Descriptive analysis of diabetes-related amputations at the Colonial War Memorial Hospital, Fiji, 2010–2012

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Setting: The Colonial War Memorial Hospital (CWMH) in Fiji.

Objective: To determine the characteristics of patients with diabetes mellitus (DM) who underwent lower limb amputations at the CWMH from 2010 to 2012.

Design: This was a retrospective review of data contained in operating theatre registers and clinical records of DM patients who had undergone amputations during the study period.

Result: Of the 938 amputations performed at the CWMH during the study period, significantly more patients were male than female (54.1% vs. 45.9%) and more *i-Taukei* (indigenous Fijian) than Indo-Fijian (71% vs. 26.2%); 15.9% of patients had not previously been diagnosed as having DM when they presented with foot sepsis. The rate of smoking was highest in male *i-Taukei* patients. A large proportion of patients (76.8%) had poor glycaemic control.

Conclusion: This study suggests that male *i-Taukeis* are most at risk, and that uncontrolled DM is a significant factor associated with amputations. There is a need to strengthen DM screening and improve glycaemic control. Foot care education needs to be implemented at diagnosis and re-enforced with regular clinic visits and complication screening sessions.

More than 170 million people suffer from diabetes mellitus (DM) globally, and this number is expected to double by 2030.¹ It is predicted that Pacific Island countries such as Fiji will experience among the greatest increases in DM prevalence worldwide.² The Fiji STEP-wise approach to surveillance (STEPS) non-communicable disease (NCD) survey in 2002 revealed that 16% of the 25–64 year age group had DM, of which 50% were previously unknown.³

The World Health Organization (WHO) estimates that two thirds of global deaths in 2008 were caused by NCDs, more than all other causes combined.⁴ The link between NCDs and development was explicitly recognised by the Pacific Islands Forum leaders who, in the 42nd Pacific Islands Forum communiqué of September 2011, declared the Pacific to be in an NCD crisis.⁴

More than a million lower leg amputations are performed worldwide each year as a consequence of DM.⁵ Schaper et al. concluded that the amputation of the lower limb is one of the most feared diabetic complications, associated with loss of mobility, poor quality of life and significant financial burden on family finances.⁶ It has been estimated that 17% of DM patients

become disabled due to amputation or lose their sight.³ The life-time risk of a person with diabetes developing a foot ulcer is reportedly as high as 25% globally.⁷ This situation is further complicated in the Pacific region by the limited capacity to address DM and its consequences, including amputations.^{8,9} The lack of awareness about foot complications among the general population and delayed presentation to clinic due to the fear of amputation further complicates the capacity of the health system to respond adequately.¹⁰ Anecdotal evidence suggests that there were approximately two amputations per day due to DM at the CWMH in 2012.¹¹ This study was undertaken to determine the characteristics of DM patients who underwent amputations in Fiji, an important first step to designing an evidence-based intervention to reduce amputations.

METHODS

Study design and setting

This study was a retrospective review of operating theatre records of DM patients who had had amputations at the CWMH in Suva, Fiji, from January 2010 to December 2012. CWMH is the largest hospital in Fiji, with four operating theatres and one post-anaesthetic recovery unit. The CWMH treats patients mainly from the Central and Eastern Divisions of Fiji, which has a higher proportion of *i-Taukei* residents than the Western and Northern Divisions (65% vs. 42% and 55% of the total population, respectively) (source: the 2007 Census).

Study population

The study population included all DM patients who had had amputations from 2010 to 2012 in the operating theatre at CWMH. All amputations performed were manually recorded in a proforma. From the 2010–2012 data set, a subsample of 413 was randomly selected to determine factors associated with DM patients who were not present in the operation theatre register by sourcing patient folders.

Data collection and analysis

Amputation data were sourced from the operation theatre register. Variables collected included age, sex, ethnicity (*i-Taukei* [indigenous Fijians], Indo-Fijians [Fijians of Indian origin] and others), type of surgery and hospital number. For the sub-sample, the variables collected from patient folders included age, place of residence (division and subdivision), ethnicity, sex, smoking status at admission, number of years as a confirmed DM patient, type of surgery, date of surgery,

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TABLE 1 Demographic data of all DM-related amputations performed at the Colonial War Memorial Hospital, Fiji Islands, 2010–2012

	2010 <i>n</i> (%)	2011 <i>n</i> (%)	2012 <i>n</i> (%)	Total <i>n</i> (%)
All amputations	320 (34.2)	325 (34.6)	293 (31.2)	938
Type of amputation				
Above the knee	31 (9.7)	37 (11.4)	20 (6.8)	88 (9.4)
Below the knee	113 (35.3)	109 (33.5)	102 (34.8)	324 (34.5)
Digit	123 (38.4)	133 (40.9)	126 (43.0)	382 (40.7)
Forefoot	53 (16.6)	46 (14.2)	45 (15.4)	144 (15.3)
Age, years				
25–34	8 (2.5)	6 (1.8)	4 (1.4)	18 (1.9)
35–44	32 (10.0)	35 (10.8)	18 (6.1)	85 (9.1)
45–54	79 (24.7)	77 (23.7)	72 (24.6)	228 (24.3)
55–64	112 (35.0)	95 (29.2)	85 (29.0)	292 (31.1)
≥65	76 (23.8)	75 (23.1)	83 (28.3)	234 (24.9)
Not recorded	13	37	31	81 (8.6)
Mean	57.5	57.6	58.8	57.9
SD	11.6	11.2	10.7	11.2
Range	29–90	31–85	32–92	29–92
Ethnicity*				
<i>i-Taukei</i>	227 (70.9)	237 (72.9)	202 (68.9)	666 (71.0)
Indo-Fijian	87 (27.2)	82 (25.2)	77 (26.3)	246 (26.2)
Others	6 (1.9)	6 (1.8)	14 (4.8)	26 (2.8)
Sex				
Male	178 (55.6)	170 (52.3)	159 (54.3)	507 (54.1)
Female	142 (44.4)	155 (47.7)	134 (45.7)	431 (45.9)

* *i-Taukei* = indigenous Fijians; Indo-Fijians = Fijians of Indian origin.
DM = diabetes mellitus; SD = standard deviation.

date of admission, date of discharge/death, admission blood pressure, initial random blood sugar (RBS) and HBA1c.

Data were double-entered into EpiData, version 3.1 (EpiData Association, Odense, Denmark) and validated. The final data set was then analysed after correcting for discordance. The cumulative incidence and exact binomial 95% confidence intervals (CIs) were calculated by dividing the number of amputations by the estimated population of each ethnic group in the Central and Eastern Divisions, available from the 2007 census (*i-Taukei*, 248 195; Indo-Fijian, 103 784; others, 29 721; total, 381 700).¹² The statistical significance of any observed differences between proportions of the variables was determined using the χ^2 test at 95%CI. Analysis was performed using SPSS, v. 22 (Statistical Package for the Social Sciences, IBM Corporation, Armonk, NY, USA).

Ethics approval

Ethics approval was obtained from the Ethics Advisory Group (EAG) of the International Union Against Tuberculosis and Lung Disease, Paris, France, and the Fiji National Research Ethics Committee and National Health Research, Suva, Fiji.

RESULTS

A total of 938 amputations were performed during the study period (Table 1). There were significantly more amputations in males than in females ($P = 0.012$), and

significantly more digit amputations in males than in females ($P = 0.0001$). Most amputations occurred in individuals aged ≥ 45 years. There was no significant difference in the cumulative incidence of amputation in *i-Taukei* and Indo-Fijian populations based on the 2007 population census ($P \geq 0.05$). In addition, the relative proportion of *i-Taukei* and Indo-Fijians was the same as the general population.¹² The ratio of males to females was the same in both ethnic groups.

The data collected in the subsample of patient records (Table 2) are considered representative of the larger data set collected from the operation theatre register, as there were no significant differences in observed proportions. The cumulative incidence rates of amputations were the same across all subdivisions. The three subdivisions with the highest rates of amputations were Suva (49.0% of CWMH amputations), Rewa (20.8%) and Serua/Namosi (7.4%).

Of the amputation patients, 16.5% were smokers; significantly more male *i-Taukeis* were smokers compared to other sex/ethnic combinations ($P < 0.05$); 15.9% of amputees had previously unknown DM status. Only 28.1% had duration of DM recorded in their medical records; the mean time from the diagnosis of DM until an amputation was performed was 8 years among those with data available.

In the subsample, 65.4% were undergoing amputation for the first time, for 31.7% it was the second amputation, 2.7% the third and 0.2% the fourth. Blood pressure and blood glucose control were generally

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TABLE 2 Characteristics of a subsample of DM-related amputations performed at the Colonial War Memorial Hospital, Fiji Islands, 2010–2012 ($n = 413$)

Variable	<i>n</i> (%)
Subdivision	
Central Division	
Tailevu	21 (5.1)
Naitasiri	13 (3.2)
Rewa	85 (20.8)
Serua Namosi	30 (7.4)
Suva	200 (49.0)
Eastern Division	
Lomaiviti	14 (3.4)
Kadavu	10 (2.5)
Lakeba	8 (2.0)
Lomaloma	9 (2.2)
Others	18 (4.4)
Not recorded	5 (1.2)
Smoking status	
Smoker	68 (16.5)
Non-smoker	342 (82.8)
Not recorded	3 (0.7)
DM status	
Confirmed DM	344 (84.1)
Previously unknown	65 (15.9)
Not recorded	4 (1.0)
Duration of DM, years	
Recorded	116 (28.1)
Not recorded	297 (71.9)
Mean duration of DM when amputation was performed	8
Number of amputations	
1	270 (65.4)
2	131 (31.7)
3	11 (2.7)
4	1 (0.2)
Blood pressure, mm Hg	
Good (<130/80)	201 (48.7)
Fair (>130/80–<140/90)	112 (27.1)
Poor (>140/90)	100 (24.2)
Initial RBS, mmol/l	
<4.4 (hypoglycaemic)	7 (1.7)
Good (4.4–<8.0)	54 (13.1)
Fair (8–<10)	35 (8.5)
Poor (>10.0)	317 (76.8)

DM = diabetes mellitus; RBS = random blood sugar.

poor, with 24.2% defined as having poor blood pressure control (>140/90 mm Hg),¹³ while 76.8% had poor capillary blood glucose (>10 mmol/l).¹³ There was no significant difference in capillary blood glucose by ethnicity or sex ($P > 0.05$).

DISCUSSION

The Asia-Pacific Region is an area where one of the greatest increases in DM is predicted.⁹ DM complication rates are high, and in most countries foot ulcers and amputations are major causes of disability.^{9,10} The 2002 Fiji STEPS survey revealed that 16% of the population was affected by DM. Based on this prevalence, there may be as many as 24 000 DM patients in the Central-Eastern division of Fiji. Given the number of amputations

in 3 years, a crude estimate of the amputation rate in Fiji is 180 per 100 000 DM patients per year. It is difficult to compare this rate in the region due to lack of evidence on the rate of amputations in other Pacific Island countries. The rate of DM-related amputations has been estimated in a number of countries, including Brazil (180/100 000),¹⁴ Italy (247/100 000)¹⁵ and Scotland (213/100 000).¹⁶ These suggest that Fiji has a DM amputation rate that is similar to other countries before significant public health interventions. However, the method of estimation used was extremely crude and only performed to give a general impression of the severity of the problem in Fiji. It is possible that this crude estimate is significantly lower than the true situation in the Central-Eastern Division. This is because records from the CWMH may not include all eligible patients. Furthermore, there is anecdotal evidence that *i-Taukei* patients are significantly less likely to present for care in Fiji, especially men. However, it is not possible to determine the impact of this on the true amputation rate, as there have been no attempts to quantify underrepresentation in Fiji.

The finding that there was no significant difference in the cumulative incidence in each of the subdivisions is interesting, as it suggests that factors associated with amputation are independent of geographic location. This means that there may be no difference between rural and urban areas, where differences in access to health services are to be expected.

Of the amputees, 16.5% were smokers, which is much lower than the prevalence of smoking in the general population, 37% (age 25–64 years) of whom are current smokers (defined as smoking any tobacco product in the past 12 months).³ Smoking was significantly more common among males than in females ($P < 0.05$). It is important to note that 15.9% of patients were only confirmed as having DM when they presented with foot sepsis leading to amputation. This figure reflects the finding of the STEPs survey, which reported that 16% of the 25–64 year age group had DM, of whom 50% were previously unknown.³

The results of this study show that there are more than twice as many amputations among the *i-Taukei* as among Indo-Fijians. These findings are similar to previous studies conducted in Fiji. However, the results of the 2002 STEPs survey revealed that Indo-Fijians had a higher prevalence of DM (21.2%) than *i-Taukeis* (11.5%). This may be due to poor health seeking behaviour and late presentation among the *i-Taukei* population.¹⁰ The evidence suggests that *i-Taukeis* have more foot complications than Indo-Fijians. The study also revealed a higher incidence of amputation among males. Again, this could be related to poor health-seeking behaviour among males compared to females. This is similar to studies conducted in the United States, which found that men are more likely to undergo lower extremity amputations.¹⁷

It should be noted that 76.8% of the sample had poor RBS at admission. As there was no record of HbA1c results, it is difficult to know how long DM status had not been controlled for before foot sepsis was diagnosed. From previous studies, and the National NCD Steps Survey of 2002, it is known that only 12% of DM patients on medication had normal fasting blood glucose levels.³ This highlights the risk of DM patients with poor glycaemic control developing complications.

Some limitations of the study are that this was a retrospective review of records of handwritten entries in several registers. It is possible that some registers were missing. However, data were collected according to the date of amputations and every effort was made to ensure that all records were reviewed. Another limitation

is the absence of any recent data on the prevalence of DM, which would have allowed an analysis of the rate of amputations during the study period.

CONCLUSION

The results of this study suggest that *i-Taukei* males are the largest risk group and that uncontrolled DM is the most significant factor contributing to amputations in Fiji. There is a need to strengthen DM screening and to enhance intervention programmes. Foot care education needs to be implemented at diagnosis and re-inforced with regular clinic visits and complication screening sessions.

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Contexte : L'hôpital Colonial War Memorial (CWMH) aux Fidji.

Contexte : Déterminer les caractéristiques des patients avec diabète (DM) qui ont subi une amputation du membre inférieur à CWMH entre 2010 et 2012.

Schéma : Revue rétrospective des données des registres du bloc opératoire et des dossiers cliniques des patients avec DM qui ont subi une amputation du membre inférieur pendant cette période.

Résultats : Au total, 938 amputations ont été pratiquées à CWMH pendant la période d'étude. Les hommes étaient significativement plus nombreux (54,1%) que les femmes (45,9%) et plus souvent d'ethnie *i-Taukei* (indigène) (71%) comparés aux patients Indo-

Fidjiens (26,2%) ; 15,9% des patients n'avaient pas eu de diagnostic de DM quand ils sont arrivés avec une infection du pied. Le taux de fumeurs était le plus élevé chez les patients masculins *i-Taukei*. Une grande proportion des patients (76,8%) contrôlait mal sa glycémie.

Conclusion : Cette étude suggère que les hommes *i-Taukei* sont le groupe le plus à risque et qu'un DM mal contrôlé est un facteur significativement associé à une amputation. Il est donc nécessaire de renforcer le dépistage du DM et d'améliorer le contrôle de la glycémie. Les patients doivent apprendre à prendre soin de leurs pieds dès le diagnostic et lors de consultations régulières par la suite, notamment de séances de dépistage des complications.

Marco de referencia: El hospital Colonial War Memorial (CMWH) de Fiji.

Objetivo: Definir las características de los pacientes con diabetes (DM), en quienes se practicó una amputación de miembros inferiores en el CMWH del 2010 al 2012.

Método: Fue este un análisis retrospectivo de los registros de los quirófanos y las historias clínicas de los pacientes con DM en quienes se practicó una amputación durante el período del estudio.

Resultado: En CMWH se llevaron a cabo 938 amputaciones durante el período estudiado. Hubo una mayoría significativa de pacientes de sexo masculino (54,1%) en comparación con la proporción de mujeres (45,9%) y de *i-Taukei* (fiyianos autóctonos; 71%) en comparación con fiyianos de origen indio (26,2%). En el 15,9% de

los pacientes no se había establecido el diagnóstico de DM antes de su consulta por sepsis del pie. La tasa más alta de fumadores se observó en los pacientes *i-Taukei* de sexo masculino. En gran número de pacientes la regulación de la glucemia era deficiente (76,8%).

Conclusión: Los resultados del estudio indican que el grupo con mayor riesgo de presentar una DM mal regulada son los *i-Taukei* de sexo masculino y la DM desestabilizada constituye un factor importante asociado con las amputaciones. Es urgente fortalecer la detección sistemática de la DM y mejorar la regulación de la glucemia. Se precisa impartir a los pacientes una educación en materia de cuidado de los pies cuando se establece el diagnóstico de DM y reforzarla en las consultas periódicas y en las sesiones de detección de complicaciones.