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Regional Distribution of Occupation Skin Disorders in Bricklayers and Brick Masons: A Cross-sectional study in Ogbomoso, Oyo State, South West Nigeria.

[2]Oluwaseyi Kikelomo Israel, [1]Michael Gbenga Israel, [1]Adeolu Oladayo Akinboro, [3]Peter K. Uduagbamen, [4]Sebastine O. Oiwoh, [5]Olanrewaju Olayemi, [6]Stephen Aiyedun, [7]Olumayowa Oninla, [7]Olayinka Olasode, [7]Olaniyi Onayemi

[1]Dermatology Unit, Department of Medicine, College of Health Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
[2]Department of Community of Medicine, College of Health Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
[3]Division of Nephrology and Hypertension, Department of Internal Medicine, Bowen University/Bowen University Teaching Hospital, Iwo/Ogbomosho, Nigeria.
[4]Department of Medicine, irrua Specialist Teaching Hospital Edo state, Nigeria.
[5]Department of Medicine, College of Health Sciences, Osun state University, Osogbo, Nigeria.
[6]Dermatology Unit, Department of Medicine, University of Ilorin Teaching Hospital, Kwara State, Nigeria.
[7]Department of Dermatology, College of Health Sciences, Obafemi Awolowo University Ile Ife, Osun state, Nigeria.

Corresponding author: Dr Israel GM, Division of dermatology, Department of Internal Medicine, Faculty of Clinical Sciences. College of Health Sciences, LAUTECH, Ogbomosho, Oyo State Nigeria.
gmisrael@lautech.edu.ng ;+2348035816592

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Abstract

Background: Occupational contacts dermatitis are quite common among bricklayers and masons, due to the chromate-associated alkalinity of cement that can cause corrosive lesions, burns, excoriations, exudations and hyperkeratotic lesions. The aim of this study is to describe the regional parts of the body affected by contact with cements, sands and water in bricklayers.

Methods This cross-sectional study involved 200 bricklayers in whom the regional distribution of cement related dermatitis was determined. Multiple regression analysis was used to determine the independent associates of occupational skin diseases on the upper limbs.

Results The mean age of the bricklayers was 39.74±17.03 years. The prevalence of contact dermatitis in the upper limbs, lower limbs and face were 39.0%„ 4.0% and 0.0 percentage respectively, $p<0.001$. Traumatic skin lesions and dermatological conditions were more common in the lower limbs than in the upper limbs and face, $p<0.001$ and $p<0.001$ respectively. While the use of hand gloves had a protective and reducing effect on the risks of upper limb disease, the usage of the rain boots, to the frequency of cement-associated dermatologic diseases on the lower limbs.

Conclusion: Reductions in the skin contact with cement are measures that could minimize the prevalence of occupational skin disorders (OSDs) in bricklayers.

Keywords: Occupational contact dermatitis**,** occupational skin disorders, bricklayers, traumatic skin injury, fungal infections.

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Introduction

Occupational contact dermatitis (OCDs) is the most common occupational skin disorder caused by exposure to substances or chemicals and this can predominantly affect be some parts of the body.[1] This pattern can be due to several factors that includes the exposure time, concentration of injurious chemicals and affinity of some chemical constituents to some body parts.[1] OCDs has been documented in up to 6.7-10.0% of work-related diseases, 90-95% of occupational skin disorder but the anatomical distribution of the dermatological conditions varies widely.[2] The degree of impairment of function and quality of life (QoL) could also be dependent on the affected part of the body.[3] Furthermore, the level of psychological and emotional impairment suffered could also be related to the frequency of exposure of the skin part in routine life activities, as parts not commonly under clothing could present with worse psychological impairment.[3] Added to these is the fact that injuries by chemicals to frequently used parts of the body at work such as the hands may come with significant decline in productivity rates.[3]

The major pathological mechanisms of injuries caused by cement are secondary to its corrosiveness (due to the alkalinity of lime), irritant quality and sensitization that can lead to allergic contact dermatitis from sensitization to hexavalent chromium.[4] The reduction in the concentration of chromium in cement is reported to have led to a reductions in the frequencies of cement-associated allergic contact dermatitis.[5] The hands and fingers are most frequently affected and these dermatoses can present in forms of hyperkeratotic papules, dry, fissuring, erythematous or exudative dermatitis as found by Yamamoto et al [6] who reported one in six affectation of the neck and face in cement dermatitis. Patch test positivity to sodium dichromate is reported in many cases of cement dermatitis of the allergic contact forms but previous works have reported cement-related burns with patch test-negativivity.[7,8]

The working methods and clothing of construction workers and other cement-related occupations have been found to be major determinants of the risk, occurrence and severity of cement-associated dermatitis.[1, 6] The water content of cement products like concrete is reported to be a significant determinant of the severity and type of dermatitis, as wet cement are common with the lower limbs, and could present with more exudative, necrotic deep ulcers. [6, 9] Occupational skin dermatoses are more common in small scale businesses and non-mechanized settings found predominantly in low socio-economic environments. This account for the expectedly higher prevalence in resource-challenged settings.[10] The availability of personal protective equipment (PPE) like gloves and rain boots has been found to be of significant importance in reducing the occurrence of these lesions[5,7-8]. The availability of these PPEs is dependent on factors such as cost, awareness of their importance and possible associated adverse effects and, possible allergic reactions to theses PPEs when they are used.[11] The fact that most of the construction workers who have prolonged contact with these chemicals are manual who may not have adequate training routine use of PPEs particularly in rural community settings (RCSs) only worsens the compliance levels of these workers.[12]

Despite the high prevalence of cement-related skin disease in RCSs coupled with the fact that regional body variations haven't been documented, literature that would have addressed these challenges is still largely inadequate particularly in RCSs. We assessed the regional body distribution of cement related dermatitis amongst bricklayers and assessed the determinants and correlates of these dermatoses. To the best of our knowledge a PubMed search does not reveal any literature on the regional body distribution of cement-related dermatoses in sub-Sahara Africa (SSA). The study hypothesized that there is no statistical difference in the occurrence of dermatitis and other skin disorders in regional body distributions among bricklayers in Ogbomoso, Oyo state, Nigeria.

Methodology

Study design: This cross-sectional study was conducted in a community in Ogbomosho, Nigeria.

Study population: Two hundred adults practicing and apprentice bricklayers participated in the study. Two hundred non bricklayers served as controls.

Settings: This study was conducted in an urban setting. Ten bricklayers' zones from two local governments were selected from 15 bricklayers' zones in Ogbomoso North and South Local government area by random sampling. Twenty consenting bricklayers were chosen by balloting from Forty bricklayers that make up each zone till a total of 200 bricklayers were chosen. The sample were

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collected within 3 weeks. Data entry and analysis with discussion took place within 9weeks.

Participants: Four hundred (200 practicing and apprentice bricklayers and mason and 200 age and sex-matched healthy non-bricklayers/brick masons) adults' participants were recruited into the study. The participants (Bricklayers/masons/apprentices) were enrolled at the work sites where interviewing and physical examination took place in a room prepared for this purpose while the controls were recruited from the same communities during their weekly local security meetings.

Patient and Public Involvement: Patients or the public WERE NOT involved in the design, or conduct, or reporting, or dissemination plans of our research.

Sample Size Determination: The minimum sample size was calculated using Leslie Fischer's formula[13] and a prevalence from a similar study conducted in Nigeria.

Qualitative outcome variable $n = Z_\alpha{}^2 pq / d^2$

Where n is the minimum sample size

Z_α is the standard normal deviate corresponding to level of significance of 5%

p is the proportion of outcome of interest from previous study 16.1% of the respondents had contact dermatitis

q = 1-p

d is the desired level of precision (usually at 5% for single proportions); d varies for single means

σ = standard deviation of the quantitative outcome of interest obtained from a previous study

$n = 1.96^2 \times 0.161^{64} \times 0.839 / 0.5^2$

=208

When population is less than 10,000, the formulae that shall be used is:

$$nf = \frac{n}{1 + n - 1/N}$$

nf = The desired sample size when population is less than 10,000

n = The desired sample size when population is greater than 10,000 which equals 208

N = the estimate of population size which is = 1000(Anecdotal evidence from the bricklayer association)

So, $nf = \frac{208}{1 + \frac{208 - 1}{1000}}$

= 172.32

Nonresponse of above population will be 10% of 172.32= 17.23

172.32+17.23=189.55

This was approximated to 200 for good representation of the population size. This gave a sample size of 200 after correcting for non-response.

Inclusion and Exclusion Criteria: Consented adult (≥18 years) bricklayers and their apprentices were included. Those that refused consent, or were less than eighteen years, those who had known or apparent chronic illnesses, and those physically unfit for practice were excluded.

Sampling Technique: Two hundred consenting bricklayers and masons were randomly selected with the purpose and modality of the study explained to them. An interviewer-administered questionnaire was used in collecting data that included age, sex, religion, tribe, educational attainment, job description, and duration on the job. Participants safety precautions at work, previous and current episodes of face, neck, hand or lower limb lesions since commencement of cement-related work, and history of atopy and nickel sensitivity (personal and family) were documented.

The height and weight of each participant was measured, and their body mass index (BMI) was calculated using the equation, BMI = kg/m². All participants with a past or current history of dermatitis had a patch test conducted on them by the principal investigator according to standard protocol.

Due to the informal training involved in the work set-up (without established training guidelines and criteria for certification), the following definitions below were applied.

Definition of terms

Supervisors: Qualified bricklayers and brick masons, team heads who can work without supervision.

Qualified bricklayers and brick masons: Those hired by the supervisor after been deemed fit by trainers, to practice with little or no supervision.

Apprentices: Participants who were still receiving informal training.

Statistical Analysis: Data generated from the study was entered into the SPSS version 22. Continuous variables presented as means with standard deviations were

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compared using paired student t-test. Categorical variables presented as proportions and percentages were compared using Chi Square. The association between the variables and the occurrence of OCD on the upper limb was determined using a univariate model. Multivariate analysis was used to determine the independent associates of upper limb OCD after adjusting for confounders. A p-value of <0.05 was considered statistically significant.

Ethical Consideration: Approval to conduct the study was obtained from the ethical review committee of Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital, Ogbomoso Nigeria. The ethical approval number/ID was LTH/OGB/EC/2014/061. Permission to conduct the study was obtained from the association of bricklayer and brick masons. Written informed consent was obtained from the eligible respondents after they have been well educated on the purpose of the study. Confidentiality was also assured.

Results

The mean age of the 200 hundred bricklayers was 37.8±17.0 years (Table I). One hundred and nine (54.5%) participants had secondary education while seventeen (35.5%) had primary education and 3.5% had tertiary education and 6.5% had no formal education. One hundred and sixty-one (80.5%) of the participants were bricklayers, 22 (11.0%) were supervisors, and 17 (8.5%) were apprentices. One hundred and fifteen (57.5%) of the participants worked every day of the week while 71 (35.5%) worked between 3 to 6 days of the week

Table I: Participants socio-demographic characteristics

Variables	Bricklayers/Masons n=200	Percentage (%)
Age, years (mean ± SD)		39.74±17.03
18-20	9	4.5
21-30	65	32.5
31-40	37	18.5
41-50]	28	24
≥51	61	30.5
Marital status		
Married	138	69.0
Single	58	29.0
Divorced	2	1.0
Widower	2	1.0
Educational status (n, %)		
No formal	13	6.5
Primary	71	35.5
Secondary	109	54.5
Tertiary	7	3.5
Religion		
Christianity	135	67.5
Islam	64	32
Traditional	1	0.5
Days worked/week (n, %)		
Twice	14	7.0
3-6	71	35.5
Everyday	115	57.5

Eighty-six (43.0%) of the construction workers had OCD and it was most common on the upper limb (Table II). Fungal infections and traumatic skin lesions were more common in the lower limbs (7.0%) and (56.5%) respectively. Other dermatological conditions found in the participants included two (1.0%) idiopathic guttate hypomelanosis, one (0.5%) dermatosis papulosa nigra, one (0.5%) onchodermatitis, 10 (5.0%) acne vulgaris and, 10 (5.0%) seborrhoiec dermatitis.

A total of two hundred participants were identified, 140 (50.4%) skin lesions were found on the upper limb (Table III). One hundred and twenty-one (43.5%) skin lesions were on the lower limb and 17 (6.1) were on the face.

From the multivariate regression analysis (Table IV), non-usage of hand gloves (aOR-2.93, 95% CI-2.23-5.61), contact dermatitis (aOR-6.17, 95% CI-4.29-11.48) was predictive of upper limb OSDs.

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Table II: Anatomical site distribution of occupational dermatoses in the population

Variables	Face n=200	Upper limbs n=200	Lower limbs n=200	P-value
Contact dermatitis, (n, %)	0 (0.0)	78 (39.0)	8 (4.0)	<0.001*
Fungal infections, (n, %)	0 (0.0)	10 (5.0)	14 (7.0)	<0.001*
Traumatic skin lesions, (n, %)	7 (3.5)	52 (26.0)	93 (56.5)	<0.001
Acne vulgaris, (n, %)	10 (5.0)	0 (0)	0 (0)	<0.001*
Others, (n, %)	0 (0.0)	0 (0.0)	6 (3.0)	<0.001*

*-Fisher's exact test

Table III: Univariate analysis of factors associated with upper limb occupational skin disorders

Variables	Upper limb n=140	Other limb n=138	P-value
Age ≥51 years (n, %)	30 (49.2)	31 (50.8)	0.93
≥101 blocks/day (n, %)	51 (58.0)	37 (42.0)	0.16
No gloves (n, %)	134 (69.8)	58 (30.2)	0.002
Rain boot (n, %)	6 (32.9)	8 (57.1)	0.18
History of allergy (n, %)	7 (58.3)	5 (41.7)	0.17
Worked everyday (n, %)	115 (29.7)	50 (70.3)	0.98
<7 working days (n, %)	46 (54.1)	39 (45.9)	0.22
≥20 years on job (n, %)	41 (54.7)	34 (45.3)	0.26
Non-supervisors (n, %)	89 (50.3)	88 (49.7)	1.0
Contact dermatitis (n, %)	78 (92.9)	6 (7.1)	<0.001
Fungal skin infections (n, %)	10 (41.7)	14 (58.3)	0.15
Traumatic skin condition (n, %)	52 (34.2)	100 (65.8)	0.001
Other skin lesions (n, %)	0 (0.0)	6 (100.0)	<0.001

Table IV: Multivariate regression analysis showing independent associates of upper limb OSDs

Variable	aOR	95% CI	P-value
Gloves	2.93	2.23-5.61	0.03
Contact dermatitis	4.17	4.29-9.48	0.001
Traumatic skin disease	0.90	0.49-0.99	0.09

Discussion

In this cross-sectional study of the anatomic region distribution of occupational skin disorders, we found that the occurrence of contact dermatitis was most likely to be on the upper limbs. Traumatic skin lesions, cement-associated fungal infections and other rare cement-associated skin disorders were more common on the lower limbs. While atopy and non-usage of hand gloves were more associated with OCD on the upper limbs, the use of rain boot tend to increase the risk of OCD and other OSDs on the lower limbs. The regional segregation of skin disorders in this study makes it an addendum to the literature from previous local and foreign studies that reported occupational skin disorders mostly on the hands.[1, 6, 14] The predilection of OCDs for the upper limbs is in agreement with findings from previous studies that reported prevalence of 38.6%.and 42.%.[15, 16] The findings in this study is however higher than the 2.3% and 15.4% found in previous studies conducted in our local setting by Soyinka et al and Olumide et al.[11, 12] Soyinka et al has a large population study of about 2,666 compared to 200 participants in this study while his own focus was on occurrence of new cases (incidence) of OCD among bricklayers and other construction workers, this study considered the prevalence among bricklayers.

The higher frequency of traumatic skin conditions on the lower limb than on the upper limb and face mirrors a previous finding which reported that trauma was more common to the lower limbs in construction sites.[17] This could partly be attributed to the fact that incidences of falling objects like walls, stair supporting structures and instruments are more likely to occur on the legs than on

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the hands. Moreover, contacts between the workers and the ground-based structures, instruments and machines are more likely with the legs than the hands. Coupled with this is the fact that contact with cements and concrete tend to be longer with the legs than hands particularly in small scale settings where the cost of a pair of rain boot or nonchalant attitude may limit their acquisition as was found in this study where participants that were using hand gloves outnumbered those that used rain boot. Even with rain boot, small quantities of cement/concrete that inadvertently get into the rain boot could remain there for longer time particularly as the wet materials may not cause significant discomfort, compared with the hands where the cement/concrete can easily be cleaned or washed away. The wet materials could also be suitable medium for multiplication of bacteria and fungi, as was found in this study where fungi infections were more common in the lower limbs than in other body parts of participants.[18]

The higher risk of lower limb involvement of skin lesions in artisans that worked is in agreement with previous findings that associated the risk and occurrence of OCD with duration of exposure.[8, 11-12] Workers that work and in contact with the building materials are more likely to be non-supervisor and, less financially-endowed hence less likely to use rain boot. Non-rain boot using construction workers are more likely to use lighter shoes, under the sole-clothing and cartons. When these materials are used and they become wet, the risk of skin infections and other dermatological lesions occurring is heightened as skin absorption tend to be better in this case compared to dry chemicals.[19, 20] The finding of more exudative and erythematous skin conditions in the lower limb further supports the additive role played by the "wetness" which under an inflammatory state aids skin excoriations that can eventually herald exudative lesions.[21] Moreover, the alkalinity of chromate and some other constituents of cement are better exhibited in wet or a fluidly skin environment.[22]

Contact dermatitis has remained the most common OSDs in construction companies.[1, 5] Physical factors (radiation, heat and cold), chemical and mechanical (friction and vibration and pressure) factors are common determinants of occupational skin disorders.[23, 24] While skin damage from physical factors such as radiation, heat and cold would most likely not be specific to a body part, other factors like friction, vibration and pressure may be more significant in covered areas such as hands and feet.[25] This perhaps explains the higher incidence of deeper skin involvement of the lower limb lesions than upper limb lesions, on account of associated wetness around the lower limb.[22, 23] The use of rain boot by bricklayers and masons would therefore be expected to be associated with deeper skin injuries as these chemical would have longer contact with the skin.[21-23] Coupled with these factors in the risk of, and aetiology of the OSDs, is the effect of environmental factors like temperature and humidity.[26] The high temperature in the sub-Sahara African coupled with higher humidity could increase the thermal and lethal effects of cement (chromate) and other constituents of cement, with an overall heightening of burns injury and other injuries associated with chromate-containing cement.[27, 28]

The occurrence of more skin lesions on the upper limbs of construction working with cement may just be reflective of the body part mostly involved in carrying out their routine duties found by Esmail et al who reported that in a construction company involving bricklayers and carpenters, OSDs were more common in the upper limb than other body parts,[29] although his own focus was on cement and hands. This study however differs from the findings in another study that is dust related OSDs whose OCDs are more common on the lower limbs than other body parts[30] found in the index study. The proper usage or otherwise of hand gloves by artisans could impact the frequency of OSDs.[31] The extent of upper limb coverage could also play a significant role in determining the frequency of the OSDs. This may partly contribute to the higher frequency of the OSDs on the upper limb than the lower limbs as most of the common hand gloves extend just beyond the wrist joint unlike most of the rain boot that extend to just below the knee.[31]

The reduction in the quantity of chromate in cement to reduce its alkalinity has led to reductions in the prevalence of cement-associated OSDs in the advanced nations. The low-level education, widespread socioeconomic deprivation and the non-formal pattern of work training in resource-challenged setting would probably have accounted for the continued high prevalence of these conditions in these settings. The use of hand gloves, rain boot and other personal protective equipment (PPE) in ways that will prevent contact with the skin and, under low-sun or heat exposure should be

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encourage as most of these workers most often work under very hot sunny and humid weather.

Limitations: This study is limited by population size which could have possibly make the study more robust. Funding capacity also limited the number of patches tested subject. The study was solely funded with no external support.

Conclusion: Occupational contact dermatitis is quite common among bricklayers and masons, and this is attributed to the chromate-associated alkalinity of cement that can cause corrosive lesions, burns, excoriations, exudations and hyperkeratotic lesions. Cement-associated skin lesions such as contact dermatitis was more common on the upper limbs while traumatic lesions and fungi infections were more common on the lower limb. Major determinants of the occurrence and location of OSDs include the duration of exposure, wetness of cement/concrete and the use or non-usage of PPE. The use of rain boot tends to increase the frequency of lower limb OSDs. Independently associated with OSDs on the upper limbs were contact dermatitis and non-usage of hand gloves. Reductions in the alkalinity (chromate) and duration of skin contact with cement (through training) are measures that could minimize the prevalence of OSDs in bricklayers and masons.

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Conflict of interest: None declared

Authors' contributions

MGI conceived the study, participated in its design, acquisition of data, analysis and interpretation of data, also involved in drafting the manuscript. OKI, AOA and OAO made substantial contributions to conception, design, analysis and interpretation of data, also involved in revising the manuscript critically for important intellectual content. PKU, SOO, OO, FOO, MMO, SOA, OAO and OEO participated in data interpretation and revising the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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