



# Comparative Study about Different Years of Amputation with Various Indications

## ARTICLE INFO

### Article Type

Descriptive Study

### Authors

Raheem K.I.<sup>\*1</sup> MD,  
Rahiem O.I.<sup>2</sup> MD

### How to cite this article

Raheem K I, Rahiem O I. Comparative Study about Different Years of Amputation with Various Indications. Iranian Journal of War & Public Health. 2023;15(1):27-33.

## ABSTRACT

**Aims** Amputation is a procedure in which an unhealthy limb or a part of it is cut because it is dangerous, or useless or disrupts life. This procedure in itself is considered a crippling procedure, yet it is also a life-saving procedure. This study aimed to compare the causes of amputation in Iraqi subjects for five years (2016-2020).

**Instruments & Methods** In this retrospective cross-sectional study, 758 amputated patients were investigated from 1st day of 2016 to the last day of 2020 at Al-Hariri Hospital for Surgical Specialty.

**Findings** The rate of amputation in 2020, 2019, 2018, 2017, and 2016 was 6%, 6%, 4%, 3%, and 2% of total admitted cases, respectively. The highest cause of amputation in 2020 was diabetes mellitus (18%) and mostly in males. Diabetes mellitus and vascular ischemia in both sexes were 18% of total amputated cases in 2019. Trauma was 23% of total amputated cases in 2018, 57% in 2017, and 64% in 2016.

**Conclusion** The rate of amputation is not so high. There is a significant association between amputation and gender, age, occupation, and the cause of amputation. There is no significant relationship between amputation and the hospital stay, the parts are either lower or upper, and the side is either left or right. Regarding the indications of amputation, the highest cause of amputations changes every year.

**Keywords** Amputation; Covid-19; Diabetes Mellitus; Iraq

<sup>1</sup>Department of Surgery, College of Medicine, University of Fallujah, Fallujah-Anbar, Iraq

<sup>2</sup>Department of Surgery, Al- Fallujah Teaching Hospital, Fallujah-Anbar, Iraq

### \*Correspondence

Address: Department of Surgery, College of Medicine, University of Fallujah, Fallujah-Anbar, Iraq.

Phone: +7702935390

Fax: -

dr.kamalismael@uofallujah.edu.iq

### Article History

Received: July 13, 2022

Accepted: January 10, 2023

ePublished: January 21, 2023

## CITATION LINKS

[1] Indications for ... [2] Stedman's medical ... [3] Limb amputation and limb ... [4] Sharp rise in number of ... [5] Gaza-strip amputees in seeking ... [6] Limb ... [7] The natural history of ... [8] The validity and reliability of ... [9] The association between ... [10] Sciatic nerve resection ... [11] Pre-B cell colony enhancing ... [12] Incidence of thrombotic ... [13] Digital ulcers: Overt vascular ... [14] Prognostic factors for ... [15] Ambulatory and inpatient ... [16] Estimating the prevalence ... [17] Diabetic foot and disaster ... [18] Epidemiology and risk ... [19] Amputation for recurrent ... [20] Acute arterial thromboembolism ... [21] Amputations in the burn ... [22] Digital amputation in ... [23] An update on the relationships ... [24] Atherosclerosis in systemic ... [25] Lower limb ...

## Introduction

Amputation is an old procedure that has been present since the time of human presence on earth. It happened as an accident when exposed to wild animals or when rockers fall on them in the caves, or as result of fighting. As time progressed, amputation became a surgical procedure with many indications [1].

Amputation linguistically means cutting a whole limb or a segment of it either by accident of any cause or surgically [2]. Trauma, as one of the causes of amputation, is relatively low in the civilian country and can occur as an occupation-related event, such as factory workers who fail to follow safety rules, victims of road traffic accidents, or swimmers exposed to sharks attacks during swimming in seas [3], in comparison to sites which is relatively pandemic in trauma and military attack such as Gaza [4, 5].

Peripheral occlusive diseases and diabetes mellitus can progress to ischemia, necessitating the need for amputation, and these two causes form the major cause to perform an amputation in the USA.

Diabetes mellitus may be considered a precursor to other causes as it might progress to peripheral occlusive disease. Also, hyperglycemia can be considered a good culture media for infection. In addition, diabetes mellitus is one of the common causes of peripheral neuropathy. Peripheral neuropathy affects small and large nerves with demyelination. Patients with peripheral neuropathy can experience burning or tingling sensations. This abnormal sensation increases during the period of increase in the blood level of glucose and may subside with better control of the blood level of glucose. Peripheral neuropathy can progress to the anesthetized foot, which in turn can induce ulcers very resistant to treatment and necessitate the amputation. This neuropathy is irreversible, and no medication can reverse these changes. The sensation of temperature and pain are not the only sensation that was disturbed in this situation, but proprioception and motor functions may be involved. This elevated sugar might lead to peripheral vascular occlusion, even if it is a short or long segment of an artery, or even partial occlusion can progress to ulcer, infection, or gangrene. This vessel abnormality can be detected clearly by angiography. The patients may experience pain, altered sensation in the limb with the feeling of cold extremity, atrophic changes of the skin, and loss of hair in the affected limb, progressing to pain, blisters, then ulceration, or even gangrene.

Tumors and congenital abnormalities are the minor causes of performing such procedures [6].

Many cases of chronic ulceration or infection or both of them can present as a complication of vascular occlusive disease [7] or diabetes mellitus [8, 9] or as cases of oncological bases [10, 11] that make amputation the most available treatment. Sarcomas,

in general, are rare with unknown etiology. Although some of them have a genetic background but exposure to the hazard of radiation increases the risk. Sarcomas can present at any age, mainly adulthood. It has no sex predilection. Amputation is not the only procedure that can be used to treat sarcomas. Local surgical resection can be used to treat sarcomas with a high possibility of local recurrence rate. At that time, amputation may be considered. Amputation should be done for the patient in which wide surgical resection resulting in a hopeless or nonfunctioning limb or the safety margin cannot be achieved without amputation. Amputation is rarely indicated for the treatment of sarcomas unless the neurovascular bundle is primarily involved.

Amputation, as a procedure, can be used in Covid-19 cases because of ischemia resulting from its thromboembolic effect [12]. The pathogenic agent responsible for this condition is enveloped RNA beta-corona viruses. This viruses are named covid-19 as it is discovered early in 2019 in china. Then the viruses became a pandemic all over the world. The presentation of this virus was acute respiratory distress in the majority of cases, and the hyper coagulopathy effect may progress to arterial thromboembolic complications. This thromboembolic complication can be expressed despite thromboprophylactic treatment. This complication, if it happened, has a worse prognosis as it may lead to limb loss, or it may progress to life-threatening conditions such as stroke or multiple organ failure and even death of the patients.

Rheumatologic diseases collectively are autoimmune diseases. Most of the causes of rheumatologic diseases are unclear. These diseases can present as soft tissue problems due to various tissue inflammatory responses. These inflammations involve the vascular system from the capillaries till they reach the major arteries as an example of this behavior is Reynaud's phenomenon. Vasculitis and its complications, in rheumatologic problems, can progress to amputations in some situations [13]. Digital ulceration and digital necrosis can present in 30% of people with scleroderma annually. These ulcers can appear as annoying problems, which start as local pain and progress to ulcer, then infection of soft tissues and bone, and finally gangrene of the involved digit. According to the Pittsburgh database, the percentage of reported cases with gangrene requiring amputation was 11%.

Burn with different etiology, such as electrical or thermal or chemical burn with its complications, might make amputation the procedure of choice. Amputation as an operation for the treatment of burns is very rare, with an incidence of 2% whatever the cause. Burn can progress to infection, then septicemia and death. So, sometimes amputation is chosen to prevent complications related to burns, especially in electrical and thermal burns. Electrical

burns increase the risk of amputation more than thermal or chemical burns. Electrical burn is more common in males, especially those who work with electricity [14].

This study aimed to investigate the causes of amputation in Iraqi people in the last five years and compare the results of each year with other years.

### Instruments and Methods

This retrospective cross-sectional study involved five years from 1st day of 2016 to the last day of 2020 was carried out at Al-Hariri Hospital for Surgical Specialty. It included 758 amputated cases collected from chronicles of admitted patients to the Orthopedics Department who needed amputation. Patients were of both genders (males and females). The age of involved patients was designed to be unlimited and range from neonate to elderly ages. This study included the parts of the upper and lower limbs and also involved the side of the right and left. The enrolled patients were of various indications, which included trauma of various types, whether it is (occupational or accidental), diabetes mellitus, peripheral vascular occlusion, tumors, chronic ulcerations, chronic infections, rheumatologic cases, Covid-19 cases, and finally, burns of various etiology. All cases admitted to Orthopedic Department in Al-Hariri Hospital for Surgical Specialty as cases needed amputation were included in this study. However, some of cases were already received as amputated cases due to accident or trauma. Exclusion criteria included those cases with congenital amputation.

The amputation as a surgical procedure of involved patients was carried out according to classical methods written in *Camble Operative Approaches in Orthopedic and Trauma*, although some of cases already received amputated either surgically or accidentally by special events.

The procedure, which was either in the lower or upper limb, included receiving the patients in the emergency unit. After receiving the patient and stabilizing the patient vitally, consent was taken from the patient or his relatives unless he was in life threatened condition and the operation was in need to save his life, or no relative with him, or in unconscious patients, which in such cases, the consent was taken from the police station.

The next step was to transfer the patients to the operative theater after detecting the level of amputation with the help of the vascular team. In the operative theater, the patient was anesthetized. Painting of the limb that required amputation was done with povidone iodine 10%. Then the involved limb was draped with a sterile dressing. After being sure that the patient was completely anesthetized, the surgical incision was done according to the level previously decided and according to the classical incisions described in the mentioned textbook, as possible. After cutting the bone and the soft tissue,

sometimes the wound is left open to be seen later on for a second look to assess the vitality of tissues or the presence of infection. After that, dressing in sterile gauze and bandaging of the wound was done to be seen later. After that, if the wound was free from infection and the state of soft tissues was healthy, the next step was the closure of the wound in any possible way.

### Statistical analysis

Statistical Package for Social Sciences version 24 was used to analyze collected data. Continuous variables were presented as mean and Standard Deviation (SD), and discrete variables were presented as numbers and percentages. The chi-square test for independence was used to test the significance of the association between discrete variables.

### Findings

The total numbers of these patients in these five years were 758 (100%). The majority were males (66.7%), and the highest number of these patients were above 60 years old (32%). The range for this age group was 1-98 years, with a mean of  $46.2 \pm 20.8$  years. Most of these patients were housewives (26.3%). Most of these patients stay in the hospital for less than five days (77.3%), with a mean of  $4.3 \pm 5.0$  days. Left-sided amputations formed the majority of cases (52.8%) and mostly in lower limbs (90.4%). Trauma was the most cause of amputation (35.8%), while burns were the least cause (0.1%). The amputation as procedures increased in 2016 to form about 198 (26.5%) of total amputated cases in these five years, while the lowest number of amputations occurred in 2018, which was about 104 (13.9%; Table 1).

The highest number of amputated cases occurred in 2017, with male predominance. The males showed dominance in all these five years. There was a significant association between sex and amputation ( $p < 0.001$ ). The highest percentage of amputations occurred in 2016 and 2017, and most of them occurred in age groups of 20-39 years ( $p < 0.001$ ).

In terms of occupations, the highest percentage was 40.4% in 2018 as housewives, while the lowest percentage was 1.8% in 2016 as clerks ( $p < 0.001$ ).

The majority of these patients stayed in hospital for less than five days, with the highest percentage in 2017, while the minority of these patients stayed for more than five days, with the highest percentage in 2016 ( $p = 0.289$ ).

Left side predominance with the highest percentage occurred in 2019, while the lowest percentage occurred in males in 2017. In females, the highest percentage was in 2017, while the lowest percentage was in 2020 ( $p = 0.753$ ).

The highest percentage of upper lower limb amputation was in 2020 and the lowest percentage was in 2018. The highest percentage of upper limb amputation was in 2017, while the lowest percent

was in 2020. The amputation side showed no significant relationship ( $p=0.185$ ).

**Table 1)** Frequency of characteristics of the studied patients (n=758)

Variable	No.	%
<b>Sex</b>		
Male	499	66.7
Female	249	33.3
<b>Age group</b>		
1-19 y	73	9.8
20-39 y	219	29.3
40-59 y	217	29.0
≥60 y	239	32.0
<b>Occupation</b>		
Student/child	56	7.5
Retired	79	10.6
Unemployed	197	26.3
Housewife	201	26.9
Clerk	26	3.5
Military	189	25.3
<b>Hospitalization duration</b>		
Up to 5 days	578	77.3
>5 days	170	22.7
<b>Amputation side</b>		
Left	395	52.8
Right	353	47.2
<b>Lower/upper</b>		
Lower	676	90.4
Upper	72	9.6
<b>Cause</b>		
Trauma	268	35.8
Diabetes Mellitus	233	31.1
Vascular Occlusion	206	27.5
Tumor	32	4.3
Infection	4	0.5
Covid-19	2	0.3
Rheumatologic disease	2	0.3
Burn	1	0.1
<b>Year</b>		
2016	165	22.1
2017	198	26.5
2018	104	13.9
2019	149	19.9
2020	132	17.6

Trauma was the major cause of amputation in this study, although it declined in the last years. Vascular occlusive disease and diabetes mellitus were the second most common causes in all these five years, with the highest percentage in 2020 and the lowest percentage in 2016 and 2017, respectively.

Tumors as an indication of amputation were rare, with the highest percentage in 2020, but this percentage declined in 2018. Other causes of amputations, such as chronic infection, burns, rheumatologic causes, and covid-19, were very rare, and varied in appearance from year to year (Table 2).

The observation of these five years showed that the amputated males always took the high percentage except in 2018 when the females (51.9%) were higher than the males (48.1%; Figure 1).

Regarding the age groups of amputated patients, the lowest percentage of the age group of 1-19 years was in 2017, and the highest was in 2018. The age group of 20-39 years showed the highest percentage of all age groups. The lowest percentage of amputation in this age group was in 2020, while 2016 showed the highest percentage. The age group of 40-59 years showed slight differences in percentage among all these five years ranging from 22.7% in 2017 to 34.1% in 2020. The last age group (≥60 years) showed a variation in a percentage ranging from 20.6% in 2016 to 41.6% in 2019 (Figure 2).

**Table 2)** Frequency of characteristics of the studied patients according to year (n=758)

Variable	2016	2017	2018	2019	2020	p
<b>Sex</b>						
Male	119(72.1)	148(74.7)	50(48.1)	102(68.5)	80(60.6)	<0.001
Female	46(27.9)	50(25.3)	54(51.9)	47(31.5)	52(39.4)	
<b>Agegroup</b>						
1-19 y	16(9.7)	13(6.6)	20(19.2)	11(7.4)	13(9.8)	<0.001
20-39 y	70(42.4)	83(41.9)	18(17.3)	26(17.4)	22(16.7)	
40-59 y	45(27.3)	45(22.7)	32(30.8)	50(33.6)	45(34.1)	
≥ 60 y	34(20.6)	57(28.8)	34(32.7)	62(41.6)	52(39.4)	
<b>Occupation</b>						
Student/Child	12(7.3)	11(5.6)	15(14.4)	7(4.7)	11(8.3)	<0.001
Retired	14(8.5)	15(7.6)	11(10.6)	24(16.1)	15(11.4)	
Unemployed	26(15.8)	43(21.7)	20(19.2)	57(38.3)	51(38.6)	
Housewife	38(23.0)	40(20.2)	42(40.4)	38(25.5)	43(32.6)	
Clerk	3(1.8)	10(5.1)	3(2.9)	7(4.7)	3(2.3)	
Military	72(43.6)	79(39.9)	13(12.5)	16(10.7)	9(6.8)	
<b>Hospitalization duration</b>						
≤ 5 days	118(71.5)	158(79.8)	81(77.9)	114(76.5)	107(81.1)	0.289
> 5 days	47(28.5)	40(20.2)	23(22.1)	35(23.5)	25(18.9)	
<b>Amputation side</b>						
Left	85(51.5)	100(50.5)	53(51.0)	85(57.0)	72(54.5)	0.753
Right	80(48.5)	98(49.5)	51(49.0)	64(43.0)	60(45.5)	
<b>Limb</b>						
Lower	148(89.7)	174(87.9)	91(87.5)	138(92.6)	125(94.7)	0.185
Upper	17(10.3)	24(12.1)	13(12.5)	11(7.4)	7(5.3)	
<b>Cause</b>						
Trauma	83(50.3)	100(50.5)	35(33.7)	36(24.2)	14(10.6)	<0.001
Diabetes	34(20.6)	52(26.3)	28(26.9)	63(42.3)	56(42.4)	
Vessel occlusion	41(24.8)	40(20.2)	35(33.7)	43(28.9)	47(35.6)	
Tumor	5(3.0)	5(2.5)	2(1.9)	7(4.7)	13(9.8)	
Others	2(1.2)	1(0.5)	4(3.8)	0(0.0)	2(1.5)	

Numbers in parentheses are percentages.

The frequency of amputation in students and children varied from 4.7% in 2019 to 14.4% in 2018. Amputation in retired patients ranged from 7.6% in 2017 to 16.1% in 2019. Unemployed amputated patients varied from 15.8% in 2016 to 38.6% in 2020. Housewives ranked second in amputations in the study, ranging from 20.2% in 2017 to 40.4% in 2018. The lowest percentage is occupied by clerks, with 1.8% in 2016 to 5.1% in 2017. Military occupations accounted for the largest percentage of amputees,

ranging from 43.6% in 2016 to 6.8% in 2020 (Figure 3).

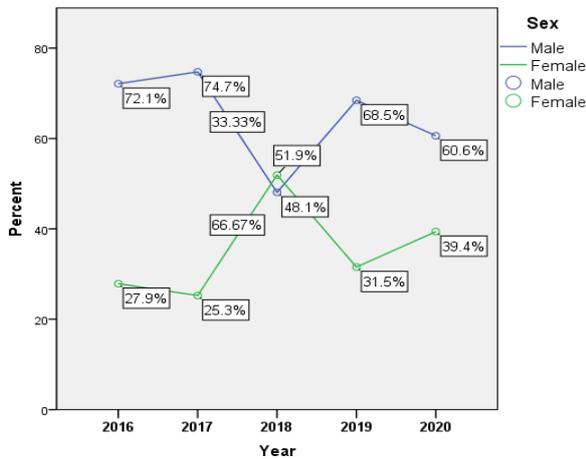


Figure 1) Frequency of the studied patients according to the year of amputation and sex of the patients

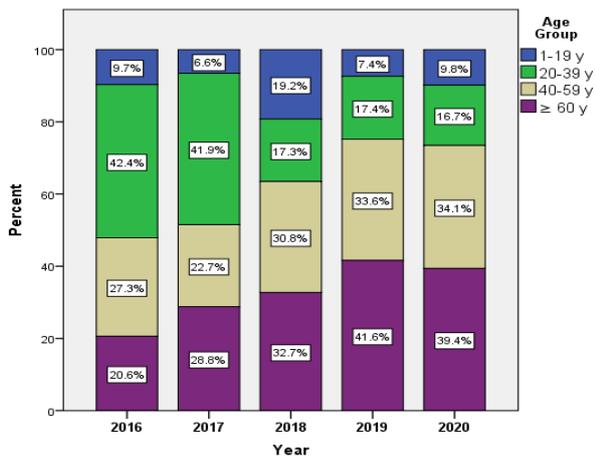


Figure 2) Frequency of the studied patients according to the year of amputation and age group

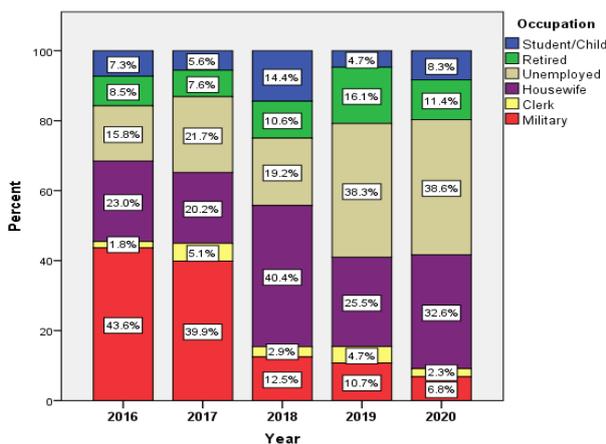


Figure 3) Frequency of the studied patients according to the year of amputation and occupation

The percentile of indication for amputation changes every year. Trauma as a cause showed a higher percentile in 2016. The decline of this percentile continued until 2020. The second most common cause of amputation in this study included diabetes

mellitus and vascular occlusive diseases, which showed an increase in percentiles from 2016 to 2020. Tumors showed a constant lower level in all these five years. Other cases of amputation (chronic infections, rheumatologic cases, burn, and covid-19) occurred as sporadic cases (Figure 4).

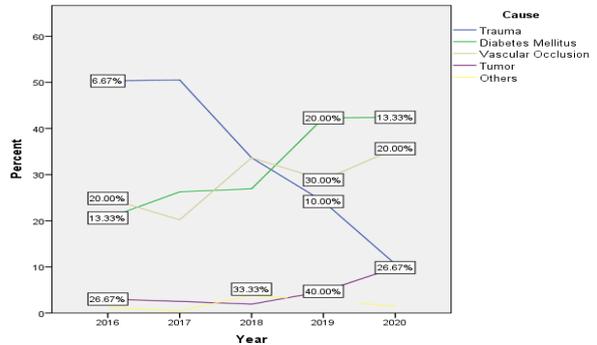


Figure 4) Frequency of the studied patients according to the year of amputation and causes

### Discussion

The results gained from this study state that the percentage of admitted patients does not exceed 6% in all these five years, which is not so high concerning other studies, which state that the admitted cases are much higher [15]. From all these years of study, gender showed a significant association with amputation. In all these five years, the male gender was the highest percentage except in 2018, which showed a relative increase in female amputations concerning other years. This behavior cannot be explained according to all available papers, which showed that the males showed predominance in other similar studies [16].

The age group, occupation, and causes showed significant association with amputation in this study. The highest percentile of age groups was 20-39 years, which is mostly military in this study. The causes of amputation in this age group was mostly trauma, which increased in 2016 and declined in 2020. It can reflect the state of conflict at that time. Some studies talk about the trauma as a major cause of amputations, like Gaza [5], which showed similarity to what happened in 2016, while other studies talk about trauma as a secondary cause for trauma, such as accidental industrial injury [3], which showed similarity to what happened in 2020.

The second cause of amputation in this study was diabetes mellitus and vascular occlusive diseases, which had a significant relationship with occupation because most of them were housewives and unemployed with an age group above 60 years, although these causes of amputation showed a slight increase in percentile from 2016 until 2020. The percentage increase in behavior was gradual. This study showed similarities with other studies that explain the impact of this disease and its synergistic effect on vascular occlusion and diabetes [17, 18]. This sentence explains that vascular occlusion diseases are the aging process, and this occlusion increases in

case of aging or diabetes due to the synergistic effect on the vessels.

Tumors ranked third as the cause of amputation. Most of them were males with the age group of 1-19 years. Although these patients were few in all five years, they were almost apparently stable from 2016 to 2018, even after that, the percentile increase was not so great even in 2020, which was the highest of all five. The year showed. This study is not much different from other studies that talk about tumors as a cause of amputation [19]. The explanation is that malignant tumors of limbs are the disease of young patients and need an amputation.

Other causes, including chronic infections (0.5%), rheumatologic disease (0.3%), covid-19 (0.3%), and burn (0.1%), were very rare, although they still appeared in some years but disappeared in others. The paucity of samples makes the analysis difficult. So they were collected under the heading as "other causes", although other papers talk about the relationship between amputation and these causes separately.

The papers, which discuss covid-19, talk about its complication as a case of thromboembolism [20] and its end stages, but do not mention it as a cause of amputation, so this paper may be the first paper that mention covid-19 as a cause of amputation.

Other minor causes, such as chronic infection, might be present as cases of pure infection, as a case of chronic osteomyelitis, as a case of complication of diabetes mellitus [17], or as a case of vascular occlusive diseases or combination of both because of its synergistic effect [18].

For burns of different causes, although the sample is small to be assessed, amputation is still present as a burn treatment as in other studies [21].

Cases of rheumatoid arthritis can develop vacuities that may end with ischemia and amputation, which is similar to some papers written in this field [22-24].

Other variables seen in this article, such as lower or upper limbs, did not show any significant relationship with amputation. This finding showed dissimilarity with other papers in the world which talk about the effect of lower limbs more than other parts of the body [25].

Other variables in this study, such as a hospital stay from admission to hospital discharge and left or right side, did not have a significant association with amputation. But we had no available articles that describe these variables.

The limitations of this study were that the samples were taken from a single hospital. Although this hospital is considered a tertiary center, sampling from different hospitals is needed. It is recommended to refer patients who need amputation to a specialized hospital for amputation and its complications so that the follow-up is easy and any study in this field can be easily collected and analyzed.

## Conclusion

The rate of amputations is not so high. There is a strong association between amputation and gender, age, occupation, and the cause of amputation. On the other hand, the hospital stay, the parts either lower or upper and the side either left or right have no significant association with amputation. The indication for amputation is strongly variable. Trauma as a major cause of amputation changes every year, while diabetes mellitus, vascular occlusion, and tumors appear more stable in the percentile of presentation. Covid-19 with thromboembolism might end with amputation.

**Acknowledgements:** We are grateful to everyone who contributed to the production of this article, including patients, physicians, Medical City staff, journal sections, and reviewers.

Also, Special thanks to dr. Basil O Saleh, Ph.D. Clinical biochemistry, College of Medicine, University of Baghdad, who helped to frame this study, and dr. Lyath Al-Salihi/ M.B.Ch.B/F,I,B.M.S Community Medicine/National Tuberculosis Institute, who helped us in statistics.

**Ethical Permission:** The ethical consent for this paper was taken from Scientific Committee of College of Medicine, Al-Fallujah University and Health Directory, Baghdad Medical City.

**Conflict of Interests:** There is no conflict of interests.

**Authors' Contribution:** Raheem KI (First Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer (60%); Rahiem OI (Second Author), Statistical Analyst/Discussion Writer (40%)

**Funding:** This study is self-funded.

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