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Original article

EPIDEMIOLOGY OF TRAUMATIC UPPER AND LOWER LIMB AMPUTATIONS AMONG SAUDI ARABIAN LOCALS AND EXPATRIATES

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ABSTRACT

Current understanding of region-specific relationships and trends in amputation related parameters for the Saudi Arabian population is limited. The purpose of this study was to look at a cross-section of the Saudi population who had experienced traumatic upper and/or lower limb amputations over a ten-year period in terms of the epidemiological parameters (age, gender, and amputation side) and nationality (locals versus expatriates). Data were obtained from the medical records of five tertiary care hospitals in Al-Madina Al-Munawarah, Saudi Arabia. Data relating to 398 amputees were analyzed (age: 32.96 ± 22.68 years), of which 74% were males. Amputation frequency was found to be inversely related to the age group of the amputees. No statistically significant relationship of gender or annual distribution of amputations was found in relation to level of amputation. A considerable effect of nationality was found in relation to the level of amputation, side of amputation and gender. Further research to categorize these amputations based on the type of trauma to better understand the relationship between demographic parameters and amputation level is warranted.

1. Introduction

Amputation of a limb, defined as the removal of a part of bone, is considered as a last resort to rescue a dying or severely damaged limb [1]. The procedure of amputation, which dates back to the pre-Christian era as a therapeutic and ritualistic practice, is still in use despite remarkable medical advancement [2-5]. Despite their inevitability in certain cases, such procedures are never welcomed by the patient and healthcare professionals. Total or partial limb loss may have serious negative psychological, cosmetic and economic repercussions for the amputee. [4, 6]. The gravity of this issue, therefore, requires a comprehensive study of the relationship between frequency of amputation and different potential risk factors. Such a study may help in devising strategies to prevent limb loss.

Recent epidemiological data in the Saudi Arabian population that focuses on limb amputation is scarce.

Only a handful of studies are present, and these focus mainly on Diabetes-related limb loss [4, 7, 8].

There is clear evidence that geographical differences cause variations in amputation rates [9]. For the USA alone, there is as much as six times variation in amputation rates in different states [10].

Therefore, a region-specific observational study is necessary to accurately monitor the trends and relations between amputation related parameters. Another question that arises as a result of this regional diversity is that of ethnic diversity in a common setting. Our current scientific knowledge of the potential effects of ethnic diversity of amputation rates in Saudi Arabia is non-existent.

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The primary goal of this study was to examine the epidemiological parameters (age, gender, and side of amputation) of a certain population of Saudi Arabia, who had undergone traumatic limb amputations over a decade. The secondary goal of this study was to compare these parameters among Saudi nationals and expatriates living in Saudi Arabia.

2. Material and methods

Five tertiary care hospitals were contacted for their medical records. The data of partial and total upper and lower limb amputations was extracted from these records for the past ten years, i.e. 2010 to 2019. Demographic data for each amputee was obtained from these records.

Data included in the study were only of traumatic amputation. Any participant with a history of diabetes was excluded. Categorization of trauma type was not performed.

Data was retrieved manually and entered in SPSS v20 (SPSS Inc., USA) spreadsheets. All analyses were performed using SPSS v19 and MS Excel. An alpha value of 0.05 was set for the determination of statistical significance. Correlation between nominal variables was evaluated using Pearson's Chi Square Test, while continuous variables were analyzed using Student's *t*-test. For the projection of geographic distribution of the data, an interactive tool powered by https://paintmaps.com was used.

3. Results

The study sample included 398 participants. 74% of these were men (male: female ratio = 2.86: 1). The mean age of the participants was 32.96 ± 22.68 years.

Variable		Number Mean ± SD	Percentage
Gender			
	Male	295	74.12
	Female	103	25.88
Age (years)		32.96 ± 22.68	
Level of Amputation			
	Partial Hand Amputation	152	38.19
	Hand Amputation	10	2.51
	Transradial Amputation	21	5.28
	Transhumeral Amputation	4	1.01
	Partial Foot Amputation	87	21.86
	Foot Amputation	6	1.51
	Transtibial Amputation	63	15.83
	Transfemoral Amputation	55	13.82
Side of Amputation			
	Right	223	56.03
	Left	175	43.97

Table 1. Demographic distribution of major upper and lower limb amputations Saudi Arabia between 2010 and 2019.

The sample consisted of participants from different nationalities. Figure 1 shows the categorical distribution of participants according to their nationality. A majority of the sample was from Saudi Arabia (245, 61.55%), followed by Pakistan (44, 11.05%) and Egypt (32, 8.04%).

Table 1 and Figure 2 represent the frequency of amputations for each amputation level.

Partial hand amputation accounted for the majority of amputations (38.19%), followed by partial foot amputation (21.86%) and transtibial amputation (15.83%).

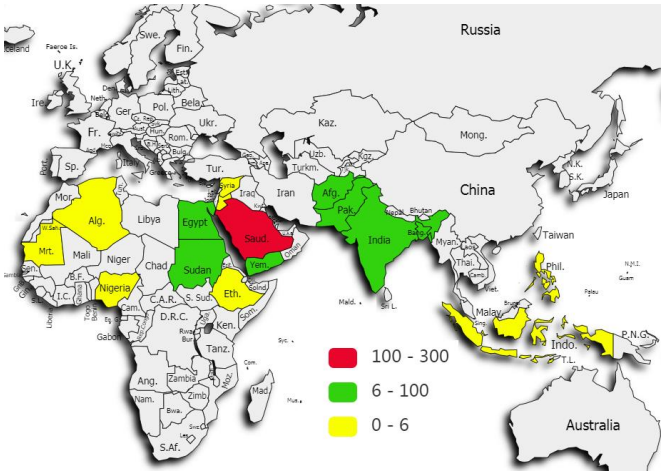

Figure 1. Geographic distribution of major upper and lower limb amputations in Saudi Arabia between 2010 and 2019.

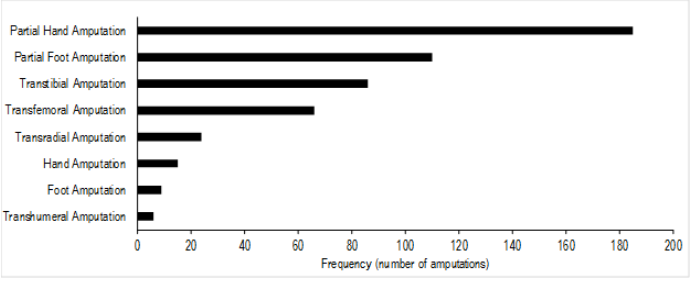

Figure 2. Frequency of amputations for each amputation level.

Figure 3 represents the annual distribution of amputations at each level. No significant correlation was found between the level of amputation and annual distribution of the amputations ($p > 0.05$).

Table 1 shows that a majority of the amputations in our sample were of the right side (56.03%). Out of 189 upper limb amputations, 53.43% were of the right side. While out of 209 lower limb amputations, 59.33% were of the right side.

Figure 4 shows a trend line representing the relationship between age groups and frequency of amputations.

The number of amputations and the age group were found to be significantly, inversely related ($p = 0.02$).

A chi-square test of independence was performed to examine the relationship between gender and the level of amputation.

The relationship between these variables was not significant, $\chi 2$ (7, N = 398) = 13.63, $p = 0.058$. Figure 5 presents a graphical representation of the distribution of different levels of amputation according to gender.

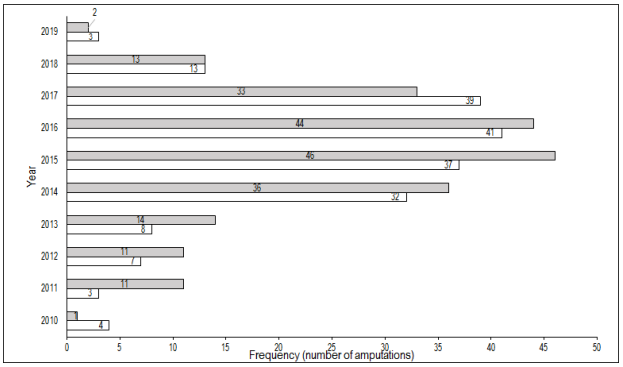

Figure 3. Annual distribution of the number of amputations. The solid blocks in each bar represent the frequency of lower limb amputations, while the transparent blocks represent the frequency of upper limb amputations.

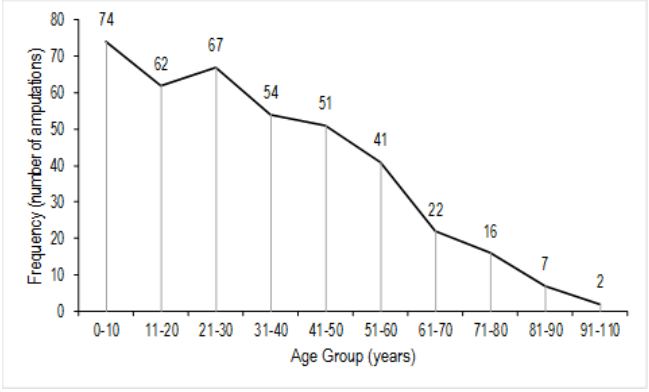

Figure 4. Distribution of upper and lower limb amputations according to age groups.

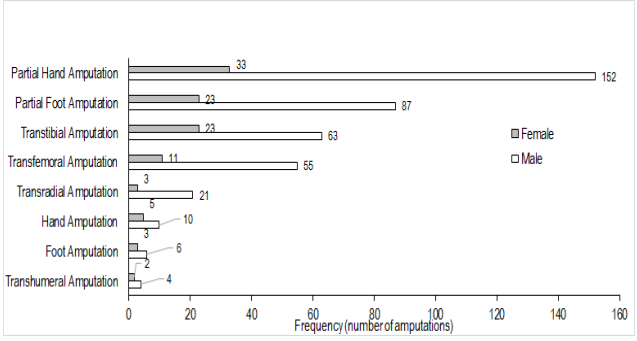

Figure 5. Distribution of different levels of amputation according to gender.

For ethnic diversity, the data was analyzed according to two categories: Saudi Arabian locals and expatriates living in Saudi Arabia. Figure 6 shows the number of amputations at each amputation level in the local versus expatriate population. Figure 7 shows the same data expressed as a percentage of the total number of amputations for each of the two groups. In both groups, partial hand amputation remained the most common type of amputation, i.e. 45% in locals and 25% in expatriates.

Figure 8 shows ethnic distribution of amputation frequency according to gender. 71% of the local and 78% of the expatriate amputees were male. Figure 9 depicts the distribution of amputation frequency according to the side of amputation. 59% of the amputations in local population and 51% of the amputations in expatriate population were of the right side.

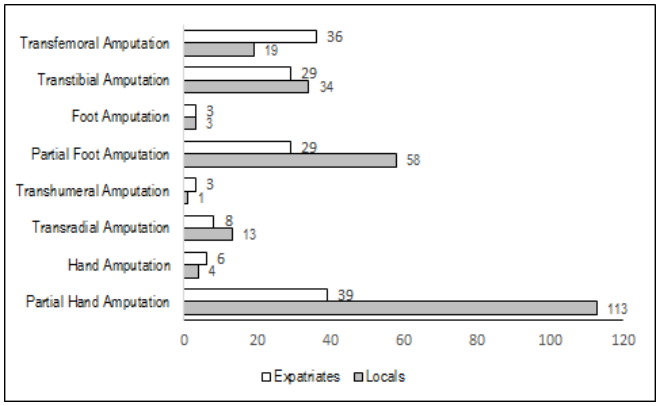

Figure 6. Amputation levels for Saudi Arabian local and expatriate population, expressed as number of amputations.

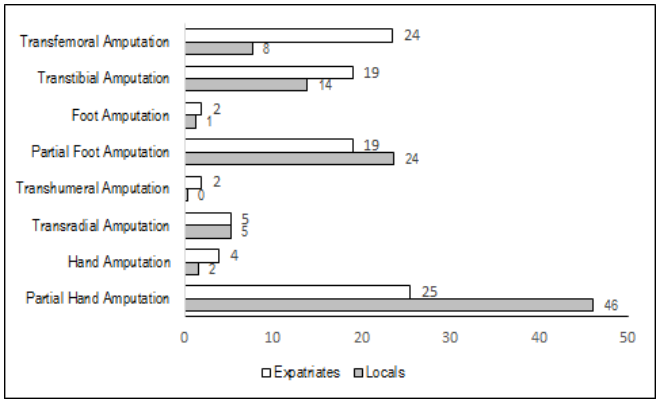

Figure 7. Amputation levels for Saudi Arabian local and expatriate population, expressed as a percentage of the total number of amputations for each of the two ethnic groups.

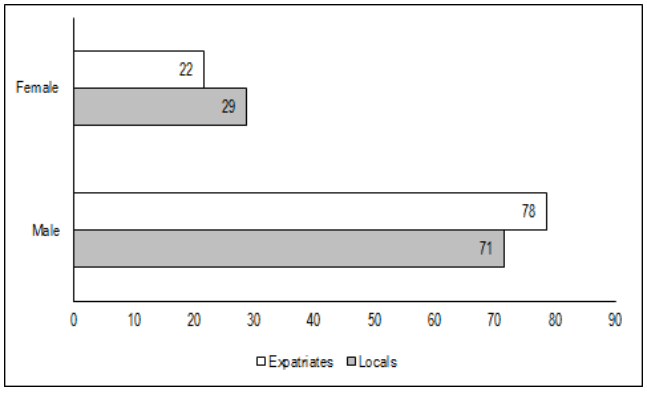

Figure 8. Amputation frequency according to gender, expressed in percentage for Saudi locals and expatriates.

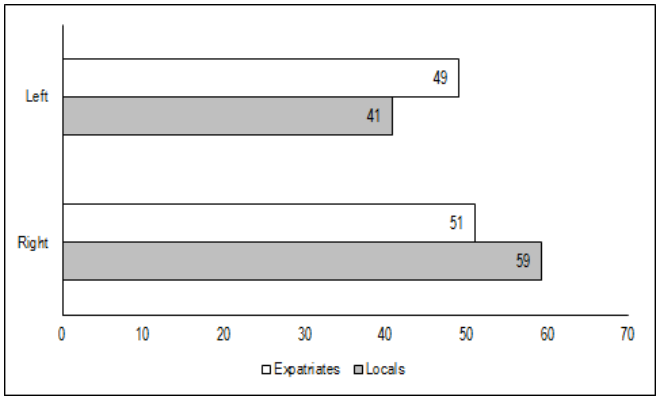

Figure 9. Amputation frequency according to side of amputations, expressed in Saudi percentage for locals and expatriates.

4. Discussion

The study aimed primarily at carrying out a cross-sectional analysis of Saudi Arabian population for the past ten years in terms of epidemiological factors associated with traumatic limb loss. Analyses have revealed a considerable range of variations according to age, gender and side of amputation. There was no significant difference in amputation frequencies over the past ten years. The most common type of amputation according to the level of amputation was found to be partial hand amputation. Considering the fact that more than half of partial hand amputees lose their ability to continue their previous jobs [11], this is a matter of concern for healthcare providers and policy-makers.

A clear dominance of males was evident in the overall data. The trend is consistent with older studies by Al-Turaiki and Al-Falahi, Al-Jarrah et al and Maimani et al [12-14] who studied the Saudi Arabian population, without considering the cause of amputation. The same trend of male dominance was found in upper limb amputations in France by Pomares et al [15]. In the USA, however, the female amputation rate is higher [9].

Age group was found to be an impacting parameter in amputation rates. Interestingly, our analyses show an inverse relation between age group and frequency of amputations, i.e. amputation was performed mostly in the younger patients. Since we did not consider the cause of trauma in our analyses, an educated guess based on previously published works could account for this trend. According to Al-Wahbi et al, road traffic accidents mostly affect the younger population [16]. Furthermore, a study in Greece reports inadequate door closure systems to be a major cause of hand amputation among children [17].

Most amputations were of the right side. This is understandable since Saudi Arabia is primarily a Muslim country, and there is a clear right-hand preference among Muslims [18]. This leads to the right hand being exposed to traumatic incidents more often. The same trend is reported by Al-Jarrah et al for the country [14] and an opposing trend is reported for France by Pomares et al [15].

For further analyses, the data was categorized according to nationality (Saudi locals versus expatriates). There was a clear overrepresentation of Saudi locals in the frequency of amputations. Analyses reveal that the percentage of each amputation level was different for expatriates and Saudis.

Among Saudis, amputation rate was highest for partial hand amputations, followed by partial foot amputation and transtibial amputation. Among the expatriates, amputation frequency rates were almost equal for partial hand and transfemoral amputations (~25%), and equal for partial foot amputation and transtibial amputation (19%). The reasons for the differences between these nationality groups are still unknown. However, the pattern of amputation was same in both Saudis and expatriates in terms of gender, i.e. male amputees were predominant compared to female amputees. A similar pattern was seen for the side of amputation for both the groups, i.e. amputation in right limb was higher than left for both upper and lower limbs. This difference was, however, more pronounced in Saudi amputees.

The fact that the cause of amputation was not considered, is a limitation of this study. A deeper understanding of the reported trends may be achieved by analyzing what type of trauma caused the amputation.

5. Conclusions

Amputation frequency was found to be inversely related to age group in five Saudi tertiary care hospitals. There was no statistically significant relationship between gender and annual distribution of amputations and level of amputation. A considerable effect of nationality was found on the level of amputation, side of amputation and gender. Further research should categorize these amputations based on the type of trauma to better understand the relationship between demographic parameters and amputation level.

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