



EVALUATION OF BLOOD SUGAR, BLOOD PRESSURE AND FOOT HEALTH IN INDIVIDUALS NOT DIAGNOSED WITH DIABETES, HYPERTENSION

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Abstract

Objective: Diabetes Mellitus constitutes a significant health concern given its incidence and associated complications. Furthermore, obesity, being a chronic disease, represents a risk factor for hypertension, cardiovascular diseases, and diabetes. In light of these considerations, our study aims to perform a public screening for conditions that are closely related, including hypertension, obesity, diabetes, and foot health.

Methods: The study was conducted over a three-day period from September 12 to September 15, 2017, between the hours of 09:00-17:00. The sample comprised of volunteers who passed by the established stands and were not diagnosed with diabetes or hypertension. Blood glucose levels (BG) were measured using a glucometer, while weight and height were measured using a scale. Waist circumference was measured using a tape measure, and foot examinations were conducted using a podoscope. In addition, a questionnaire was administered to gather sociodemographic information and health-related data from participants. Measurements were taken of random capillary BG, blood pressure (BP), height, weight, and waist circumference. A general foot examination was performed, and any pressing foot issues were evaluated with a podoscope.

Results: In our study, the mean BG level of 428 participants was 126 g/dl, with 7% of them recording BG levels above 200 g/dl. During foot examinations, 29% of participants reported experiencing pain, while 26% had issues with false nail clipping. Pes planus was detected in 14% of individuals during podoscopic examination, and it was observed that those who used sports shoes and those who had previous foot examinations had fewer foot health problems. Additionally, individuals with high BMI values exhibited a higher prevalence of claudication findings, ingrown nails, and dryness and cracks in the skin. Participants with higher systolic BP were found to have more instances of ingrown nails and other nail problems, including interdigital maceration.

Conclusion: The selection of appropriate footwear and regular foot examinations are crucial in the prevention of foot health problems. Our study found a significant association between foot health problems and high BMI and systolic blood pressure levels.

Keywords: Diabetic feet, diabetes mellitus, hypertension, obesity, public health.

Introduction

Diabetes Mellitus (DM) is a chronic disease that results from insulin deficiency or impaired insulin action, leading to carbohydrate, protein, and fat metabolism disorders. The disease progresses with complications and requires continuous medical care.^{1,2} The incidence of DM is rapidly increasing worldwide, including in our country. It is considered an epidemic since it directly or indirectly affects health systems and social life, although it is not contagious.^{1,3} In recognition of DM's global impact, the United Nations General Assembly adopted a resolution (A/61/L39/ Rev.1 and Add.1 61/225) in which a non-communicable disease was identified as a global threat for the first time.⁴ In the resolution, the United Nations urges Member States to develop national policies for the prevention and treatment of diabetes.

Diabetes is a rapidly increasing health problem in Turkey, as it is globally. In response, studies on early diagnosis and prevention of complications are underway in the country. To this end, the Turkish Society of Endocrinology and Metabolism has published a guide recommending that adults be evaluated for diabetes risk factors based on their sociodemographic and clinical characteristics.⁵⁻⁷

Diabetic foot is a serious complication of diabetes that leads to non-traumatic amputations of the lower extremities and is preventable. It has negative impacts on the quality of life of individuals with diabetes and increases both morbidity and mortality. As such, it is considered a major health concern that affects the mental, physical, social, and economic aspects of individuals with diabetes.⁸⁻¹¹ Research studies have demonstrated that approximately 15% of individuals with diabetes develop foot ulcers at some point in their lives. Additionally, the hospitalization period for those with diabetic foot ulcers is 59% longer than for those with diabetes without this complication.^{12,13} Early diagnosis and preventative measures are crucial in managing diabetic foot as it is a preventable complication of diabetes.

Cardiovascular diseases, including diabetes, are prevalent causes of mortality in all countries. Among these diseases, hypertension (HT) is of particular importance because it is a modifiable risk factor for cardiovascular events. If left uncorrected, HT is an independent risk factor for several vascular problems such as heart failure, cerebrovascular events, myocardial infarction, and kidney failure. The study "Heart Disease and Risk Factors Frequency in Turkish Adults" investigated the role of risk factors in the development of cardiovascular events in Turkey and found that "hypertension" increases the risk of mortality due to cardiovascular events, independent of all risk factors.¹⁴ Another study examining the prevalence of hypertension worldwide, which involved approximately 2 million people, revealed that although the prevalence of hypertension had decreased globally in the last forty years, the number of hypertensive individuals has increased by 90%, reaching 1 billion people.¹⁵ This increase is attributed to population growth, an increase in the elderly population, and low socioeconomic status. Furthermore, although the cardiovascular risks of hypertension are known, early diagnosis and treatment rates are not at the desired level. Hence, HT is regarded as a public health problem that needs to be addressed.

Obesity, which is characterized as a chronic disease, is a risk factor for both diabetes and hypertension. It continues to increase globally due to modern sedentary lifestyles,

insufficient physical activity, and irregular and unhealthy eating habits. In our study, we aimed to increase awareness and promote early diagnosis by conducting a public screening for foot health in individuals with diabetes, hypertension, and obesity, as these conditions are closely interrelated. Cases that were identified were referred to healthcare institutions and provided with necessary information.

Methods

Type of Study

Our study is a descriptive-cross-sectional study. Necessary permissions were obtained from the Research and Practice Hospital Ethics Committee in the province where the study was conducted (No:2017/182).

Place of the Study

The study was carried out in the three most populated districts of the province, between 12.9.2017 / 15.9.2017, between 09:00-17:00 for three days.

Population and Sample of the Study

The study sample consisted of all adult individuals not diagnosed with diabetes and hypertension who volunteered to participate in the study, passing in front of the stands established in the districts determined between 09.17.2017 and 15.9.2017.

Data Collection Tools and Method

The study utilized six glucometer devices for blood glucose measurement, scales for weight and height measurement, a tape measure for waist circumference measurement, and a podoscope for foot examination. A questionnaire, developed by the researchers after a thorough literature review, was administered to obtain information on the participants' sociodemographic characteristics and health issues. Measurements of random capillary blood glucose, blood pressure, height, weight, and waist circumference were taken. General foot examinations were conducted, and a foot examination form was completed while assessing pressing issues with the podoscope. Pathological findings were explained to the participants along with the necessary information and guidance.

Statistical Analysis

The data were analyzed using the SPSS 22.0 program. The Kolmogorov-Smirnov test was utilized to evaluate the conformity of the variables to the normal distribution. For independent quantitative data analysis, the Mann-Whitney U test was applied. The Chi-square test was used to analyze independent qualitative data, and the Fischer test was used when the conditions of the Chi-square test were not met.

Results

In our study, 428 individuals participated, comprising of 51% men and 82% married. The majority of participants, 55%, were primary school graduates, and 92% had social security. A large proportion of the participants, 74%, perceived their income to be equal to their expenditure. Regarding health status, 45% had no known disease, 17% reported having diabetes, 12% had hypertension, and 3% had cardiovascular disease. Among the participants, 25% were smokers, 2% consumed alcohol, and 44% engaged in regular exercise (Table 1).

Table 1. Sociodemographic characteristics

Sociodemographic Characteristics					
	n	%		n	%
Gender			Income Status		
Female	206	48.1	Income Less Than Expenses	81	18.9
Male	222	51.9	Income Equal to Expense	318	74.3
Marital status			Income More Than Expense	28	6.6
Married	352	82.2	A Known Disease		
Single	41	9.6	No	192	45.1
Divorced	9	2.1	Diabetes	75	17.6
Widow	25	5.8	Hypertension	54	12.7
Married Living Separated	1	0.2	Cardiovascular Disease	13	3.1
Last Graduated School			Other	92	21.6
Illiterate	28	6.5	Smoking		
Literate	18	4.2	Yes	111	25.9
Primary Education Graduate	239	55.8	No	275	64.3
High school graduate	101	23.6	Abandoned	40	9.4
Associate/Undergraduate Graduate	42	9.8	Alcohol Use		
Social Security			Yes	10	2.3
There is	395	92.3	No	409	95.6
No	33	7.7	Abandoned	7	1.6
Regular Exercise					
Doing	192	44.9			
Does not	236	55.1			

In our study, the mean systolic blood pressure of 428 participants was found to be 110 mmHg, and the mean diastolic blood pressure was 90 mmHg. Out of the total participants, 19% (n=78) had a systolic blood pressure over 140 mmHg, while 21% (n=87) had a diastolic blood pressure of 90 mmHg or higher. Additionally, the average blood sugar level of the participants was 126 g/dl, with 7% (n=31) having blood sugar levels above 200 g/dl. The study also revealed that the mean body mass index (BMI) of the participants was 33, with 47% (n=203) having a BMI of 25 or higher, and 15% (n=64) having a BMI of 30 or higher (Table 2).

Among the study participants, 51% (221) reported having a foot health problem, with only 29% reporting having had a prior foot examination. Among those examined, 2% were seen by an internist, 2% by a podiatrist, and 4% by a family physician. Regarding podiatrists, only 8% of the participants in the study reported having an opinion (Table 2).

Table 2 presents the findings from the foot examination, revealing that 11% of participants had nail problems, 4% had skin thickening and dryness, 2% had skin fungus, 4% had cracks, 4% had calluses, 5% had thickened nails, and 2% had ingrown toenails. In addition, 20% had sweating in their feet, 16% had foot odor, 29% had foot pain, 11% had pain at rest, 3% had claudication, 2% had rubor, 4% had an increase in temperature, 1% had hyperemia, 2% had edema, 0.5% had ulcers, 26% had false nail clipping, 5% had maceration between the toes, and 16% had foot deformities.

During the podoscopy examination, pes planus was identified in 14% of participants, pes planovalgus in 0.9%, hallux valgus in 1.4%, pes planus transversus in 0.5%, and pes cavus in 18.5%. When asked whether they had a family history of foot health problems, 32.5% of participants responded

positively. Furthermore, 23% of participants did not select appropriate footwear. Among those who did, 42% preferred sports shoes, 13% preferred orthopedic shoes, 5% preferred high-heeled or narrow shoes, and 22% preferred flat ballet-style shoes. The majority (62%) of participants wore cotton socks, while 5% opted for wool socks and 22% preferred synthetic ones. In terms of neuropathy, 16% of participants reported tingling sensations in their feet, 9% experienced numbness, 12% felt a burning sensation, and 4% had restless feet. Finally, 24% of participants had a defective result on the monofilament test.

When the relationship between foot problems and blood pressure, blood sugar and body mass index was examined, no significant finding was found (Mann Whitney U test) (Table 3).

An analysis of the relationship between foot examination findings and mean BMI, blood pressure, and blood sugar revealed that those with claudication findings had a higher body mass index than those without (chi-square test, $p=0.01$). Similarly, individuals with ingrown nails had a higher body mass index than those without (chi-square test, $p=0.02$). Moreover, dry skin (chi-square test, $p=0.02$) and skin cracks (chi-square test, $p=0.009$) were more prevalent in those with higher body mass indexes (Table 4).

A significant relationship was discovered between nail problems, interdigital maceration, and systolic blood pressure. Individuals with higher systolic blood pressure had more instances of ingrown nails (chi-square test, $p=0.01$) and other nail problems (chi-square test, $p=0.03$) as indicated in Table 5.a and 5.b. Similarly, those with greater interdigital maceration had higher systolic blood pressure (chi-square test, $p=0.007$) as indicated in Table 5.b.

Table 2. Foot examination

FOOT EXAMINATION					
				n	%
Systolic Blood Pressure	110 mmHg (\pm 18.5)		Podoscop Examination		
Diastolic Blood Pressure	90 mmHg (\pm 12.7)		Pesplanus	60	14
Blood sugar	126 g/dl (\pm 61.5)		Pesplanovalgus	4	0.9
BMI	33 (\pm 4.9)		Hallux Valgus	6	1.4
	n	%	Pesplanustransversus	2	0.5
Have Foot Health Problems?			Pescavus	79	18.5
Yes	221	51.6	Normal	271	63.3
No	206	48.1	Foot Health Problem in the Family?		
Had a Foot Examination Before?			Yes	139	32.5
Yes	126	29.4	No	286	66.8
No	300	70.1	Is Shoe Selection Appropriate?		
Who Was Examination By?			Appropriate	327	76.4
Internal Medicine Specialist	9	2.1	Not Appropriate	99	23.1
Podologist	9	2.1	Shoe Preference		
Family Doctor	19	4.4	Sport shoes	181	42.3
Other	90	21.0	Orthopedic Shoes	57	13.3
Have Any Idea About Podology?			High Heels/Slim Shoes	25	5.8
Yes	37	8.6	Diabetic Shoes	4	0.9
No	390	91.1	Flat/Babet Style Shoes	96	22.4
Problems in the Feet			Other	64	15
Nail Fungus	51	11.9	Is Socks Preference Appropriate?		
Skin Thickening/Dryness	18	4.2	Appropriate	351	82
Skin Fungus	11	2.6	Not Appropriate	75	17.5
Cracks in the skin	19	4.4	Socks Preference		
Callus	17	4	Cotton	268	62.6
Thickening of the nails	24	5.6	Woolly	23	5.4
Ingrown Nail	10	2.3	Synthetic	94	22
Feet Sweating	88	20.6	Other	41	9.6
Feet Smelling	69	16.1	Neuropathy Findings		
Pain	124	29	Tingling in Feet	70	16.4
Rest Pain	47	11	Numbness	40	9.4
Claudication	16	3.7	Combustion	52	12.1
Rubor	10	2.3	Unrest	18	4.2
Heat Rise	21	4.9	Other	75	17.5
Hyperemia	8	1.9	Monofilament Test		
Edema	11	2.6	Distorted	90	21
Ulcer	2	0.5	Normal	337	78.7
False Nail Trimming	114	26.6	Using Insoles/Special Shoes?		
Maceration	22	5.1	Yes	38	8.9
Deformity	70	16.4	No	388	90.7

Table 3. Relationship of foot examination findings with BP, BG, BMI

Trouble With The Feet	Relationship of Foot Examination Findings with BP, BG, BMI			
	Systolic BP	Diastolic BP	Blood glycosis	BMI
There is	122 mmHg (\pm 19.4)	75 mmHg (\pm 12.5)	127 g/dl (\pm 58.1)	28(\pm 5.7)
No	123 mmhg (\pm 17.5)	77 mmhg (\pm 12.8)	126 g/dl (\pm 65.2)	27(\pm 4.2)
p value	0.39	0.41	0.18	0.12

BP: Blood pressure; BG: Blood glucose; BMI: Body mass index

Table 4. The Relationship between foot examination findings, previous foot examination and shoe selection

Foot Examination	The Relationship between Foot Examination Findings, Previous Foot Examination and Shoe Selection	
	There Is A Problem With The Feet	No Problems With Feet
Have done	93 (%42.3)	32 (%15.6)
Not done	127 (%57.7)	173 (%84.4)
<i>p</i> value	0.001	
Shoe Selection		
Sport shoes	80 (%36.4)	100 (%48.5)
Orthopedic sole shoes	31 (%14.1)	30 (%14.6)
High-heeled, narrow-toed shoes	13 (%5.9)	12 (%5.8)
Flat, ballet-style shoes	63 (%28.6)	33 (%16)
<i>p</i> value	0.02	

Table 5.a. Relation of foot examination findings with BMI, blood pressure and blood sugar

Foot Examination (n) (%)	Relation of Foot Examination Findings with BMI, Blood Pressure and Blood Sugar Averages			
	BMI	Systolic BP mmHg	Diastolic BP mmHg	Blood Glucose g/dl
Monofilament				
Normal (337) (%78.9)	28.36(±5.3)	122 (±17.8)	75 (±13.1)	125 (±57.6)
Distorted (90) (%21.1)	28.20(±4.2)	123 (±20.8)	76(±10.4)	133 (±74.2)
<i>p</i> value	0.545	0.979	0.565	0.677
Rest Pain				
There is (47) (%88.9)	29.87 (±8.2)	121(±22.2)	75 (±12.9)	133 (±52.3)
No (380) (%11.1)	28.13(±4.3)	122 (±12.9)	76 (±12.5)	126(±62.6)
<i>p</i> value	0.207	0.375	0.598	0.258
Kladikasio				
There is (16) (%3.8)	30.80(±3.8)	123 (±25.5)	73 (±12.3)	172 (±137.3)
No (411) (%96.2)	28.23(±5.0)	122 (±18.1)	76 (±12.6)	125 (±57)
<i>p</i> value	0.01	0.485	0.203	0.088
Dorsalis Pedis Pulse				
Normal (374) (%87.5)	28.18(±5)	122 (±18.6)	76 (±13)	126 (±62.7)
Weak (45) (%10.5)	29.21(±3.9)	120 (±16.8)	76 (±9.8)	135 (±55.4)
Unable (8) (%1.8)	30.01(±4.8)	127 (±21.2)	76 (±7.4)	103 (±22)
<i>p</i> value	0.07	0.45	0.96	0.12
Tibialis Posterior Pulse				
Normal (354) (%82.9)	28.20(±5.1)	122 (±18.3)	75 (±13)	126 (±63)
Weak (65) (%15.2)	28.81(±3.9)	123 (±18.8)	77 (±10.6)	134 (±56)
Unable (8) (%1.8)	30.01(±4.8)	127 (±21.2)	76 (±7.4)	103 (±22)
<i>p</i> value	0.167	0.811	0.830	0.160
Heat Rise				
There is (21) (%4.9)	28.97(±3.3)	119 (±15)	73 (±17.9)	116 (±27.5)
No (406) (%95.1)	28.29(±5)	122 (±18.6)	76 (±12.2)	127 (±62.8)
<i>p</i> value	0.22	0.64	0.941	0.923
Hyperemia				
There is (8) (%1.8)	27.69 (±7.9)	118 (±11.2)	72 (±8.8)	101 (±14)
No (419) (%98.2)	28.34(±4.2)	122 (±18.5)	76 (±12.6)	120 (±62)
<i>p</i> value	0.7	0.5	0.2	0.1
Edema				
There is (11) (%2.5)	27.91(±4.7)	124 (±11.2)	80 (±7)	135 (±76.8)
No (416) (%97.5)	28.34(±4.9)	122 (±18.6)	75 (±12.7)	126 (±61.2)
<i>p</i> value	0.90	0.47	0.07	0.88
Ulcer				
There is (2) (%0.46)	26.95(±7.2)	115 (±21.2)	75 (±7.07)	116 (±23.3)
No (425) (%99.5)	28.33(±4.9)	122 (±18.4)	76 (±12.6)	127 (±61.7)
<i>p</i> value	0.82	0.56	0.89	0.83

BMI: Body mass index; BP: Blood pressure

Table 5.b. Relationship of skin and nail findings with BMI, Blood Pressure and Blood Glucose

Skin and Nail Findings (n) (%)	Relationship of Skin and Nail Findings with BMI, Blood Pressure and Blood Glucose Average			
	BMI	Systolic BP	Diastolic BP	Blood Glucose
Ingrown Nail				
There is (60) (14.05)	29.17(±4)	125 (±24.1)	77 (±12.7)	127 (±48.7)
No (367) (%85.95)	28.19(±5.1)	122 (±17.3)	75 (±12.6)	127 (±63.5)
<i>p value</i>	0.02	0.01	0.32	0.33
Other Nail Issues				
There is (69) (%16.1)	29.36	127 mmHg	77 mmHg	128 g/dl
No (357) (%83.9)	28.12	121 mmHg	75 mmHg	126 g/dl
<i>p value</i>	0.125	0.03	0.102	0.142
Finger Maceration				
There is (22) (%5.1)	29.90(±4.8)	132 (±18.1)	79 (±10.9)	130 (±54.6)
No (405) (%94.9)	28.29(±4.9)	122 (±18.3)	75 (±12.6)	126 (±62)
<i>p value</i>	0.282	0.007	0.168	0.151
Skin Dryness				
There is (178) (%41.6)	29.14(±5.8)	123 (±20.9)	77 (±14.2)	125 (±59)
No (249) (58.4)	27.74(±4.2)	122 (±16.5)	75 (±11.2)	128 (±63.4)
<i>p value</i>	0.02	<i>p</i> =0.63	0.23	0.872
Cracks in the skin				
There is (82) (%19.2)	30.16(±7.2)	124 (±23)	77 (±10.7)	125 (±62.4)
No (345) (%80.8)	27.89(±4.1)	122 (±17.2)	75 (±13)	127 (±61.4)
<i>p value</i>	0.009	0.168	0.124	0.999
Callus				
There is (65) (%15.2)	27.45(±4.7)	120 (±15.7)	74 (±11.9)	121 (±45.5)
No (362) (%84.8)	28.48(±5)	123(±18.9)	76 (±12.7)	128 (±64)
<i>p value</i>	0.13	0.39	0.17	0.86

BMI: Body mass index; BP: Blood pressure

Discussion

According to mortality data, the incidence of cardiovascular diseases is on the rise and it is the leading cause of death. In 1989, it accounted for 40% of deaths, rising to 45% in 1993¹⁶, then back down to 40% in 2009¹⁷, and finally stabilizing at 39.6% in 2013, and 40.4% in 2014.¹⁸ Hypertension, which is a major risk factor for cardiovascular disease, is responsible for one out of every four deaths.¹⁶ In our study of 428 participants, the mean systolic blood pressure was 110 mmHg and the mean diastolic blood pressure was 90 mmHg. However, 19% (n=78) of participants had a systolic blood pressure over 140 mmHg, and 21% (n=87) had a diastolic blood pressure over 90 mmHg. While our data is lower than that reported in the PatenT (30.3%) and TEKHARF¹⁴ (37.7% for men, 46.3% for women) studies, which are two large-scale studies conducted in our country¹⁹, it is similar to the data reported in the Turkish Health Statistics Yearbook.²⁰ According to this yearbook, 16.2% of adults in Turkey have hypertension.

The TURDEP study is the most comprehensive study on diabetes mellitus (DM) in Turkey. According to the TURDEP II study, the prevalence of DM was 16.5%. In our study of 428 individuals, hyperglycemia was detected in 7% (n=31) and obesity was found in 15% (n=64) of the participants.²¹ Although the results were lower than those reported in the TURDEP II study, we only diagnosed DM through blood glucose measurement, without performing an oral glucose tolerance test or HbA1c measurements for those with blood glucose levels of 140-200 mg/dL. Thus, it is possible that the actual number of individuals with DM may be higher. These results are similar to those obtained in a study conducted at a training and research hospital in Istanbul, where the average BMI of the participants was 29, and 6% had blood sugar levels above 200 mg/dL.²² DM can progress insidiously without symptoms for many years.^{1,23} If left undiagnosed, complications can develop. Therefore, screening for DM is

crucial to detect the disease during its asymptomatic phase and prevent complications.²⁴

Obesity, which is defined by BMI, is a major contributor to morbidity and mortality.²⁵ According to WHO, individuals with a BMI between 25 and 29.9 kg/m² are considered overweight, and those with a BMI over 30 kg/m² are classified as obese. In the TEKHARF study¹⁴, the prevalence of obesity was reported to be 28.7%. Unfortunately, there has been a rapid increase in obesity rates in our country.²⁶ In our study of 428 participants, we found that the mean BMI was 33, and 47% (n=203) had a BMI of 25 or higher, while 15% (n=64) had a BMI of 30 or higher. Although our rates are lower than those reported on the WHO website²⁷ and in the ATLAS study²⁸, they are higher than the WHO's 2016 global obesity rates (15% for women, 11% for men).

"Foot Health" is a neglected condition in epidemiological studies. In our study, 51% (221) of the participants stated that they had a foot health problem, and only 29% had a foot examination before. 2% of those who were examined stated that they were examined by an internal medicine specialist, 2% by a podiatrist, and 4% by a family physician. Only 8% of the participants in our study have an idea about the podologist. The obtained findings are similar to previous studies.

A study conducted to assess the knowledge and foot care habits of people with diabetes revealed that only 38% of the participants had adequate awareness about foot care.²⁹ Another study on foot care awareness reported that even though 71% of the 128 participants had experienced foot problems, only 39% had consulted medical professionals about their feet, and merely 26% recognized foot pathologies as a medical issue.³⁰

During the foot examination, it was found that 85% of the participants had at least one foot health problem. Specifically, 11% had nail problems, 4% had skin thickening and dryness, 2% had skin fungus, 4% had cracks, 4% had calluses, 5% had thickened nails, 2% had ingrown nails, 20% had sweaty feet,

16% had foot odor, 29% had foot pain, 11% had rest pain, 3% had claudication, 2% had rubor, 4% had increased temperature, 1% had hyperemia in the urethra, 2% had edema, 0.5% had an ulcer, 26% had improperly trimmed nails, 5% had maceration between their toes, and 16% had foot deformities. In a study on the foot health of elderly people in Hong Kong, it was reported that 81% of participants had at least one foot problem, such as 45% having calluses, 37% having hallux valgus, 27% having nail dystrophy, and 24% having onychomycosis; 45% of them had foot pain. The study also showed that only 28% of participants had undergone a foot examination, and 41% of the participants wore inappropriate shoes.³¹

The results of our study indicated that shoe selection was more accurate compared to other similar studies. The majority of the participants (42%) preferred sports shoes, followed by 13% who preferred orthopaedic shoes, 5% who preferred high-heeled/narrow shoes, and 22% who preferred flat ballet-style shoes, while only 23% had inappropriate shoe selection. Interestingly, fewer foot health problems were observed in sport shoe users (chi-square test, $p = 0.02$), which is consistent with findings from other studies. Additionally, 62% of the participants used cotton socks, while 5% and 22% preferred wool and synthetic socks, respectively. It was found that the choice of socks was also mostly appropriate for foot health. Previous studies examining shoe fit and foot problems have associated blisters and calluses with shoe fit and pain in areas such as between the toes, the back of the heel, and the outer edges of the foot.³² Shoe comfort, which primarily depends on the fit, has been identified as the most critical factor in determining shoe comfort, with insoles support and shaping becoming important only when the shoe fits well.³³ Footwear is also associated with musculoskeletal disorders that most workers who stand for long periods experience. For example, a study of 147 surgical nurses who stood for long periods during their working days showed that the lumbar region was the most common site of work-related musculoskeletal disorders (71%), followed by the foot (55%).³⁴ Another study has reported that shoe comfort is associated with knee and foot pain, which is consistent with previous research that linked greater shoe comfort with a reduced risk of lower extremity injury.³⁵ While modern shoes have been associated with foot pain and pathology in adults, this foot health problem does not affect the shoe preferences of young women. For example, a study of 162 young girls revealed that their shoe choices were activity-specific, with participants choosing shoe styles and designs based on the image they wanted to portray.³⁶

In our study, podoscopy revealed that 18.5% of the participants had pes cavus, while 14% had pes planus, 0.9% had pes planovalgus, 1.4% had hallux valgus, and 0.5% had pes planus transversus.

The most commonly researched foot deformity is pesplanus, or flat feet. In our study, flat feet were found to be the most prevalent foot deformity. A study conducted at Glasgow Caledonian University on educated adults found that the prevalence of flat feet was 26.6% and was associated with a higher comorbidity index and BMI. Similarly, a study conducted in Japan with 340 participants found the prevalence of flat feet to be 26%, and it was associated with obesity.³⁷ In a diabetic population of 230 patients, the prevalence was found to be as high as 37%.³⁸ The presence of flat feet was also observed in Saudi Arabian soldiers between the ages of 18-21, with a prevalence of 5%, which was related to family history, shoe use in infancy, and obesity.³⁹ A study in India suggested that the use of shoes at

an early age, combined with obesity and connective tissue laxity, could increase the prevalence of flat feet.⁴⁰ However, the literature shows variability in the prevalence of flat feet. While some studies have shown that the prevalence of flat feet increases with age⁴¹, others show that it decreases with age⁴², and still, some show no association between age, gender, or BMI with flat feet⁴³. In our study, BMI was not found to be associated with flat feet, but it was found to be associated with other foot health problems such as claudication, ingrown nails, dryness, and cracks in the skin. These foot problems could be associated with excessive weight bearing of the foot.

In our study, we observed that 16% of the participants experienced tingling in their feet, 9% had numbness, 12% reported burning, and 4% felt restless. Additionally, 24% of the participants had a defective monofilament test result during the neuropathy examination. While foot health studies conducted with individuals without diabetes do not typically include a neuropathy examination, studies conducted on diabetic populations can provide some comparison. For instance, an Australian study found that 61% of 899 participants with diabetes had peripheral neuropathy or worse foot morbidity and were at high risk of future limb-threatening foot morbidity. Similar studies conducted in Australia indicate that low socioeconomic status is associated with foot pathologies, and the relationship between diabetes age and foot pathology is stronger than the relationship between being young or older.^{44,45} This is consistent with the findings of the AusDiab study⁴⁶, which demonstrated that a longer duration of diabetes is associated with a higher risk of foot pathology and that diabetes-related foot pathology has a known natural history.⁴⁷

The study revealed a significant correlation between nail problems, interdigital maceration, and systolic blood pressure. Individuals with higher systolic blood pressure were found to have a higher incidence of ingrown nails and other nail issues. Similarly, the group with interdigital maceration had higher systolic blood pressure levels. Although epidemiological studies exploring factors affecting health have received limited focus on foot health, this study highlights the significance of including foot health in such studies. To date, no studies have been found that examine the association between systolic blood pressure and foot health, making the results of this study crucial in emphasizing the importance of exploring this relationship.

Conclusion

Despite the undeniable impact of foot health on quality of life and socioeconomic consequences, it is still a neglected issue. Our study highlights the relationship between foot health problems, foot examination, and shoe selection. Furthermore, we found that foot health problems are associated with both BMI and systolic blood pressure. Although there are many studies on diabetes and foot health, there is a lack of research examining the relationship between hypertension and obesity and foot health. Thus, there is a need for more comprehensive studies with larger sample sizes, and preventive practices should also include foot health.

Limitations

Limitations of this study include the relatively small sample size of 428 participants, which may not be representative of the entire population. Additionally, the study only diagnosed diabetes mellitus through blood glucose measurement, without performing an oral glucose tolerance test or HbA1c measurements for those with blood glucose levels of 140-200

mg/dL, potentially underestimating the actual number of individuals with diabetes.

Conflict of Interest

The authors report no actual or potential conflicts of interest.

Compliance with Ethical Statement

Necessary permissions were obtained from the Research and Practice Hospital Ethics Committee in the province where the study was conducted (No:2017/182).

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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