



Prevalence estimation and familial tendency of common forefoot deformities in Turkey: A survey of 2662 adults

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ABSTRACT

Objective: This survey was designed to evaluate the prevalence estimations of HV, bunionette, hammertoe as well as their relations to shoe wearing and also familial tendency, in Turkey.

Material and Methods: Two thousand six hundred sixty two volunteers (1615 females and 1047 males) with a mean age of 34.15 ± 14.23 (range; 18 to 96) years were asked to answer the predetermined questionnaire between January and June, 2016. Hallux valgus, hammertoe and bunionette images were provided as references and every adult participant without any known forefoot problems or past forefoot surgery history was asked to rate his/her foot and to respond the questions about family history and shoe wearing habits. Responses were statistically analyzed.

Results: The prevalence estimations of hallux valgus, bunionette and hammertoe were calculated as 54.3%, 13.8% and 8.9% and positive family history rates were 53.2%, 61.2% and 56.1%, respectively. All three deformities were more common in females than in males ($p < 0.001$). Nonetheless the older age group reported significantly higher prevalence rates for only HV ($p < 0.001$). Likewise, among the three deformities, females reported a higher rate of positive family history only in HV compared to men ($p < 0.001$). Constricting shoe wear was found to affect HV incidence in women ($p < 0.001$) and bunionette incidence in both sexes ($p < 0.01$).

Conclusion: This study concludes that forefoot deformities are common with high familial tendency. Hence it is worthwhile to work on molecular genetics and this may enable the anticipation of forthcoming deformities in order to take early action in prevention, in nearly the half of the population.

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Introduction

First metatarsophalangeal (MTP) joint bunion (Hallux valgus-HV), bunionette (tailor's bunion) and hammer toe deformities are highly prevalent forefoot disorders presenting with similar complaints like difficulty in shoe wearing, pain, enlargement of the forefoot, painful callosities and distortions in cosmetics.^{1,2} These deformities are the major contributors to foot surgery bills and also related to functional disabilities, like foot pain, balance disorders and increased fall rates, especially in elderly.^{2–6}

The absolute prevalences of these deformities are not known accurately, prevalence studies for HV presents a wide range from 3 to 74% with acute differences owing to a number of factors including age, gender and race/ethnicity.^{4–11}

There is no comprehensive study about the frequencies of forefoot deformities (at least to our knowledge) in Turkey, so this survey was designed to evaluate the prevalences of HV, bunionette and hammertoe in adults, to promote an awareness about the potential impact of these highly prevalent conditions and to reveal the necessity to design a programme for prevention as well as relations of these deformities to shoe wearing and familial tendency.

Material and methods

The research team consisted of 6 researchers, all of them but one was medical doctor. Before initiation of the survey, the team

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WE DO APPRECIATE YOUR CONTRIBUTION TO THE SURVEY ABOUT FOREFOOT DEFORMITIES IN OUR COUNTRY. CAN WE KINDLY ASK TO ANSWER THE FOLLOWING QUESTIONS?

1-) Age : **2-) Occupation :** **3-) City :** **4-) Gender :**

For Male	For Female
5-) Do you prefer tight- narrow shoes?	5-) Do you prefer high heels?
<ul style="list-style-type: none"> • Yes • No 	<ul style="list-style-type: none"> • Yes • No

6-) If Yes, how often?

a) Every day b) Several days a week c) Rare d) Never




A
B




C
D

Which of the above is the best fit for your foot? (Right and Left)

7-) Right foot A) B) C) D) **8-) Left foot** A) B) C) D)

Fig. 1. Self-report questionnaire.

designed a user friendly questionnaire (Fig. 1). For each attendee, the purpose of the study and a brief information was described by a member from the team and an oral consent was taken.

The Material group consisted of 2662 participants, 1615 (60.7%) were females, and 1047 (39.3%) males with a mean age of 34.15 ± 14.23 (18–96). The research period was between January to June, 2016.

9-) Any family member having a foot deformity similar to yours? (multiple answers viable)

- My mother
- My father
- My sibling
- My aunt and / or uncle
- None of them

10-) Do you have hammer toe in your feet?

- a) 2nd toe
- b) 3rd toe
- c) 4th toe
- d) 5th toe
- e) None of them

**11-) Any family member having a foot deformity similar to yours? (multiple answers viable)**

- My mother
- My father
- My sibling
- My aunt and / or uncle
- None of them

12-) Do you have a bulge (bunionette) on the side of your 5th toe?

- a) Yes
- b) No

**13-) Any family member having a foot deformity similar to yours? (multiple answers viable)**

- My mother
- My father
- My sibling
- My aunt and / or uncle
- None of them

THANK YOU FOR YOUR PARTICIPATION.

Fig. 1. (continued).

As this survey was designed to estimate the forefoot deformity (HV, bunionette and hammer toe) prevalences, the patients admitting to orthopaedics clinic with foot deformity and any foot

complaints or past history of previous forefoot surgeries and anyone younger than 18 were not included. Briefly the material group consisted of the ones admitting to outpatient clinics

(orthopaedics and other specialities), their accompanies, university and college students and hospital staff.

The questionnaire had 13 questions; first 4 were about age, working status, gender and city of residency. The fifth question depended on gender; males were questioned for narrow-tight shoe wearing habits while females were asked for frequency of high heel wear. When the answer was “yes” to this question, he/she was asked to choose one of the following options: every day, many days of the week (more than half of the week), rare and never.

The participants were requested a thorough interpretation of the pictures for HV (as none, mild, moderate and severe, with referring the Manchester scale), bunionette and hammer toes on the questionnaire and asked to rate their foot condition with reference to sample images.^{12,13} The rest of the survey was about their family history of the deformities.

The study was performed in accordance with ethical standards of the 1964 declaration of Helsinki as revised in 2013 (Fortaleza, 2013) with the approval of an Ethical Committee (Istanbul, 11/02/2016, No:570).

Responses to self-reported surveys were statistically analyzed using IBM SPSS Statistics software, version 23 (IBM, Somers, NY, USA). Variables were analyzed using Kolmogorov–Smirnov test to determine whether they were distributed normally. Data for continuous variables were presented as mean \pm standard deviation, minimum and maximum values. Data for categorical variables were presented as frequencies and percentages. Chi-square test was used to analyze the frequency differences between groups. A p -value < 0.05 was considered to be statistically significant.

Based on previous studies,^{1,2,4,14} it was assumed that HV deformity incidence is at least 3%. Using α error 0.05, $1-\beta$ error 0.80 and effect size 0.01, power analysis indicated that at least 2599 people were required for the study to represent the population living in the metropolitan area of İstanbul (with a population of approximately 14,000,000 and the country population being calculated as 78,741,053 in the last Census Of Turkey).^{7,15}

Results

As the literature research on forefoot deformity prevalence rates consistently indicate higher rates in older adults,^{16,17} so the study group was divided into two based on age: Group 1 consists of 1846 (69.3%) participants, with ages between 18 to 39 years and 816 (30.7%) dwelled the second group aged 40 and above (Table 1). Forefoot deformities were seen much more commonly in females than males ($p < 0.003$).

The results will be presented for each three deformity, individually.

Hallux valgus

One thousand four hundred forty three of 2662 attendees (54.3%) reported various degrees of HV; 951 (65.9%) were females and 492 (34.1%) were males (Table 2). Prevalence of HV was significantly higher in females than males ($p < 0.001$).

Table 1
Demographics of the participants.

Gender	Age group		Total	P value
	18–39 (N = 1846)	40 and above (N = 816)		
Female	1155 (62.6%)	460 (56.4%)	1615 (60.7%)	0.003 ^a
Male	691 (37.4%)	356 (43.6%)	1047 (39.3%)	
Total	1846 (69.3%)	816 (30.7%)	2662	

^a $p < 0.05$ statistically significant. Chi–Square test p values.

Table 2
Gender specific prevalences.

	Gender		Total	P value
	Female	Male		
HV	951 (65.9%)	492 (34.1%)	1443 (54.3%)	0.000 ^a
Bunionette	291 (79.5%)	75 (20.5%)	366 (13.8%)	0.000 ^a
Hammer toe	176 (74.3%)	61 (25.7%)	237 (8.9%)	0.000 ^a

^a $p < 0.05$ statistically significant. Chi–Square test p values.

Analyzing the gender specific results, revealed that 951 (59%) of 1615 females and 492 (47%) of 1047 males had HV, and the difference was statistically significant ($p = 0.000$) (Table 2).

Nine hundred thirty one out of 1443 with HV deformity (50.5%) were in the first age group and 512 (63.1%) were in Group 2 (age 40 and above). Older age predominance for HV showed statistical significance ($p < 0.001$) (Table 3).

Laterality statistics revealed; Seventy nine (5.5%) had only right-sided HV, 56 (3.9%) only on the left side, while the remaining 1308 (90.6%) reported bilaterality (Table 4).

The severity of the deformity was graded as mild, moderate and severe, with the ratios of 72.1% (2079/2886), 17.6% (506/2886) and 5.8% (166/2886), respectively. As the severity grading was not always equivalent on both sides, number of feet (1443 reported HV 2, so the number of feet for statistical work was 2886) was the reference number for statistical work instead of participant number.

Family history was positive in 53.2% (767 of 1443) in which females reported higher heritability rates (593 of 767, 77.3%) than the males (174 of 767, 22.7%) with significant difference ($p < 0.001$). (Table 5).

Six hundred and forty nine (69%) women with HV deformity, expressed that they never/very rarely prefer high heels, and 291 (31%) were frequent high heel-users ($p < 0.001$). In women, high heel preference statistics revealed unveiled an effect over deformity development. Of men 421 (87.9%) preferred narrow shoes very rarely/never and 58 (12.1%) were frequent users. Statistical work showed that use of narrow shoes in males seemed not to be a risk factor for HV development ($p > 0.05$) (Table 6).

Table 3
Forefoot deformities according to age group.

	Age group		Total	P value
	18–39	40 and above		
HV	931 (50.5%)	512 (63.1%)	1443 (54.3%)	0.000 ^a
Bunionette	246 (13.4%)	120 (14.8%)	366 (13.8%)	0.335
Hammer toe	156 (8.5%)	81 (10%)	237 (8.9%)	0.201

^a $p < 0.05$ statistically significant. Chi–Square test p values.

Table 4
The laterality of HV deformity.

Fore Foot	Frequency (%)
HV (n = 2656)	1443 (54.3%)
HV only right (n = 1443)	79 (5.5%)
HV only left (n = 1443)	56 (3.9%)
HV bilateral (n = 1443)	1308 (90.6%)

Table 5
Forefoot deformities and the familial inheritance.

	Gender		Total	P value
	Female	Male		
HV	593 (77.3%)	174 (22.7%)	767 (53.2%)	0.000 ^a
Bunionette	176 (60.7%)	48 (62.6%)	224 (61.2%)	0.335
Hammer toe	97 (55.4%)	36 (59%)	133 (56.1%)	0.201

Table 6
HV and footwear habitus.

Hallux valgus Use of high heels (for female) or tight-narrow shoes (for male)	Gender	
	Female	Male
Never or Rarely	649 (69%)	421 (87.9%)
Several days a week or Everyday	291 (31%)	58 (12.1%)
P value	0.004 ^a	0.157

^a p < 0.05 statistically significant. Chi–Square test p values.

Bunionette (Tailor's bunion)

Three hundred sixty six (13.8%) participants had bunionette deformity: 291 were female (79.5%) and 75 were male (20.5%). The difference between two genders were statistically significant (p < 0.001) (Table 2). Tailor's bunion deformity revealed frequent cooccurrence with HV (75.6%)(p < 0.001).

When comparing the prevalences for each sex; 291 of the women (18%) and 75 of the men (7%) reported the deformity, the difference was significant (p = 0.000) (Table 2).

In the first age group (Group 1), two hundred forty six (246/1846, 13.4%) reported bunionette and 120 (14.8%) were in older age group. The age group difference was statistically insignificant (p > 0.01) (Table 3).

Family history was positive in 224 (61.2%) participants, females reported family history in 60.7%, while in male group it was 62.6% (statistical insignificance p > 0.01) (Table 5).

One hundred ninety (66.2%) women reported “rare/never preference of high heels” while ninety seven (33.8%) were frequent high heel users (p < 0.005). Men rates of narrow toe box preferences were 61 (81.3%) as rare/none and 14 (18.7%) as frequent (p < 0.005) (Table 7). The relation to shoe preference in both sexes showed statistical significance.

Hammer toe deformity

Two hundred thirty seven (8.9%) reported hammer toe, 176 of them (74.3%) were females, and the remaining 61 (25.7%) were males (significant difference, p < 0,001) (Table 2). 77.2% of all hammer toes also reported bunion deformity (p < 0.001).

One hundred seventy six (11%) women in study group and 61 men (5,8%) reported hammer toe statistically significant difference (p = 0.000) (Table 2).

One hundred fifty six belongs to Group 1 and 81 were aged 40 and over (p > 0.05) (Table 3).

Family history was positive in 97 of 176 females (55.4%) and 36 of the 61 (59%) males (p > 0.05) (Table 5).

In women with hammer toe, the rare/never use of high heeled shoe ratio was 122/176 (69.3%), and frequent use were 54/176 (30.7%). While 50/81 of men rarely/never preferred narrow toe boxed shoe, 11/81 were frequently preferred narrow shoes (Table 8).

Table 7
Bunionette and foot-wear habitus.

Bunionette Use of high heels (for female) or tight-narrow shoes (for male)	Gender	
	Female	Male
Never or Rarely	190 (66.2%)	61 (81.3%)
Several days a week or Everyday	97 (33.8%)	14 (18.7%)
P value	0,025 ^a	0,018 ^a

^a p < 0.05 statistically significant. Chi–Square test p values.

Table 8
Lesser toe deformity and foot wear habitus.

Hammer toe Use of high heels (for female) or tight-narrow shoes (for male)	Gender	
	Female	Male
Never or Rarely	122 (69.3%)	50 (82%)
Several days a week or Everyday	54 (30.7%)	11 (18%)
P value	0.452	0.055

p < 0.05 statistically significant. Chi–Square test p values.

Discussion

Hallux valgus, bunionette and hammer toe are the most common surgically treated forefoot deformities.^{2,3,18} Despite the high frequency of these disorders and substantial work on especially HV in the distant and recent literature, there are still controversies regarding their prevalences, etiopathogenesis, hereditary and genotypic factors, and even treatment modalities.^{1,2}

Forefoot deformities can easily be diagnosed by clinical examination, yet still, most of the patients admit to the orthopaedic clinics by their own diagnoses. Radiologic studies and sometimes further imaging modalities may be needed for decision making (treatment methods) and follow-ups. The diagnostic methodology in this survey was based on the participants' self observation of their own feet and matching them with the questionnaire photos. Whenever the participants had difficulty to match their foot deformity with the corresponding images, they had the opportunity to discuss it with one of the research team members. Garrow et al, described a reliable, non invasive method to assess the severity of HV deformity by means of standardized photographs in 2001, which was named as Manchester scale.¹³ Menz et al assessed HV in 138 individuals and concluded a high re-test reliability of self-assessment scores of Manchester scale and advised the safe use of this method in surveys.¹² Wu and Louie, also, in their survey of 1056 Chinese women preferred this methodology to rate the foot deformities from self-reported questionnaires.¹⁶

In the literature, prevalence studies vary widely in terms of population and diagnostic methods, like clinical examination, interviews, questionnaires, radiological studies or combinations.^{6,17–19} We delivered a pre-determined self-reported questionnaire which was both noninvasive and practical (Fig. 1).

Despite the wide estimation variations in the literature with a range of 2–70%, it is clear that HV is prevalent. Mann and Coughlin reported a frequency rate of 33% in adults for hallux valgus.¹ Roddy, Zhang and Doherty concluded 28.4% prevalence based upon a sample of 4249 respondents.¹⁸ Wu and Louie, in their survey of 1056 Chinese women, concluded a prevalence of 36.5%.¹⁶ Their preferred method was to rate the foot deformities from self-reported questionnaires. The prevalence was higher in the age group of 40 and above. 88.8% of the subjects with HV reported positive family history. In a rural Korean community aged over 40 up to 69, the reported prevalence of HV was 64.7%.¹⁹

Hannan et al, in Framingham Foot Study, studied HV, lesser toe deformities and plantar soft tissue atrophy prevalence along with heritability in 2446 participants. The reported prevalences were 31%, 29.6% and 28.6% respectively and concluded high heritability.¹⁷ Coughlin and Jones, found that 83% of the treated patients for hallux valgus had a positive family history.⁷

In our survey of 2662 participants with a mean age of 34.15 (ranging from 18 to 96), the prevalence for HV was 54.3%. The females were more affected, 65.9% of them being women and the remaining 34.1% being males. Also HV prevalence was more common in participants older than 40 compared to 18–39 age group (63.1%–50.5%). Majority of the participants mentioned bilaterality

(90.6%). The severity rates from mild to severe were 72.1%, 17.6% and 5.8%, respectively.

Family history was positive in 767 of 1443 (53.2%) and mostly being in the female group (62.6%): 593 women and only 174 men indicated positive family history. According to Wu and Louie, without family history only 2.8% of the HV group reported frequent high heel wear and that family history may be considered as a major concern while high heel shoe wearing is not a predisposing factor.¹⁶ Framingham study concludes significant heritability for HV with a range of 0.29–0.89 depending on age and sex.¹⁷

Women prefer fashionable high-heels especially in metropolitans due to their positive effect on empowerment, self-confidence. In the literature, there are some studies and discussions relating high-heels and HV.^{20–23} This survey resulted in statistical significance between HV development and shoe wear only in women, but significant family history in both sex.

The lesser toes play role in balance and pressure distribution of the foot. In the literature, lesser toe deformity prevalences are present up to 20%, women are more affected and the incidence seems to increase with age.^{24–26} Dunn et al reported, an account of 34.5% of all ankle–foot disorders, especially in elderly. In diabetic clinics, hammer toe prevalence is about 32%.²⁵

In our survey, 8.9% of the participants complained of lesser toe problems. Framingham study results are higher. This is probably due to methodology as the present study's participants report only fixed deformities not the dynamic ones needing clinical evaluation.

In analysis of lesser toe problems, 176 (74.3%) were females, and the remaining 61 (25.7%) were males. Family history was positive in 97 of 176 females (55.4%) and 36 of 61 males (25.7%). In the younger group (18–39) the incidence was 8.5% and in the second group (40+) the rate was 10%, the difference was insignificant.

In the etiology of lesser toe deformities narrow and constricting footwear is usually questioned. Not all the narrow-constricting foot wearers have lesser toe deformities, so some other factors may be speculated like chronic plate injuries engendering hammer toe deformity. This survey's results showed no significant correlation between shoe preference and lesser toe deformities but a relation between HV and hammer toe (77.2%).

The bunionette is characterized by a prominence on the lateral edge of forefoot.^{26–28} Kelikian shows an analogous relation between the bunion and bunionette but controversy does exist.^{2,29,30} Three hundred sixty six (13.8%) of the material group reported bunionette, most of them being women (79.5%), men with a ratio of only 20.5% and this was statistically significant ($p < 0.001$). Comparing the two age groups, the difference was found to be insignificant. Two hundred twenty four (61.2%) of 366 bunionette group indicated positive family history. When analyzed, both males and females reported positive family history but this was found to be statistically insignificant. 75.6% of the bunionette group has HV simultaneously. Shoe preference affects bunionette development. These findings may reveal although bunionette is not analogous to HV in etiopathogenesis, but these deformities go together frequently.

There were some study limitations. One of them was that we did not determine high heels/tight toe box shoe wear duration in exact units (i.e. days). Second our study was short in showing dynamic effect of tight footwear on forefoot. We presume high heels increase the mechanic pressures on metatarsal area but probably also forcefully deviates the proximal phalanx of the first ray laterally. The lateral part of the shoe usually pushes the 5th proximal phalanx medially, to subluxate 5th MTP joint.

While analyzing prevalences of forefoot deformities and their genetic contributors, it will certainly be more valuable to examine population under 18 year old, as with aging environmental factors like shoe style, overuse and foot traumas (even minor) are more

pronounced ending up with symptomatic deformities. For the present study we have got the approval of the ethical committee only on adult population studies, so this may be considered as a weak point. It would be more conclusive to establish the diagnosis via X ray measurements, but in a survey of 2662 participants, it would not be ethical and cost effective to order X rays for people with no foot complaints.

Conclusions

HV is common, shows significant female predominance, the deformity incidence increases with age. Heredity seems the most effective factor in the etiopathogenesis, while inappropriate footwear habits aggravate the symptoms.

Bunionette prevalence is 13.8% with female predominance. Shoe preference seems to affect bunionette development. Bunionette and HV deformities are seen simultaneously with high frequency.

Hammer toe deformities are seen less than HV and bunionette with a female predominance and women with hammertoe reported HV frequently.

This study concludes high familial tendency of forefoot deformities, it should be worthwhile to work on molecular genetics and only by this way, it may be possible to anticipate the forthcoming disorders and to take action in prevention in at least half of the population. Shoe wearing habits seem to aggravate the symptoms.

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