. We excluded pregnant women and participants with metal objects in their bodies, such as pacemakers, catheters, stents, etc. Informed written consent was obtained from all participants. All questionnaires except the International Physical Activity Questionnaire –short form (IPAQ-SF) were completed through face-to-face interviews with trained experts.

2.2. Evaluation of anthropometric variables

Weight was measured with light clothes and barefooted. The InBody BSM370 device measured weight with minimal coverage and an accuracy of 100 grams and height with an error range of ± 1mm. The BMI was subsequently calculated using the same device. In our study, we classified participants BMI into six groups based on American Heart Association criteria: Underweight (BMI < 18.5 kg/m²), Normal Weight (18.5≤ BMI≤24.9 kg/m²), Overweight (25≤ BMI≤29.9 kg/m²), Obesity-Class I (30≤ BMI ≤34.9 kg/m²), Obesity-Class II (35≤ BMI ≤39.9 kg/m²) and Obesity-Class III (BMI ≥ 40 kg/m²) (15).

Mid-arm circumference (MAC), Waist Circumference (WC), and hip circumference were measured using a non-stretchable measuring tape. All the variables were measured by trained experts. For WC measurement, the tape was placed at a point halfway between the bottom of the ribs and the top of the hips, and it was pulled tightly, but it wasn't digging into the skin. During the measurement, the participants breathed naturally. MAC was measured in the arm in the middle between the vertex of the olecranon and the acromion. Hip circumference was measured at the largest circumference around the buttocks.

We categorized participants based on their WC into three groups according to the American Heart Association: Low risk (Men: WC<94 cm; Women: WC<80 cm), High risk (Men: 94≤WC<102 cm; Women: 80≤WC<88 cm) and very high risk (Men: WC≥102 cm; Women: WC≥88 cm) (16).

2.3. Physical Activity Assessment

The participant's physical activity level was evaluated using IPAQ-SF, which has validity and reliability (20). This questionnaire was designed based on the last seven days. According to this test, the physical activity level is sub-divided into three categories: Intense activity (above 6000 kcal/day), such as running; Moderate activity (300-6000 kcal/day), such as medium-level cycling; and No Activity (below 300 kcal/day).

2.4. Blood pressure and heart rate assessment

Blood pressure and heart rate were evaluated by BPBIO320 from Inbody company with the accuracy of ± 2mmHg(Pressure), ±1.5%(Pulse). The patients were lightly dressed and in a stable position. In our study, we categorized participants' Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) into distinct groups according to the American Heart Association's classification in Table 1 (18).

Table 1. Blood pressure categories.

Blood pressure category	Systolic mm Hg		Diastolic mm Hg
Normal	Less than 120	and	Less than 80
Elevated	120-129	and	Less than 80
Hypertension stage 1	130-139	or	80-89
Hypertension stage 2	140 or higher	or	90 or higher
Hypertension crisis	Higher than 180	and/or	Higher than 120

2.5. Blood sugar assessment

To analyze the blood glucose concentration of all participants, the trained experts measured their blood sugar levels in either fast or random conditions, using an AccuCheck active glucose meter. In our study, we categorized participants' Fasting blood sugar (FBS) test results into three groups according to the American Diabetes Association criteria for diagnosing diabetes: Normal (FBS < 100 mg/dL), Prediabetes (100 mg/dL ≤ FBS < 126 mg/dL) and Diabetes (FBS ≥ 126 mg/dL) (19).

2.6. Body composition assessment

The body composition was analyzed via X-Scan plus 970, and factors such as body protein, body Mineral, Percentage of body fat (P.B.F), Soft lean mass (S.L.M), Skeletal muscle mass (S.M.M), Total body water (T.B.M) were obtained. To ensure more accuracy, the following conditions were observed: 1-A 2–3-hour gap between the last meal taken and the analysis. 2-Alcohol, tobacco, and caffeine avoidance. 3-Minimal physical activity. 4-Wearing light clothes. 5-No accessories or electronic devices were carried during the measurement. 6-We recommended that pregnant women and those on their period not be tested to avoid errors.

2.7. Statistical analysis

All statistical analyses were conducted using SPSS software (Version 27.0, IBM Corp., Armonk, NY, USA). To assess the difference in the proportion of gender between groups, we utilized the chi-square test. The independent T-test was employed to compare continuous variables, including systolic blood pressure, diastolic blood pressure, age, weight, and FBS. A p-value of less than 0.05 was considered statistically significant for all tests.

3. Result

We commenced data collection in February 2023 and concluded in April 2024. Of the 400 individuals who participated in the research, 121 (30.25%) were women, while 279 (69.75%) were men. We conducted a Chi-squared test to compare the proportion of genders that showed the proportion of men were significantly higher than women (P <0.01) (Table 2). Table 3 provides a comprehensive report of the participant demographics, including age, waist circumference, BMI, FBS, SBP, DBP, PBF, SLM, and SMM. Women had a mean age of 34.49 ± 7.98 years, while men had a mean age of 35.27 ± 6.97 years.

Table 2. The comparison of gender proportion

Chi-square	62.410[a]
df	1
Asymp. Sig	<.001

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 200.0.

Table 3. The descriptive statistics of anthropometric and health measures of study participants.

Gender			Age	WC	BMI	FBS	SBP	DBP	P.B.F	S.L.M	S.M.M
Female	N	Valid	121	120	121	77	120	120	119	119	119
		Missing	0	1	0	44	1	1	2	2	2
	Mean		34.49	88.775	27.7718	96.04	115.93	75.89	34.053	42.556	25.495
	Median		33.00	89.000	26.8000	94.00	115.00	75.00	34.500	41.600	24.900
	Mode		27	96.0	26.50	90[a]	114	70	34.0	40.5[a]	24.3
	Std. Deviation		7.984	11.9547	5.27363	13.904	13.331	11.166	6.0841	5.6845	3.4065
	Variance		63.752	142.915	27.811	193.327	177.717	124.686	37.016	32.314	11.604
	Range		50	58.0	25.70	122	72	66	27.2	30.7	18.4
	Minimum		22	63.0	17.20	61	90	45	19.2	31.9	19.1
	Maximum		72	121.0	42.90	183	162	111	46.4	62.6	37.5
Male	N	Valid	279	278	279	185	279	279	277	277	277
		Missing	0	1	0	94	0	0	2	2	2
	Mean		35.27	96.257	26.7302	96.24	117.18	74.62	24.785	56.382	33.833
	Median		34.00	96.000	26.7000	96.00	116.00	74.00	25.400	55.000	33.000
	Mode		30	96.0[a]	28.70[a]	98	104	66	19.7	53.4[a]	31.2[a]
	Std. Deviation		6.971	10.5566	3.98688	13.657	13.300	11.444	5.6377	7.3942	4.4530
	Variance		48.593	111.442	15.895	186.522	176.898	130.956	31.784	54.674	19.829
	Range		35	63.0	24.30	111	80	81	31.2	75.2	44.6
	Minimum		22	72.0	18.00	54	88	42	8.3	4.2	3.0
	Maximum		57	135.0	42.30	165	168	123	39.5	79.4	47.6

a. Multiple modes exist. The smallest value is shown

Of the 400 participants in our study, 93 (23.2%) reported being smokers. In contrast, the remaining 307 (76.7%) participants did not smoke (Fig. 1). 14 (3.5%) subjects of our examined community were intensely active, and 102 (25.8%) were moderately active. In comparison, 279 (70.6%) were non-active (Fig. 2). The majority, 44 (11.4%) individuals, opted for Vitamin D, followed by 37 (9.6%) who took Multivitamins. Fewer participants used Vitamin C, Omega-3, Iron, and Zinc (Fig. 3).

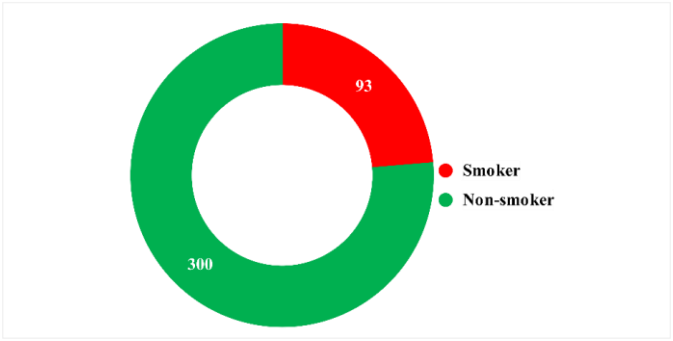

Fig. 1. Smoking habits among participants: A breakdown of smokers and non-smokers.

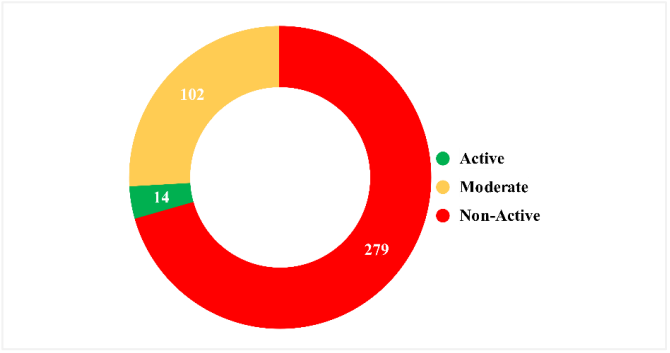

Fig. 2. Physical activity status of participants: Active, Moderate, and Non-active.

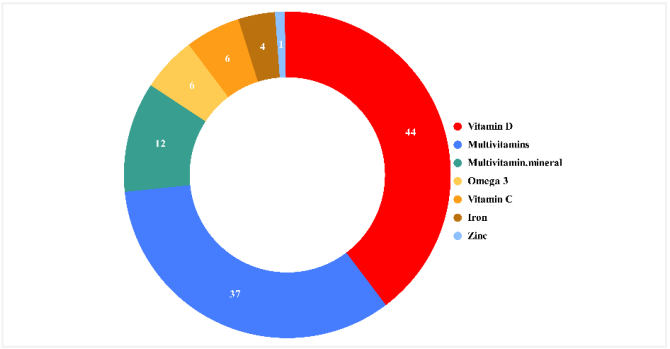

Fig. 3. Types of supplements used by participants: A comparative analysis.

Of 400 participants, 262 (63.6%) were eligible for the FBS test. 195 of them had normal FBS, while 62 (23.7%) were Prediabetes and 5 (1.9%) were Diabetes (Fig. 4). Following our blood pressure assessment, 195 participants (49.12%) exhibited normal blood pressure, while 87 (21.91%) had elevated. Additionally, 73 (18.39%) fell into the Hypertension stage I category, 41 (10.33%) were in Hypertension stage II, and a single individual (0.25%) had hypertensive crisis Blood pressure (Fig. 5). The proportion of women with over waist circumference (61 individuals) was significantly higher than men (15 individuals).

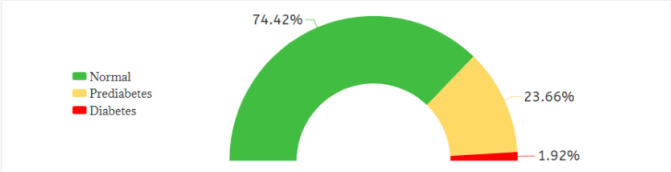

Fig. 4. Prevalence of fasting blood sugar levels among participants.

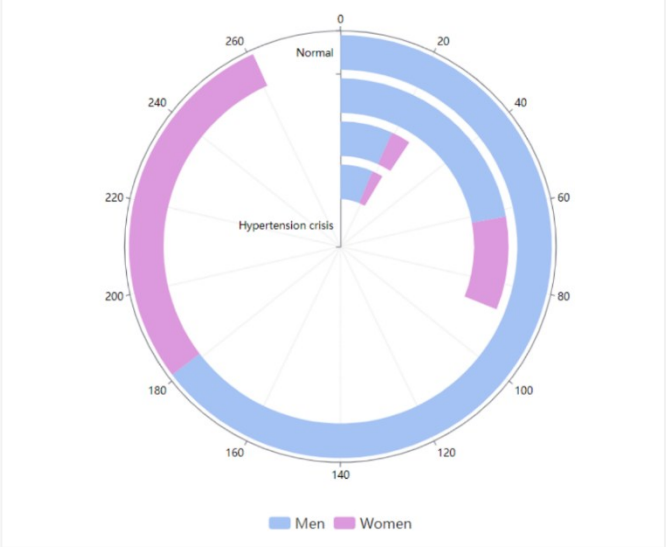

Fig. 5. Distribution of blood pressure categories among participants.

Based on our findings, SBP and DBP were not significantly different between women and men (P=0.387, P=0.306); furthermore, in terms of age, there was no statistically significant difference between women and men groups (p = 0.326). At the same time, the prevalence of PBF was significantly higher in women than men (p = 0.01). Moreover, it revealed comparable differences in weight between men and women (p = 0.01) (Table 4).

4. Discussion

This study aimed to explore the anthropometric indicators of non-Iranian students referred to the Electronic Health and Statistics Surveillance Research Center of Science and Research Branch of Islamic Azad University to report and investigate BMI-related diseases. Our findings determined the prevalence of obesity, hypertension, and blood sugar among participants, with an average age of 34 in women and 35 in men. Since NCDs impose substantial costs on society and

forasmuch as this study was carried out for the first time in this population, this data can be used for proper projects such as medical tourism and a higher proportion of travel insurance in terms of screening and treatment can be helpful for individuals who are at higher risk.

Table 4. The comparison of SBP, DBP, PBF, Age, and Weight by gender.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SBP	Equal variances assumed.	.032	.859	-.866	397	.387	-1.258	1.453	-4.114	1.599
	Equal variances not assumed.			-.865	225.048	.388	-1.258	1.454	-4.124	1.608
DBP	Equal variances assumed.	.008	.928	1.025	397	.306	1.272	1.240	-1.167	3.710
	Equal variances not assumed.			1.035	230.650	.302	1.272	1.228	-1.148	3.691
P.B.F	Equal variances assumed.	.352	.553	14.642	394	.000	9.2677	.6330	8.0233	10.5122
	Equal variances not assumed.			14.203	208.954	.000	9.2677	.6525	7.9813	10.5541
Age	Equal variances assumed.	1.958	.163	-.984	398	.326	-.781	.794	-2.342	.779
	Equal variances not assumed.			-.933	202.880	.352	-.781	.837	-2.432	.870
Weight	Equal variances assumed.	1.829	.177	-7.485	398	.000	-10.8581	1.4506	-13.7099	-8.0063
	Equal variances not assumed.			-7.206	209.671	.000	-10.8581	1.5067	-13.8283	-7.8878

Our study found that the prevalence of obesity was 21.75%, with 17.56% among males and 31.93% among females. Compared to the MENA region, where obesity prevalence is reported at 19.86% (17.60–22.40) for males and 25.40% (23.66–27.27) for females, our findings indicate a substantial disparity, particularly among females (20). Furthermore, the prevalence of overweight individuals in our study was 44.25%, with 47.31% among males and 37.81% among females, compared to 37.80% (36.20–39.47) for males and 31.24% (29.96–32.57) for females in the MENA region. This suggests that the overweight rate in our population is significantly higher than the regional average. In addition to BMI, our study assessed waist circumference, PBF, SMM, and SLM as critical indicators of body composition. The average waist circumference was found to be 96.25±10.55 cm for males and 88.77±11.95 cm for females, which is above the recommended thresholds, indicating a higher risk of central obesity (21). The average SMM was measured at 33.83±4.45 kg for males and 25.49±3.40 kg for females, while the average SLM was 56.38±7.39 kg for males and 42.55±5.68 kg for females. These findings suggest that despite a higher prevalence of overweight and obesity, a significant proportion of our study population also exhibits low muscle mass, which may further contribute to the risk of metabolic disorders.

According to the study by Afshin A et al.(2017), overweight and obesity have been shown to elevate the risk of non-communicable diseases such as hypertension, hyperlipidemia, type 2 diabetes mellitus, cardiovascular disease, metabolic syndrome, high cholesterol levels, and various types of cancer (22). These differences may be attributed to specific local factors such as physical inactivity, which our study found prevalent in 70.6% of non-active participants. As reported by Musaiger AO, other factors include beliefs and attitudes toward obesity, prolonged periods of sedentary activities like watching television or using the internet, exposure to food advertisements, high fast-food consumption, and increased eating outside the home (23).

In our study, 70.6% of our assessed population was found to be non-active, indicating a predominantly sedentary lifestyle; 25.8% were moderate, and only 3.5% were active. The significant proportion of non-active individuals highlights the risk of physical inactivity, which can lead to mechanisms such as reduced insulin sensitivity, increased risk of obesity, elevated blood pressure, and impaired lipid metabolism (24). These factors contribute to the development of non-communicable diseases like type 2 diabetes, cardiovascular disease, and metabolic syndrome (23). The prevalence of sedentary behavior underscores the need for interventions to promote more consistent physical activity.

Our results demonstrated that the prevalence of pre-HTN and HTN was 21.91% and 28.72%, respectively, in our target group, with a mean age of 35.03±7.291 years. According to Balochi et al., the prevalence of pre-HTN and HTN in the MENA region was 30.6% and 26.2%, respectively, in subjects aged between 19.9-72.5 years (25). The prevalence of HTN in our target group was significantly higher compared to the MENA area; however, the prevalence of pre-HTN was lower. This difference in the pre-HTN prevalence between the two

studies may be due to the difference in the number of studied subjects included and the period in which the study was conducted. The lower prevalence of pre-HTN in our study population compared to the MENA area can be explained by the younger mean age of our subjects. Moreover, this could indicate a higher risk of HTN among the young community. Additionally, the worldwide prevalence of HTN was 1.28 billion (16%) adults aged 30–79.

The results of the present study showed that the prevalence of HTN was significantly higher than the global level, possibly due to a lack of awareness, inadequate treatment, and poor control of HTN in the target population. In addition, other risk factors, including a sedentary lifestyle, salt intake, obesity, and excessive smoking, may affect the increased prevalence of HTN (25, 26). HTN is a significant risk factor for numerous complications, which may lead to mortality through several mechanisms. As pointed out by Syed Muhammad A. et al., HTN may lead to chronic kidney disease through altered activity of the renin, angiotensin, and aldosterone systems (27). Furthermore, Shenasa M et al. stated that higher blood pressure may induce ischemia through left ventricular hypertrophy (28). In line with Masenga S. K. et al., elevated blood pressure can accumulate atherosclerotic plaques in the arteries, which may lead to coronary artery disease (29). Moreover, Johansson, B. reported that HTN may cause intracerebral hemorrhages by altering the function of smooth muscle cells and the endothelium (30). Based on our findings, which highlight the importance of prevention and control of HTN, more attention should be paid by health policymakers to increase awareness, screening, and rapid diagnosis of HTN.

The prevalence of diabetes in our target population was 1.9%, and 23.7% were prediabetes. According to the IDF , the prevalence of diabetes in MENA stood at 18 percent in 2021 (9). The incidence of diabetes in our study is lower than the average rate of diabetes in the MENA region. Because of the difference in the data, our study group was young and limited, But the statistics in our target population can be dangerous and may cause many problems. Several risk factors affected the increase in T2D prevalence in MENA. These factors include sedentary lifestyle, the westernization of dietary habits, obesity (31), genetic (32), cigarette and waterpipe(hookah) smoking (33) and Gomaa A. and Lonardo A. have reported that high prevalence of hepatitis C in some countries (34, 35). Diabetes can harm the body through various mechanisms. Chronic hyperglycemia can damage blood vessels and nerves. This damage can lead to complications like DR , nephropathy, and neuropathy (36). Boulton AJ showed that DFU is an outcome of neuropathy and/or peripheral vascular disease (37). Hotamisligil GS. showed that high blood sugar levels can cause chronic inflammation in T2DM, known as "Metaflammation" (38). Diabetes can lead to endothelial dysfunction and vascular complications (39). Having diabetes essentially increases the risk of having a major adverse vascular event defined as nonfatal myocardial infarction, stroke, heart failure, and/or cardiovascular death by 2-3-fold after adjusting for age, sex, and smoking status (40-42). Diabetic dyslipidemia is a distinct lipid profile that elevated TG, TRLs, sdLDL, and reduced HDL levels (43-45). Taskinen MR. research has shown that factors such as hyperglycemia, insulin resistance, hyperinsulinemia, and abnormalities in adipokines, as well as adipocytokines, have played a role (46). Yang T. has reported even after blood sugar levels are managed, earlier episodes of high blood sugar can have enduring effects (metabolic memory) that can result in ongoing damage (36). Insulin resistance leads to higher blood sugar levels, harming various organs and tissues (36). Also, different organs can be impacted in other ways. For example, Ho KL. Showed that the heart may rely more on fatty acids for energy, resulting in metabolic imbalances (47).

One of the key strengths of our study is the accuracy and validity of the measurements; however, there are several limitations to this study. Our study faced limitations due to the challenges of accessing a population fully representative of Iran's foreign population. As a result, we relied on convenience sampling, which may limit the external validity of our findings. Consequently, the sample may not fully capture the population's border age and demographic characteristics. Nonetheless, it adequately represents the population of foreign university students. Another limitation of our study was the absence of dietary assessments despite our comprehensive evaluation of various indicators, including anthropometric measurements, blood sugar, systolic and diastolic blood pressure, and physical activity.

5. Conclusion

In the current study, we concluded that the prevalence of obesity, high blood pressure, and blood sugar for several reasons is higher in our target population than in MENA and WHO reports. Thus, the risks of NCDs, such as metabolic syndrome, D2M, CVD, and several cancers, are more expected in the assessed society. Multiplied expenses followed by obesity and its shocking widespread throughout the non-Iranian target community require serious actions, and we're able to provide facilities that both monitor and control and enhance medical tourism by providing better insurance shares, especially for people at higher risk.

6. Acknowledgments

We extend our gratitude to all the participants participating in this research.

7. Conflict of interest

The authors declared no conflict of interest.

8. Contribution

All authors contributed equally to data collection. The data analysis was conducted by Dr. Behnood Abbasi, followed by Amirfaham Rezaee. The manuscript was written collaboratively, with the initial draft prepared by all authors. However, the writing process followed this order: Amirfaham Rezaee, Mahsa Aghaei, Niloofar Bayat, Melika Sajadhosseini,

and Melika Tahmasbi. The manuscript was revised and finalized by Dr. Behnood Abbasi.

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