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Factors associated with functional limitations and subsequent employment or schooling in Buruli ulcer patients

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Summary

OBJECTIVES To evaluate former Buruli ulcer disease (BUD) patients to assess the factors associated with functional limitations and subsequent employment or schooling.

METHODS The previously validated Buruli ulcer functional limitation score (BUFLS) questionnaire and interviews about educational and professional consequences incurred by BUD.

RESULTS Of 638 participants, 362 (57%) had a functional limitation after a median period of almost 4 years after treatment for BUD. A lesion on a joint, older age, female gender, a lesion on a distal part of an extremity and a persistent wound were found to be independent risk factors for stopping work or education. The same risk factors applied to the development of a functional limitation. Both functional limitations and financial difficulties due to BUD disease often led to job loss and school dropout.

CONCLUSIONS Rehabilitation programmes are urgently needed to diminish the suffering from the functional limitations and employment or schooling problems caused by BUD.

keywords functional limitations, employment, risk factors, Buruli ulcer, *Mycobacterium ulcerans*, Africa

Introduction

Buruli ulcer disease (BUD), caused by *Mycobacterium ulcerans*, is emerging in West Africa (Asiedu *et al.* 2000). BUD may lead to fibrosis, scarring, and contractures with permanent disabilities. The treatment of BUD is difficult, with long hospital admissions (with an average of 3 months), and involves extensive surgery, which is the present standard treatment, but which in itself may add to scarring and subsequent physical limitations (Stienstra *et al.* 2002; Ellen *et al.* 2003). To assess the nature and severity of the functional limitation caused by BUD, a questionnaire was developed to enable a simple and functional scoring system. Nineteen items were identified with good internal consistency (Ellen *et al.* 2003; Stienstra *et al.* 2004). Reliability and validity of the Buruli ulcer functional limitation score (BUFLS) was analysed. In 107 participants the functional limitation score was reassessed by another interviewer and interpreter within 1 and 3 weeks after the first interview to determine inter-observer reliability. The inter-observer reliability was good (ICC of 0.86). The functional limitation scores measured in the second assessment were slightly higher than in the first assessment (a mean score of 17 *vs.* 21). The validity was assessed in 638 former Buruli ulcer patients in Ghana and Benin. The overall impression of the limitations and the range of motion (ROM) of affected joints correlated well ($\rho = 0.66$) with the functional limitation scores (Stienstra *et al.* 2005).

Not only may BUD result in economical problems because of treatment costs, also indirect costs may occur due to a loss of occupation or schooling by functional limitations or the psychosocial impact of the disease (Asiedu & Etuaful 1998). It is unknown what the risk factors are for stopping the occupation and education because of BUD.

Currently it is also unknown which (risk) factors contribute to functional limitations due to BUD. Thus it is not clear which (risk) factors should be focussed upon in health care programmes aimed at preventing functional

limitations or reducing the functional limitations through rehabilitation measures. Based on the database that we developed for the study on reliability and validity of the BUFLS, in the present study we analysed consequences of BUD on education and occupation of former patients, risk factors for functional limitations, and risk factors for stopping occupation and education.

Methods

The study population and the questionnaire have been presented in detail elsewhere (Stienstra *et al.* 2005). Briefly, 678 participants who had finished their treatment for BUD more than 3 months earlier were included in the study based on records of five hospitals (in Benin: Centre de Santé, Unité de traitement des ulcères de Buruli, Lalo; Hôpital Saint Camille, Davougon; Centre Sanitaire et Nutritionnel Gbemontin, Zagnanado; in Ghana: Dunkwa Governmental Hospital, Dunkwa and St. Martin's Catholic Hospital, Agroyesum). Between January and June 2003 participants were interviewed in their home village and were asked general questions about consequences of BUD on education and occupation. The BUFLS with 19 items of activities of daily living was used to assess the functional limitations. The activities in this questionnaire cover four areas: preparation of food and eating, clothing and personal care taking, working, and mobility. Responses were scored as 'easily, on a normal level', 'with difficulty', 'not possible at all' or 'not applicable'. In the calculation of the individual functional limitation score, an ordinal scale was used, with 0 points if the activity was unimpaired (compared to other community members of the same sex and age), 1 point if the activity could be undertaken 'with difficulty', and 2 points if the activity was 'not possible at all'. The sum was divided by the maximum possible score for that individual, multiplied by 100%. A higher score therefore indicates more functional limitations. The theoretical range of the BUFLS is from 0% to 100%. For 638 former BUD patients (of a total of 678 individuals examined) a sufficient number of daily activities (≥13 of the 19) were applicable to calculate a score.

For further analysis, the BUFLS score was divided into a) no limitations (a score of 0) and b) functional limitations (a score ≥1), because of the skewed distribution of the BUFLS scores (Figure 1). Chi-square tests and as appropriate *t*-test for independent samples or Mann–Whitney *U* (MWU)-test were used to analyse the association between BUFLS score and potential risk factors for functional limitations. For the analysis of the risk factors of stopping work or education, Chi-square tests and MWU-test were used to analyse this association on a univariate level. Risk factors significantly related to functional limitations were included in the multiple logistic regression analysis (forward entry). If interactions were found, stratified data are presented.

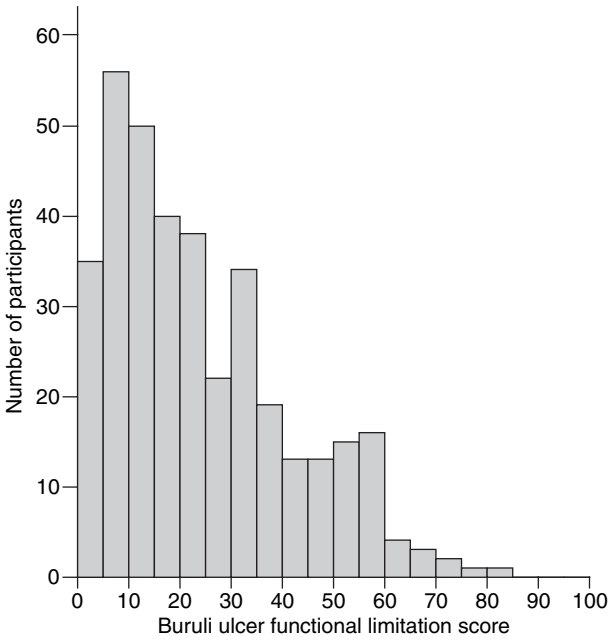

Figure 1 The BUFLS of participants. 276 Participants had a score of 0, whereas 362 participants had a score >0. Of these 362 participants, the distribution of the BUFLS outcomes is given in this figure.

Results

Of 638 patients of the 678 individuals examined, a functional limitation score could be calculated. Within this group, 49% were male and the median age at inclusion was 15 years. Fifty-nine per cent of participants were from Benin. The median time passed since the end of the treatment for BUD for patients was 4 years. For detailed characteristics of the total group of 678 participants included we refer to our earlier publication addressing the reliability and validity of the BUFLS in this patient population (Stienstra *et al.* 2005). The theoretical range of the BUFLS is from 0% to 100%. In the study population, the maximum score was 84%. Many participants perceive severe difficulties in performing their daily activities with scores much lower than this maximum score; of the 236 participants who worked before developing BUD, 126 (53%) had to stop working due to BUD. The median score of the participants who had to stop work was 23.7%, whereas the median score of the participants who continued in their profession was 2.6% ($P < 0.0001$, MWU-test). Of the 251 participants who went to school before

developing BUD, 42 (17%) participants had to stop going to school due to BUD. Of the total 638 participants, 147 did not have a job or did not go to school before developing BUD. In Table 1, the percentages of participants who stopped their job or education because of BUD in different levels of BUFLS are shown. If a BUFLS was more than 40, 97% of the workers had to stop working and 45% of the students had to stop attending school. For farmers, the main reason to leave their occupation was a physical limitation (94%). About 75% of the farmers who had to stop their occupation did not manage to find another job. For traders and shop owners the main reasons for giving up their occupation were financial difficulties due to BUD (55%), as well as physical limitations (45%). Of the traders who had to stop their occupation, 88% could not find another. For children, the main reasons to stop going to school after developing BUD were financial difficulties due to BUD (55%), physical limitations (38%) and embarrassment (7%). In total, 88% of the participants perceived financial difficulties due to BUD.

Different characteristics of participants and the related percentage of participants that had to change their education or job are given in Table 2. In the univariate analysis, the following variables were associated with higher risk for having to change education or occupation: living in Benin, being female, a non-healed lesion, an amputation, a lesion on an extremity (particularly a lower extremity), a lesion on a distal or proximal part of the extremity, a lesion on a left extremity and a lesion affecting a joint (Table 2). A distal extremity was defined as a lower arm or leg or involvement of a wrist or hand or of an ankle or foot. No effect modifications were found among the variables. The median age of participants who changed education or occupation due to Buruli ulcer was 27 *vs.* 13 years in the participants who did not change their education or occupation due to Buruli ulcer ($P < 0.0001$, MWU-test). In the multivariate

Table 1 Percentage of participants who stopped their job/education because of BUD in different groups of BUFLS outcome

	BUFLS	*n*	Change of occupation [% (*n*)]*
Working before BUD**	0	65	22 (14)
	>0–≤10	37	31 (11)
	>10–≤20	35	57 (20)
	>20–≤40	70	74 (52)
	>40	29	97 (28)
Attending school before BUD***	0	125	8 (10)
	>0–≤10	43	17 (7)
	>10–≤20	36	19 (7)
	>20–≤40	25	32 (8)
	>40	22	45 (10)

BUFLS, Buruli ulcer functional limitation score; BUD, Buruli ulcer disease.
*BUD related **$P < 0.001$, chi-square for trend ***$P < 0.001$, chi-square for trend.
The percentages are row percentages.

Table 2 Different characteristics of participants and the related percentage of participants having to change their education or job

Variable	*n*†	Change of job/school
Country		
Benin	375	121 (32.3%)*
Ghana	260	53 (20.4%)
Sex		
Male	309	66 (21.4%)*
Female	326	108 (33.1%)
Number of lesions		
1	547	151 (27.6%)
>1	88	23 (26.1%)
Lesion healed or non-healed		
Healed	562	145 (25.8%)**
Non-healed	73	29 (39.7%)
Amputation		
Yes	25	14 (56%)*
No	610	160 (26.2%)
Affected body part		
Trunk/head	83	14 (16.9%)**
Extremity	552	160 (29.0%)
Upper extremity affected		
Yes	224	123 (29.9%)
No	411	51 (22.8%)
Lower extremity affected		
Yes	357	119 (33.3%)*
No	278	55 (19.8%)
Affecting a joint of an extremity		
Yes	334	125 (37.4%)
No	301	49 (16.3%)*
Proximal extremity affected		
Yes	296	65 (22%)***
No	339	109 (32.2%)
Distal extremity affected		
Yes	382	138 (36.1%)*
No	253	36 (14.2%)
Right side of extremity involved		
Yes	341	85 (24.9%)
No	294	89 (30.3%)
Left side of extremity involved		
Yes	308	99 (32.1%)***
No	327	75 (22.9%)
Bilateral extremities involved		
Yes	34	13 (38.2%)
No	601	161 (26.8%)

† Information on schooling/job not available for three patients.
* $P \leq 0.001$, ** $P < 0.05$, *** $P < 0.01$ (Pearson's chi-square).

Table 3 Logistic regression model for patient and BUD characteristics to predict stopping occupation or education

	Need to stop occupation		
	B	SE	OR (95% CI)**
Sex (0 = male, 1 = female)	0.65*	0.22	1.9 (1.2–2.9)
Country (0 = Ghana, 1 = Benin)	0.67*	0.23	1.9 (1.2–3.1)
Age (years)	0.05*	0.006	1.05 (1.04–1.06)
Lesion on extremity (0 = no, 1 = yes)	0.63	0.48	–
Lesion on a lower extremity (0 = no, 1 = yes)	0.08	0.25	–
Lesion on a joint (0 = no, 1 = yes)	0.74*	0.25	2.1 (1.3–3.4)
Lesion on a proximal part of extremity (0 = no, 1 = yes)	−0.16	0.28	–
Lesion on a distal part of extremity (0 = no, 1 = yes)	0.82	0.33	2.3 (1.2–4.3)
Lesion non-healed (0 = no, 1 = yes)	0.73*	0.32	2.1 (1.1–3.9)
Amputation (0 = no, 1 = yes)	0.94*	0.48	2.6 (1.01–6.49)
Lesion on left extremity (0 = no, 1 = yes)	0.31	0.21	–

CI, confidence interval; OR, odds ratio.
* $P < 0.05$.
** No OR was calculated when B was not significant.

model, being female, living in Benin, older age, a lesion on a joint, a lesion on a distal part of the extremity, a non-healed lesion, and an amputation showed a statistically significant association with job loss and school dropout (Table 3). A model with only the variable of age could correctly predict stopping occupation or education in 75.7%. A model with all the seven variables that showed a statistically significant association could correctly predict stopping occupation or education in 77.6%.

Of the 638 former BUD patients, 362 (57%) had a BUFLS score ≥1 (Figure 1). The median BUFLS outcomes for different characteristics are given in Table 4. Participants who had an amputation had a median score of 52.6%. In the univariate analysis, the following variables were associated with higher risk for functional limitations: being female, having multiple lesions, a non-healed lesion, an amputation, a lesion on an extremity, in particular a lower extremity, a lesion on a distal part of the extremity or bilateral involvement, older age ($P < 0.001$, MWU-test), and a lesion affecting a joint (Table 4). The mean age of participants who had a functional limitation was 26 *vs.* 16 years in the group of participants who did not have a functional limitation. The median time passed since treatment was similar, both for the participants with and without functional limitations, was similar (4 years). The gender of the patient was found to be an effect modificator for the association between a lesion on the joint and the risk for a functional limitation. Therefore, the data were stratified according to sex for further multivariate analysis. In the model for male participants, only being older and a lesion on a joint showed a statistically significant association with functional limitations (Table 5). A model with a lesion on a joint as the only variable could correctly predict having a functional limitation in 63.7%. A model with both having a lesion on a joint and age could correctly predict having a functional limitation in 64.3%.

In the model for female participants, being older, having a lesion on a joint, a lesion on a distal part of the extremity, and a non-healed lesion showed a statistically significant association with functional limitations (Table 6). A model with only the variable of a lesion of a joint could correctly predict having a functional limitation in 72.8%. A model with all four variables that showed a statistically significant association, combined with information on having an amputation, could correctly predict having a functional limitation in 75.2%.

Discussion

In our study population of 638 former BUD patients, up to 57% of the participants experienced one or more functional limitations. In an earlier study, it was found that 49% of the participants had a functional limitation, yet this number was based on measurements of the ROM of joints (Ellen *et al.* 2003). The functional limitations considerably impact on the occupations and education of the participants, supporting the earlier finding that Buruli ulcer leads to high indirect costs (Asiedu & Etuaful 1998). Financial difficulties due to BUD were the main reason for children to stop going to school. The BUFLS outcome gives an indication about the risk the patient has to stop his/her occupation.

The BUFLS can be applied in rehabilitation to make individualized plans for treatment, for comparison between

Table 4 Patient and BUD characteristics and their BULFS

Variable	*n*	BUFLS >1 (=limitation present)	Median BUFLS
Country			
Benin	378	208 (55%)	5.3
Ghana	260	154 (59%)	5.3
Sex			
Male	311	157 (51%)*	2.6
Female	327	205 (63%)	7.9
Number of lesions			
1	550	301 (55%)*	2.9
>1	88	61 (69%)	10.5
Lesion healed or non-healed			
Healed	565	304 (54%)**	2.8
Non-healed	73	58 (80%)	21.1
Amputation			
Yes	25	25 (100%)**	52.6
No	613	337 (55%)	3.1
Affected body part			
Trunk/head	83	30 (36%)**	0
Extremity	555	332 (60%)	7.9
Upper extremity affected			
Yes	225	129 (57%)	5.3
No	413	233 (56%)	5.3
Lower extremity affected			
Yes	359	227 (63%)**	8.8
No	279	135 (48%)	0
Affecting a joint of an extremity			
Yes	336	248 (74%)**	15.8
No	302	114 (38%)	0
Proximal extremity affected			
Yes	297	179 (60%)	7.9
No	341	183 (54%)	2.9
Distal extremity affected			
Yes	384	256 (67%)**	10.5
No	254	106 (42%)	0
Right side of extremity involved			
Yes	342	199 (58%)	3.6
No	296	163 (55%)	5.3
Left side of extremity involved			
Yes	310	186 (60%)	7.9
No	328	176 (54%)	2.6
Bilateral extremities involved			
Yes	35	27 (79%)*	27.7
No	603	335 (56%)	4.6

BUFLS, Buruli ulcer functional limitation score.
The percentages are row percentages.
* $P \leq 0.01$, chi-square test, ** $P < 0.001$, chi-square test.

different interventions, and for the planning of the resources needed. In an earlier study (Stienstra *et al.* 2004), we found a higher score in the BUFLS outcome for patients in Benin compared to Ghana. In the current study patients living in Benin had a higher risk of stopping their occupation due to Buruli than patients from Ghana. Differences in the stage patients are in when they present at hospital or differences within treatment centres may explain this finding (Teelken *et al.* 2003).

One of the reasons for delay to hospital treatment of BUD patients is the widespread fear of an amputation (Stienstra *et al.* 2002; Aujoulat *et al.* 2003). In our data, patients with an amputation had high functional limitation scores. This fear is therefore understandable, but might be diminished by educational programmes clarifying the need of early treatment obviating the need for amputation, and by introducing or strengthening rehabilitation programmes reducing the functional limitations after an amputation.

The effect of the risk factors age and having a lesion on a joint on having a functional limitation was stronger in female patients. Having a lesion on a distal extremity and having an open wound did not reach statistical significance in male patients, whereas they did in females. In general female participants experienced functional limitations more often than the male participants and more often had to stop their occupation. This might be due to differences in social or occupational activities between men and women or to differences in self-reporting or perception of functional limitations. Perhaps however, female patients do indeed have more disabilities as a consequence of BUD. In leprosy, female patients have higher rates of deformity than male patients – probably resulting from a much longer patient delay in women (Peters & Eshiet 2002). Perhaps, gender differences in patient delay might also lead to more functional limitations in BUD. Not only patients' delay but also age of the patient was found to be a risk factor for a presentation with impairment in leprosy patients (Meima *et al.* 1999). In our current study, higher age was also associated with a higher risk of functional limitations. The mean age of participants who had a functional limitation was 26 *vs.* 16 years in the group of participants who did not have a functional limitation. Reducing compensatory strategies with increased age is probably not the only explanation for the association found, since the patients in the group with a functional limitation are still rather young. Possibly, differences in activity pattern, in self-reporting and perception of functional limitation with changing social responsibilities with age, have led to higher functional limitation scores. The same possible explanations hold for the association between increasing age and stopping the occupation.

Lesions on a joint and increasing age were associated with functional limitations and with stopping the occupation. These risk factors and the gender of the patient, a lesion on a distal extremity, having a non-healed lesion and an amputation should be taken into account in the treatment of patients presenting to the hospital. Participants who retained open lesions despite completion of

Table 5 Logistic regression model for patient and BUD characteristics to predict the presence of a limitation in male participants

	BUFLS (≥1) (limitation present)		
	B	SE	OR (95% CI)*
Age (years)	0.02	0.009	1.02 (1.01–1.04)
Lesion on extremity (0 = no, 1 = yes)	−0.24	0.48	–
Lesion on a lower extremity (0 = no, 1 = yes)	0.46	0.29	–
Lesion on a joint (0 = no, 1 = yes)	0.74	0.27	2.1 (1.2–3.6)
Lesion on a distal part of extremity (0 = no, 1 = yes)	0.19	0.30	–
Lesions on bilateral extremities (0 = no, 1 = yes)	0.66	0.81	–
Lesion non-healed (0 = no, 1 = yes)	0.73	0.41	–
Amputation (0 = no, 1 = yes)	6.68	14.68	–
Multiple lesions (0 = no, 1 = yes)	0.19	0.42	–

CI, confidence interval; OR, odds ratio; BUFLS, Buruli ulcer functional limitation score.
* No OR was calculated when B was not significant.

Table 6 Logistic regression model for patient and BUD characteristics to predict the presence of a limitation in female participants

	BUFLS (≥1) (limitation present)		
	B	SE	OR (95% CI)**
Age (years)	0.04	0.01	1.05 (1.03–1.07)
Lesion on extremity (0 = no, 1 = yes)	0.74	0.46	–
Lesion on a lower extremity (0 = no, 1 = yes)	−0.26	0.31	–
Lesion on a joint (0 = no, 1 = yes)	1.76	0.29	5.8 (3.3–10.3)
Lesion on a distal part of extremity (0 = no, 1 = yes)	0.87	0.31	2.4 (1.3–4.4)
Lesions on bilateral extremities (0 = no, 1 = yes)	−0.23	0.89	–
Lesion non-healed (0 = no, 1 = yes)	1.49	0.61	4.5 (1.3–14.8)
Amputation (0 = no, 1 = yes)	7.27	12.97	–
Multiple lesions (0 = no, 1 = yes)	0.11	0.54	–

CI, confidence interval; OR, odds ratio; Buruli ulcer functional limitation score.

treatment in one of the participating hospitals more often stopped their occupation or education due to BUD. Non-healed lesions led to more functional limitations in female patients. This finding calls for close follow up of BUD patients during and after treatment to avoid further functional limitations resulting from long standing non-healed BUD.

Rehabilitation programmes are urgently needed to diminish the suffering of the long-term consequences of BUD.

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