AJEHS
African Journal of Environmental Health Sciences
Volume 6, November, 2019
http://www.ehsanonline.org
ISSN: 2476-8030
pp 85-97

Self-Reported Fatigue Among Construction Workers in Gaborone, Botswana

Patience N. Erick[1]*, Unangoni Ditsala[1], Roy Tapera[1] and Bontle Mbongwe[1]

[1]Department of Environmental Health, Faculty of Health Sciences, University of Botswana, Gaborone, Botswana. Notwaneand Mabuto Road, Pvt Bag UB 0022 Gaborone, Botswana

E-mail: erickp@ub.ac.bw

*Corresponding author:
Patience N. Erick, as above

*Corresponding Author:
Udensi, J. U., as above

Keywords:
Fatigue, construction workers, accidents, injuries, building workers

Mots-clés:
Fatigue, ouvriers du bâtiment, accidents, blessures, ouvriers du bâtiment

Abstract

Although fatigue has been recognized as a workplace hazard contributing to reduced productivity and increased worker's compensation costs in the construction industry, suboptimal epidemiological studies have been carried out among construction workers in developing countries. The job task of construction workers often involves heavy workloads, awkward working postures, and prolonged working hours, which place workers at increased risk of fatigue. This study aimed to investigate the prevalence and risk factors of fatigue among construction workers in Gaborone. A descriptive cross-sectional study was conducted among ten construction companies in Gaborone. An anonymous self-administered questionnaire was used to gather information on demographic characteristics of participants, work related factors associated with fatigue and individual's perception on their company's fatigue management strategies. Chi-squared tests and logistic regression analysis were performed to analyse the data. The prevalence of self-reported fatigue was 66% (79). Of these, 62% of respondents reported high fatigue whereas 38% reported borderline fatigue. The strongest predictor of reporting fatigue was taking energy drinks or coffee to stay awake at work (Adjusted Odds Ratio (AOR: 2.833, 95% Confidence Interval (CI): 1.290 – 6.219). Social stress and working for more than 8 hours a day were also significantly associated with fatigue. Having been trained on fatigue management was associated with decreased odds of reporting fatigue (AOR: 0.372, 95% CI: 0.157 – 0.883). This study suggests that fatigue is common among construction workers in Gaborone and multifactorial in nature. Therefore, to help reduce the prevalence, progression and burden of fatigue among construction workers in Gaborone, companies must implement and train workers on fatigue management systems.

Fatigue autodéclarée chez les ouvriers du bâtiment à Gaborone, Botswana

Abstrait

Bien que la fatigue ait été reconnue comme un danger sur le lieu de travail contribuant à réduire la productivité et à augmenter les coûts d'indemnisation des travailleurs dans le secteur de la construction, des études épidémiologiques sous-optimales ont été menées auprès de travailleurs de la construction dans les pays en développement. La tâche des travailleurs de la construction implique souvent de lourdes charges

de travail, des postures contraignantes et des heures de travail prolongées, qui exposent les travailleurs à un risque accru de fatigue. Cette étude visait à étudier la prévalence et les facteurs de risque de fatigue chez les ouvriers de la construction à Gaborone. Une étude transversale descriptive a été menée auprès de dix entreprises de construction à Gaborone. Un questionnaire auto-administré anonyme a été utilisé pour recueillir des informations sur les caractéristiques démographiques des participants, les facteurs liés au travail associés à la fatigue et la perception des individus sur les stratégies de gestion de la fatigue de leur entreprise. Des tests du chi carré et une analyse de régression logistique ont été effectués pour analyser les données. La prévalence de la fatigue autodéclarée était de 66% (79). Parmi ceux-ci, 62% des répondants ont signalé une fatigue élevée, tandis que 38% ont signalé une fatigue à la limite : 1,290 - 6,219). Le stress social et le fait de travailler plus de 8 heures par jour étaient également associés de manière significative à la fatigue. Avoir été formé à la gestion de la fatigue était associé à une diminution des chances de déclarer la fatigue (AOR: 0,372, 95% IC: 0,157 - 0,883). Cette étude suggère que la fatigue est courante chez les ouvriers de la construction à Gaborone et qu'elle a un caractère multifactoriel. Par conséquent, pour aider à réduire la prévalence, la progression et le fardeau de la fatigue chez les travailleurs de la construction à Gaborone, les entreprises doivent mettre en œuvre et former des travailleurs sur les systèmes de gestion de la fatigue.

Introduction

Fatigue has been acknowledged as a workplace hazard and associated with workplace injuries (International Labour Organization, 2009).

Fatigue affects individual's ability to think clearly and respond appropriately (Lewis and Wessely, 1992, Swaen *et al.,* 2003). The International Labour Organization (ILO) (2005) estimates that every year, there are at least 60,000 fatal accidents at construction sites around the world and construction workers are three to four times more likely to die from accidents at work than other workers(ILO, 2009). Work fatigue is one of the main causes of injuries in the construction industry (Zahra and Kurniawidjaja, 2018) and whether physical or mental, fatigue impairs a construction worker's ability to safely and effectively perform their duties, thereby increasing the risk of accidents and injuries, which could lead to unnecessary workers' compensation costs and greatly reduce productivity(Jones, 2017).

According to Jones (2017) work fatigue may be defined as extreme tiredness and reduced functional capacity experienced during and at the end of a workday. It may also be described as the lassitude or exhaustion of mental and physical strength that results from bodily labour or mental exertions (Lewis and Wessely, 1992). Work fatigue may lead to reduced mental and physical capacities and may subsequently lead to injuries or accidents in the workplace. Fatigue has thus been shown to have several safety-related consequences, including slowed reaction time, reduced vigilance, reduced decision-making ability, poor judgment, distraction during complex tasks, and loss of awareness in critical situations(Lerman *et al.,* 2012), which could contribute to accidents and injuries(Swaen et al., 2003). Previous research has also suggested that construction workers are at an increased risk of fatigue with prevalence rates reported at between 10% and 59% (Kant *et al.,* 2003, Zhang et al., 2015).

Although worker fatigue is often an overlooked hazard on the construction site(Jones, 2017), its impact may be more serious in construction work, where working environments are usually regarded as dynamic and risky to safety and health(Pinto *et al.,* 2011, Ringen *et al.,* 1995). Wahyu Adi and Ayu Ratnawinanda (2017) suggest that the construction industry is one of the riskiest industries when compared to other industries as the industry uses workers as its main

power source and this has led to more occupational accidents than in other industries. Kadiri *et al.,* (2014) have reported that the annual rate of injury in the construction industry are higher than in any other industry in Nigeria, with many workers falling victim to injury, harm, and even death. Fatigue contributes to occupational accidents by either reducing the ability to process information about a hazardous situation or by reducing the ability to adequately respond to a hazardous situation (Swaen *et al.,* 2003). Furthermore, the job task of construction workers often involves heavy workloads, awkward working postures, and prolonged working hours, which place workers at increased risk of fatigue (Dong, 2005, Hartmann and Fleischer, 2005, Mattila *et al.,* 1993). The increased demand for physical effort is similarly a potential cause of increased risk of fatigue among construction workers(Zhang *et al.,* 2015).

Moreover, factors such as overtime and poor schedules may contribute to fatigue.

According to Jones (2017) the impact of fatigue for construction workers may be more austere where the work environments are always changing due to a number of people from day to day, mandatory overtime due to deadlines, inclement weather and progress of the work, materials, equipment and vehicles onsite. These may lead to increased risk of worker fatigue. This risk is also higher for shift work, which includes non-daytime hours (6:00 pm to 7:00 am), for employees working overtime (> 40 hours/workweek) and/or working extended hours (> eight hours/workday) (Lerman et al., 2012). Work environment factors such as weather conditions, wind pressure, noise and sun exposure and work stress factors such as long working hours, rest periods and improper work shifts arrangement have been associated with fatigue in another study(Chang *et al.,* 2009).

Despite construction workers' large demography and associated potential for fatigue, few epidemiological studies have investigated fatigue prevalence and risk factors among construction workers globally. Considerable research has been carried out occupational hazards, health and safety awareness, occupational disease awareness and work-related accidents and injuries among construction workers in Botswana (Emuron, 2007, Musonda and Smallwood, 2008, Mwanaumo and Thwala, 2012, Ooteghem, 2006). There is therefore scarcity of studies conducted to investigate fatigue in the construction industry in Botswana. Hence the aim of this study was to assess the prevalence and factors associated with fatigue among construction workers and their perception of fatigue risk management systems in Botswana.

Materials and Methods

A descriptive cross-sectional study of fatigue management was carried out among construction workers in Gaborone, Botswana between February and April 2018. At the time of the study, seven construction sites with a total of 10 companies were identified around the city and all these were invited to participate in the study. Using Cochran (Cochran, 1963), variability in the proportion that would have fatigue was 45%; therefore, we assumed p=0.45. Using 93% confidence level and ±7% precision the resulting sample size was 196.Research permit was obtained from Ministry Health and Wellness and permission to conduct research at individual companies was sought from the company management. Informed consent was implied by voluntarily completing and returning the questionnaire.

An anonymous self-administered questionnaire was used to gather information from construction workers. The questionnaire comprised of four sections with demographic characteristics, Fatigue Severity Scale (FSS) to evaluate the impact of fatigue on participants (Krupp *et al.,* 1989), participants' fatigue risk and management factors, and perception of fatigue management in their workplaces using the Fatigue Management "at a place" evaluation tool (Van der Graaf and Hudson, 2002). FSS has nine items which a participant has to rate from 1-7 according to whether they strongly disagree (1) or strongly agree (7). An average of 4 and less means no fatigue while averages of more than 4 but less than 5 and 5 or more means borderline or high fatigue respectively (Krupp *et al.,* 1989). With regard to the fatigue management 'at a glance' tool, respondents were to rate different elements of fatigue management program as to whether the element was in a 'not begun,' 'emerging,' 'transitional' or 'progressive' state. According to Van der

Graafand Hudson(2002),emerging (vulnerable / reactive) means that the fatigue management system is not effectively managing fatigue risks, transitional (active / proactive) mean the system manages fatigue risks with increasing effectiveness and sophistication. Universal implementation and understanding is developing. Progressive (resilient) means the system is working well and continual improvement is built in to the fatigue management system. The fatigue management 'at a glance' tool provides information on how fatigue management is perceived by different workers/managers.

All data were coded and entered into SPSS 25.0 and analysed. Chi-squared test was used to analyse categorical data. Basic statistical associations between demographic and work-related variables were initially evaluated using Chi-squared tests. Risk factors were then evaluated using logistic regression and expressed as Odds Ratios (OR) with 95% Confidence Intervals (95% CI). Fatigue was taken as a dependent variable, with demographic and work-related factors as independent variables. P-values less than 0.05 were regarded as statistically significant for all analyses.

Results

Demographic characteristics of participants

A total of 120 construction workers responded giving a response rate of 61%. Of these respondents, 108 (90%) and 12 (10%) were males and females, respectively. The majority of respondents were aged between 21-30 years (47.5%), single (94.2%), and tobacco smokers (69.2%) and worked for 8 hours a day (81.0%). A high proportion of participants reported working for more than 5 days a week (57.5%). The main demographic characteristics of respondents are shown on Table 1.

Table 1: Demographic characteristics of participants

Characteristics	Number of respondents (N=120)	Percentage (%)
Gender		
Male	108	90
Female	12	10
Age (years)		
=20	14	11.7
21-30	57	47.5
31-40	36	30.0
=40	13	10.8
Job title		
Brick layer	27	22.5
Carpenter	12	10
Electrician	13	10.8
General Labourer	20	16.7
Safety Manager	5	4.2
Scaffolder	5	4.2
Other	38	31.7
Alcohol consumption		
No	69	57.5
Yes	51	42.5
Tobacco smoking		
No	37	30.8
Yes	83	69.2

Characteristics	Number of respondents (N=120)	Percentage (%)
Regular physical exercise		
No	40	33.3
Yes	80	66.7
Have children less than 6 years		
No	49	40.8
Yes	71	59.2
Daily work hours (hours)		
<8	12	10.3
8	94	81.0
=8	10	8.6
Number of workdays per week (days)		
5	51	42.5
>5	69	57.5
Hours of sleep		
<8	61	54.0
8	30	26.5
=8	22	19.5
Daily water consumption (glasses)		
<8	65	54.2
=8	55	45.8
Have breakfast before work		
No	19	15.8
Yes	101	84.2
Take energy drinks/coffee to stay awake at work		
No	59	49.2
Yes	61	50.8
Rest on weekends		
No	23	19.2
Yes	97	80.0
Do errands on weekends		
No	35	29.2
Yes	85	70.8

Prevalence of fatigue

Self-reported fatigue prevalence among construction workers was 79 (66%). As shown on Figure 1, 62% of respondents reported high fatigue whereas 38% reported borderline fatigue.

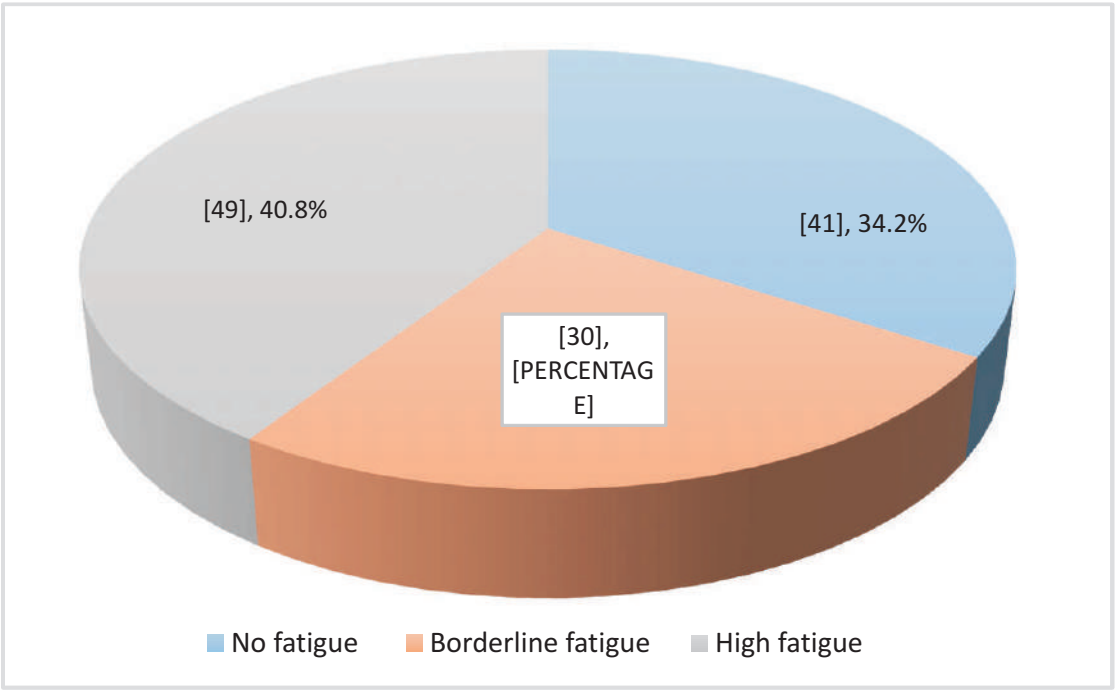

Figure 1. Prevalence of fatigue among construction workers

As shown in Table 2, construction workers who worked for more than 8 hours a day had significantly higher prevalence rates of fatigue when compared to those who worked for 8 hours per day (67.6% vs 50%, p=0.025). There was a significant difference between workers who took energy drinks or coffee to stay awake at work and those who did not in reporting fatigue (77.0% vs 54.2%, p=0.008). Workers who reported that they easily get tired when they have social stress had a higher prevalence of fatigue when compared to those who did not report getting easily tired when faced with social stress (71.1% vs 50%, p=0.035).

Table 2: Prevalence of fatigue among construction workers in Gaborone in relation to individual and lifestyle factors

Risk factors*	**n (%) with fatigue**	***p*- value**
Gender		**0.949**
Male	71 (65.7)	
Female	8 (66.7)	
Age (years)		**0.753**
=20	11 (78.6)	
21-30	37 (64.9)	
31-40	23 (63.9)	
=40	8 (61.5)	
Job title		**0.309**
Brick layer	14 (51.9)	
Carpenter	9 (75.0)	
Electrician	9 (69.2)	
General Labourer	15 (75.0)	
Safety Manager	4 (80.0)	
Scaffolder	5 (100.0)	
Other (for example)	23 (60.5)	

Risk factors*	n (%) with fatigue	*p*- value
Alcohol consumption		**0.316**
No	31 (60.8)	
Yes	48 (69.6)	
Tobacco smoking		**0.053**
No	50 (60.2)	
Yes	29 (78.4)	
Regular physical exercise		**0.341**
No	24 (60.0)	
Yes	55 (68.8)	
Have children less than 6 years		**0.202**
No	29 (59.2)	
Yes	50 (70.4)	
Daily work hours (hours)		**0.025**
=8	6 (50)	
>8	73 (67.6)	
Number of workdays per week (days)		**0.540**
5	32 (62.7)	
>5	47 (68.1)	
Hours of sleep		**0.163**
<8	42 (68.9)	
8	16 (53.3)	
>8	17 (77.3)	
Daily water consumption (glasses)		**0.760**
<8	42 (64.6)	
=8	37 (67.3)	
Have breakfast before work		**0.064**
No	9 (47.4)	
Yes	70 (69.3)	
Take energy drinks/coffee to stay awake at work		**0.008**
No	32 (54.2)	
Yes	47 (77.0)	
Rest on weekends		**0.577**
No	14 (60.9)	
Yes	65 (67.0)	
Do errands on weekends		**0.659**
No	22 (62.9)	
Yes	57 (67.1)	
Social stress		**0.035**
No	15 (50.0)	
Yes	64 (71.1)	

* Statistical associations between independent variables and fatigue were evaluated using chi-squared. Statistically significant differences ($p<0.05$) are marked in bold.

Among the work-related factors, results suggest that construction workers who knew that fatigue was an occupational health hazard had a higher prevalence of fatigue. Similarly, the prevalence of fatigue was higher among workers who have been trained on fatigue management. These findings were statistically significant with $p<0.05$ (Table 3).

Table 3: Prevalence of fatigue among construction workers in Gaborone in relation to work-related factors

Risk factors*	n (%) with fatigue	*p*-value
Colleagues support		**0.181**
No	7 (87.5)	
Yes	72 (64.3)	
Supervisor support		**0.480**
No	9 (75.0)	
Yes	70 (64.8)	
Carry/pull/push heavy loads		**0.571**
No	23 (62.2)	
Yes	56 (67.5)	
Machines used for heavy loads		**0.385**
No	9 (56.3)	
Yes	70 (67.3)	
Awkward posture		**0.241**
No	9 (81.8)	
Yes	70 (64.2)	
Work in hot environments		**0.432**
No	14 (73.7)	
Yes	65 (64.4)	
Work in noisy areas		**0.211**
No	17 (77.3)	
Yes	62 (63.3)	
Exposed to vibration		**0.220**
No	58 (48.3)	
Yes	62 (51.7)	
Task well planned		**0.129**
No	8 (88.9)	
Yes	71 (64.0)	
One-hour rest at work		**0.949**
No	8 (66.7)	
Yes	71 (65.7)	
Take breaks when tired		**0.720**
No	32 (64.0)	
Yes	47 (67.1)	
Fatigue knowledge		**0.032**
No	2 (28.6)	
Yes	77 (68.1)	
Awareness of fatigue management programmes		**0.079**
No	56 (61.5)	
Yes	23 (79.3)	
Trained on fatigue management		**0.022**
No	45 (58.4)	
Yes	34 (79.1)	

* Statistical associations between independent variables and fatigue were evaluated using chi-squared. Statistically significant differences ($p<0.05$) are marked in bold.

Table 4: Risk factors for fatigue among Botswana construction workers

Risk factors	Logistic odds (95%CI)	*P* value
Daily work hours (hours)		**0.003**
=8	1†	
>8	1.230 (1.105 – 1.977)	
Take energy drinks/coffee to stay awake at work		**0.008**
No	1†	
Yes	2.833 (1.290 – 6.219)	
Social stress		**0.035**
No	1†	
Yes	2.462 (1.054 – 5.751)	
Fatigue knowledge		**0.273**
No	1†	
Yes	1.951 (0.590 – 6.455)	
Trained on fatigue management		**0.025**
No	1†	
Yes	0.372 (0.157 – 0.883)	

†Reference group

Risk factors for fatigue

The strongest predictor of reporting fatigue was taking energy drinks or coffee to stay awake (AOR 2.833, 9%% CI: 1.290 – 6.219). Social stress and working for more than 8 hours a day were also significantly associated with fatigue. Having been trained on fatigue management was associated with decreased odds of reporting fatigue (Table 4).

Fatigue risk management

About three quarters (91) of respondents were not aware of the existence of any fatigue risk management program in their construction sites. Figure 2 depicts that, 37.5% of construction workers reported that no consultation, clear responsibilities, and commitment on fatigue management has been demonstrated in their companies. About 36% reported that fatigue

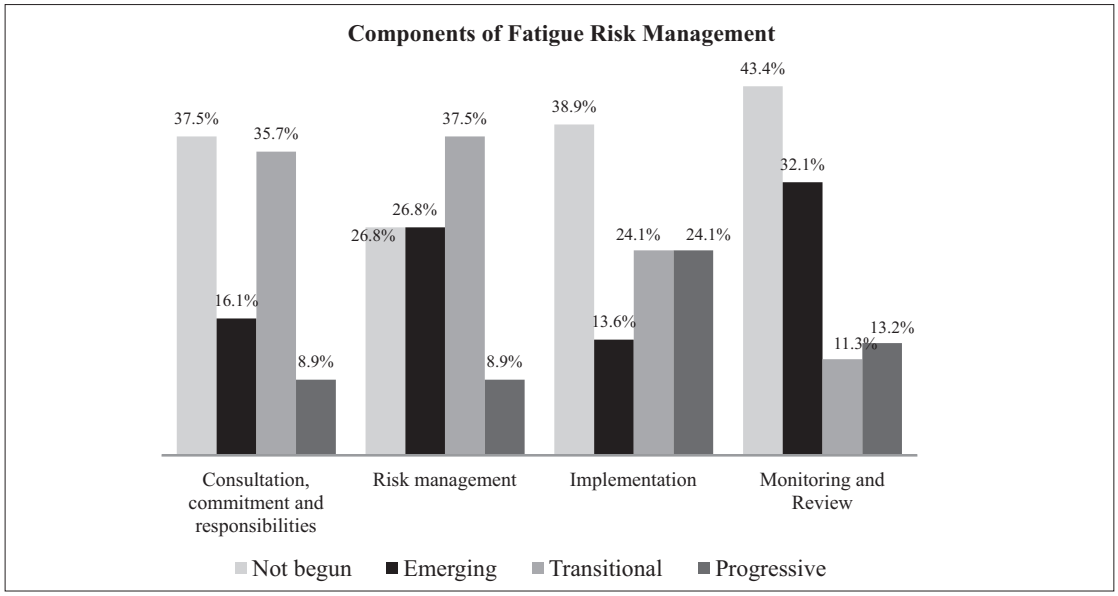

Figure 2: Perception of respondents on fatigue risk management in Gaborone construction industry

risks were transitional, whilst less than 10% reported that their fatigue management system was progressive. About 27% construction workers reported that fatigue risk management has not begun or was emerging in their companies whereas over a third of workers (37.5%), reported that fatigue risk management was transitional. Almost two fifths (38.9%) reported that nothing had been done while 24.1% reported that systems in place were transitional or progressive. The majority of respondents (43.4%) reported that monitoring and review of fatigue management systems in their companies has not begun whereas 32.1% report that it was emerging and 13.2% reported that they were progressive.

Discussion

Fatigue prevalence

The first aim of the study was to estimate the prevalence of fatigue among construction workers in Gaborone, Botswana. This study found that two-thirds of construction workers have reported fatigue with 62% reporting high fatigue and 38% borderline fatigue. When compared to previous research, the current overall prevalence of fatigue is relatively lower than prevalence rate of fatigue of a study that was conducted in Indonesia where all construction workers complained of fatigue. Of these, 7.9%, 60.4% and 30.7% reported severe, moderate and mild fatigue, respectively (Zahra and Kurniawidjaja, 2018).

However, the prevalence of fatigue of the current study was higher than those found in other studies. In a study carried out in Taiwan for example, 58% of construction workers reported being tired sometimes while 19% reported being very tired(Lin et al., 2015). In another study conducted in United States of America by Zhang *et al.,* (2015), 49% of construction workers reported being tired some days while 10% reported being tired most days or every day. Kant *et al.* (2003) reported low prevalence of fatigue (13.8%)in Netherlands. The high prevalence of fatigue in the current study could possibly be attributed to reduced recovery time between shifts. Although there was no statistical significance, the majority of workers reported working more than five days a week (57.5%) and sleeping for less than 8 hours/day (54%). These could lead to reduced recovery time between shifts. Additionally, Botswana construction workers do not know much about occupational health and safety and there is generally lack of health and safety management systems.

Fatigue risk factors

The second aim of this study was to determine risk factors associated with fatigue among construction workers in Gaborone. This study revealed that construction workers who worked for more than 8 hours a day had a significantly higher prevalence of fatigue when compared to those who worked for 8 hours a day. Our results are similar to previous studies conducted among construction workers in different countries such as the US(Dong, 2005), Taiwan(Lin *et al.,* 2015) and Indonesia (Zahra and Kurniawidjaja, 2018). In a study carried out in Ethiopia, it was found that construction workers who worked for more than 8 hours were 14 times more likely to report occupational injury compared to those who worked for 8 hours/day (OR: 14.06, 95% CI: 5.67-34.86)(Adane *et al.,* 2013). Long working hours lead to decreased recovery time before the next shift. This therefore means that workers will be exposed to the same stressors before they have recovered from the previous exposure.

The results of this study also indicated that construction workers who took energy drinks or coffee to stay awake at work were almost three times more likely to report fatigue. It has previously been reported that many construction workers rely on caffeinated drinks, such as coffee to assist them to manage fatigue. These however, contribute to sleep loss if used within 6 hours before sleep(Theron and van Heerden, 2011). Furthermore, caffeine can only provide a temporary energy boost to the body and once this energy boost is depleted, it will trigger fatigue(Theron and van Heerden, 2011).

Having social stress was significantly associated with reporting fatigue. This is in agreement with previous research in which it

was found that psychological factors such as depression, anxiety, stress and grief are often present in at least 50% of fatigue cases(Theron and van Heerden, 2011). In their study, Hallowell (2010) reported stress and anxiety syndromes as a risk factor of fatigue among construction workers.

On the other hand, workers who were trained on fatigue management were less likely to report fatigue when compared to those who have not been trained. This could be explained by the fact that, the trained workers understand the impacts and control measures of fatigue and thereby take measures to prevent fatigue.

According to Gander *et al.,* (2011) employees must have an understanding of the causes and consequences of fatigue that is sufficient for them to meet their responsibilities in relation to FRMS.

Respondents' perception of on fatigue risk management

The majority of respondents did not know of the existence of any written fatigue management program as either a stand-alone program or part of the general health and safety program. This finding is worrying as workers play a vital role in the implementation of FRMP. For workers to have no knowledge of FRMP may mean that little is being done with regard to fatigue management in the construction industry. It must be noted that full participation of all stakeholders is essential for successful fatigue prevention (Gander *et al.,* 2011, Grech, 2016).

Grech (2016) has reported that lack of a workplace fatigue risk management program has been identified as a risk factor in a number of accidents. Furthermore, the current study found that the majority of the respondents perceived that all the components of fatigue risk management program have not begun or emerging. According to the Culture Maturity Ladder which is based on the Hudson Maturity Model, it means that fatigue management systems in these companies are either vulnerable or reactive(Van der Graaf and Hudson, 2002).

The fatigue management system are thus not effectively managing fatigue risks (Van der Graaf and Hudson, 2002). This therefore means that a lot has to be done to reduce fatigue in the construction industry in Botswana.

Study limitations

Data was collected for a limited time which limited the number of follow ups that could have been done on non-respondents. Also data was self-reported which could led to miss-reporting.

Conclusion

This study has shown that fatigue is reasonably common among construction workers in Gaborone, Botswana. Long working hours, taking energy drinks and stress were positively associated with fatigue. The components of fatigue risk management program were found to still be emerging. Therefore, to help reduce the prevalence, progression and burden of fatigue among construction workers in Gaborone, companies must implement the fatigue management systems and train workers on them.

Acknowledgements

The authors would like to thank the University of Botswana for their support of this study, construction companies and workers who participated in the study.

Authors' contributions

UD and PE conceived and designed the study. UD was involved in data collection, PE and RT were involved in statistical analysis. PE and BM were involved in drafting the manuscript. All authors read and approved the final manuscript.

References

Adane, M. M., Gelaye, K. A., Beyera, G. K., Sharma, H. R. & Yalew, W. W. (2013). Occupational injuries among building construction workers in Gondar City, Ethiopia. *Occupational Medicine & Health Affairs*.

Chang, F.-L., Sun, Y.-M., Chuang, K.-H. & Hsu, D.-J. (2009). Work fatigue and physiological symptoms in different occupations of high-

elevation construction workers. *Applied Ergonomics,* 40, 591-596.

Cochran, W. G. (1963). *Sampling Techniques,* New York, John Wiley and Sons.

Dong, X. 2005. Long workhours, work scheduling and work-related injuries among construction workers in the United States. *Scandinavian Journal of Work, Environment & Health*, 329-335.

Emuron, J. (2007). Occupational health hazards among construction workers in Gaborone, Botswana. *Texila International Journal of Public Health,* 5.

Gander, P., Hartley, L., Powell, D., Cabon, P., Hitchcock, E., Mills, A. & Popkin, S. (2011). Fatigue risk management: Organizational factors at the regulatory and industry/company level. *Accident Analysis & Prevention,* 43, 573-590.

Grech, M. R. (2016). Fatigue Risk Management: A Maritime Framework. *International journal of environmental research and public health,* 13, 175-175.

Hallowell, M. R. (2010). Worker Fatigue: Managing Concerns in Rapid Renewal Highway Construction Projects. *Professional Safety,* 55, 18-26.

Hartmann, B. & Fleischer, A. G. (2005). Physical load exposure at construction sites. *Scandinavian Journal of Work, Environment & Health*, 88-95.

International Labour Organization (2005). Facts on Safety at Work. *In:* International Labour Office (ed.). Geneva.

International Labour Organization (2009). World Day for Safety and Health at Work 2009 Facts On safety and health at work. *In:* International Labour Organization (ed.). Geneva.

Jones, K. (2017). *Combating Construction Worker Fatigue* [Online]. Available: https://www.constructconnect.com/blog/construction-safety/combating-construction-worker-fatigue/ [Accessed 11 June 2019].

Kadiri Z.O; Nden T; Avre G.K; Oladipo T.O; Edom A: Samuel P.O & Ananso G.N. (2014). Causes and Effects of Accidents on Construction Sites (A Case Study of Some Selected Construction Firms in Abuja F.C.T Nigeria) *IOSR Journal of Mechanical and Civil Engineering* 11, 66-72.

Kant, I. J., Bültmann, U., Schröer, K. A. P., Beurskens, A. J. H. M., Van Amelsvoort, L. G. P. M. & Swaen, G. M. H. (2003). An epidemiological approach to study fatigue in the working population: the Maastricht Cohort Study. *Occupational and environmental medicine,* 60 Suppl 1, i32-i39.

Krupp, L. B., Larocca, N. G., Muir-Nash, J. & Steinberg, A. D. (1989). The Fatigue Severity Scale: Application to Patients With Multiple Sclerosis and Systemic Lupus Erythematosus. *JAMA Neurology,* 46, 1121-1123.

Lerman, S. E., Eskin, E., Flower, D. J., George, E. C., Gerson, B., Hartenbaum, N., Hursh, S. R., Moore-Ede, M. & Management:, A. P. T. F. O. F. R. (2012). Fatigue Risk Management in the Workplace. *Journal of Occupational and Environmental Medicine,* 54, 231-258.

Lewis, G. & Wessely, S. (1992). The epidemiology of fatigue: more questions than answers. *Journal of epidemiology and community health,* 46, 92-97.

Lin, Y.-H., Ho, S.-C. & Lai, C.-Y. Physiological workload and musculoskeletal fatigue among construction workers involving squatting/ kneeling task in Taiwan. Proceedings 19th Triennial Congress of the IEA, 2015. 14.

Mattila, M., Karwowski, W. & Vilkki, M. (1993). Analysis of working postures in hammering tasks on building construction sites using the computerized OWAS method. *Applied Ergonomics,* 24, 405-412.

Musonda, I. & Smallwood, J. (2008). Health and safety (H&S) awareness and implementation in Botswana's construction industry. *Journal of Engineering, Design and Technology,* 6, 81-90.

Mwanaumo, E. & Thwala, W. D. (2012). Construction practitioners' awareness of occupational diseases in the Botswana construction industry: An exploratory study. *Occupational Health Southern Africa,* 18.

Ooteghem, P. V. (2006). Work-related Injuries and Illnesses in Botswana. *International Journal of Occupational and Environmental Health,* 12, 42-51.

Pinto, A., Nunes, I. L. & Ribeiro, R. A. (2011). Occupational risk assessment in construction industry – Overview and reflection. *Safety Science,* 49, 616-624.

Ringen, K., Englund, A., Welch, L., Weeks, J. L. & Seegal, J. L. (1995). Why construction is different. *Occup Med,* 10, 255-9.

Swaen, G. M. H., Van Amelsvoort, L. G. P. M., Bültmann, U. & Kant, I. (2003). Fatigue as a risk factor for being injured in an occupational accident: results from the Maastricht Cohort Study. *Occupational and Environmental Medicine,* 60, i88-i92.

Theron, W. J. & VAN Heerden, G. M. J. (2011). Fatigue knowledge - a new lever in safety management. *Journal of the Southern African Institute of Mining and Metallurgy,* 111, 1-10.

Van Der Graaf, G. C. & Hudson, P. T. W. Hearts and Minds: The status after 15 years Research. Society of Petroleum Engineers (SPE 73941). International conference on HSE in Oil and Gas

Exploration and production, 20-22 March 2002 Kuala Lumpur.

Wahyu Adi, T. J. & Ayu Ratnawinanda, L. (2017). Construction Worker Fatigue Prediction Model Based on System Dynamic. *MATEC Web Conf.,* 138, 05004.

Zahra, A. N. & Kurniawidjaja, L. M. (2018). Construction Workers' Fatigue Conditions at PT. X Construction Contractor Apartment Development in the 2017 Work Year. 2018, 13.

Zhang, M., Murphy, L. A., Fang, D. & Caban-Martinez, A. J. (2015). Influence of fatigue on construction workers' physical and cognitive function. *Occupational medicine (Oxford, England),* 65, 245-250.

Patience N. Erick, Unangoni Ditsala, Roy Tapera and Bontle Mbongwe
© *African Journal of Environmental Health Sciences*
Volume 6, November, 2019
ISSN: 2476-8030
pp 85-97