AIMS AND SCOPE

ergonomics SA (esa) provides a medium for publication of material relevant to occupational conditions and needs in Southern Africa at a time of change unparalleled in history. To this end the journal accepts articles in the following categories: research papers, review articles, conceptual theories, methodological articles involving technology for recording and/or analysing humans at work, observational reports from the field, brief research reports/updates, and news and views.

The editors aim to ensure that professional rigour characterises all published material while recognising that the needs of Southern Africa in this field and of Ergonomics anywhere, are for the generation and dissemination of technical, non-technical, fundamental and applied knowledge. To this end the journal welcomes review papers and encourages contributions to its News and Views section.

RESEARCH PAPERS: Original empirical articles of significance for the broadly ramified field of Ergonomics are welcomed, particularly those related to the problems associated with Industrially Developing Countries, and particularly in a Southern African context. These may involve original theory and/or unique application.

REVIEW ARTICLES: Review articles are encouraged and those whose focus is on application of the contained knowledge to the situation as it pertains in Southern Africa are most sought. The requirement of readability and appropriate writing style is particularly crucial here.

METHODOLOGICAL REPORTS: Papers devoted to the technology for recording and/or analysing of parameters relative to humans at work, so long as these are presented in a form intelligible to readers representing a wide variety of professional backgrounds, are welcomed. The requirement of clarity of exposition, particularly in terms of illustrations, is particularly relevant here.

CASE STUDIES/OBSERVATIONAL RECORDS: Interesting case studies/observations from the field, especially if they suggest problems or solutions not previously considered, will be accepted.

RESEARCH NOTES/UPDATES: Ongoing research information which may stimulate debate or foster contacts between professionals with similar interests may be summarised in short (one or two page) updates. These are not subjected to formal blind review by referees, but are published at the discretion of the Chief Editors.

NEWS AND VIEWS: Submissions for this section of the journal are personal reports or position statements and these are encouraged in the interest of fostering debate, stimulating thought or revision and promoting exchange of ideas. Views expressed do not necessarily carry endorsement from the editorial board but they must be expressed in conformity with accepted norms and standards. Contributions to News and Views are subjected to an open review process. Letters to the Editors in Chief, engendered by contributions appearing earlier in the journal, may be published in subsequent issues under this section.

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Human Factors and Ergonomics (HFE) adopts a systems approach to understand, optimize or balance the interactions between people and the systems with which they interact (Carayon, 2009; Dul et al., 2012). It is also design driven, where the ergonomist works (or at least, should work) with system users (and designers) to ensure that the design of a tool, a task or activity, the physical environment or the working time arrangements accommodate the needs and limitations of the users as far as is reasonable (Dul et al., 2012). Too often though, the design of systems do not consider the needs of the users, which affects both user safety and performance, two outcomes that HFE aims to enhance. In this edition of Ergonomics SA, the three articles emphasize the importance of being human/user-centered in how various systems are designed to ensure that humans remain safe and productive, no matter the context.

Thambura and Swindon report on various occupational risk factors and the attendant physical and psychosocial impacts experienced by radiographers in the KwaZulu Natal region of South Africa and how these experiences have influenced the migration of these allied healthcare professionals. As commonly reported in the local media and healthcare-related research (Hignett et al., 2018) the study revealed that radiography departments are often understaffed, resulting in extended and, at times, irregular work hours, high workloads and social isolation. When combined with the required physical and cognitive demands of the task, these systemic challenges result in a high reported incidence of work-related pain and job dissatisfaction, which the authors argue contributes to the migration of radiographers. The authors offer some important recommendations for broader system improvement, including the introduction of employee assistance programs, designated health and safety officers and a reporting system to foster engagements between staff and managers.

Mkuzo and colleagues offer interesting insights into the results of their observation of more than 45 houses from three different sites around South Africa that were built under the ‘Breaking New Ground (BNG)’ initiative, a national project that provides affordable housing to low-income earners. Using BNG’s own housing standards checklist and an observational diary, the authors found and report on a plethora of problems with the overall design, finishing and location of the houses they visited. While the authors did not interview housing occupants, they highlight some of the potential health and safety risks that may emerge from the observed defects, emphasizing that administrators responsible for these projects should ensure the contractors adhere to the required standards when building these houses.

Lastly, Mhlongo, Gabela and Reddy focus on an important aspect of work - working time arrangements and the associated psychosocial and health risks in the context of local biscuit manufacturer. Shift work, defined as work that occurs outside of the normal ‘9-to-5’, usually includes work at night, in the early morning or evening, which are times that can interfere with normal sleep-wake behavior and the social life of workers. Using an amended version of the Standard Shift work Index, Mhlongo et al. highlight that shift workers in this context experience various, negative psychosocial
and physical health-related challenges normally associated with shift work (Moreno et al., 2019).

However, the study also revealed that workers with longer shift working experience reported better health and more time for social and domestic activities. From a design perspective, these findings show that while shift work may be detrimental to the alertness, performance and health of most workers, for some, this is not the case and that potentially with experience, workers develop strategies to cope with the stressors of shift work. This is not to say that health status may not change during a career of shift work and the associated changes in lifestyle behaviors (Moreno et al., 2019), but it is important to appreciate the individual-specific responses to the way working time is designed.

One of my favourite quotations about the importance of design comes from Henry Dreyfuss, an industrial design pioneer who wrote in one of his iconic books, ‘Designing for people’ (1955), the following: ‘If the point of contact between the product and people becomes a point of friction, then the designer has failed. If, on the other hand, people are made safer, more comfortable, more desirous of purchase, more efficient — or just plain happier — by contact with the product, then the designer has succeeded.’

While Dreyfuss talks about a product in this quotation, this line of thinking can be extended to the design of broader systems, whether it be a simple human-task interaction or the many complex interactions that occur within a multi-national organization. At the heart of this quotation, which reflects Dreyfuss’ philosophy and that of HFE, is that design needs to have humans at the centre. Those responsible for designing and managing systems, no matter how large, should always remember this.

Jonathan Davy (Editor-in-Chief)
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Occupational risk factors and their impact on migration of radiographers from KwaZulu-Natal, South Africa

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Abstract

Radiography is one of the allied healthcare professions known to be stressful. It is often associated with long working hours, ethical dilemmas, high patient demands and frequent disruptions from ancillary departments, which are all known to result in negative physical and psychosocial effects that may motivate migration. In this context, migration means; leaving one health sector to seek employment in another (i.e. private and public), resignation to join other professions or moving to a foreign country to practise radiography. The aim of this study was to identify occupational-risk factors that contribute to the migration of radiographers in order to provide input for mechanisms that can be put in place to alleviate the negative physical and psychosocial effects identified, thereby improving staff wellbeing and service delivery in KwaZulu-Natal. A cross-sectional, quantitative study, using a questionnaire as the data collection instrument was employed. The study targeted three categories of respondents: radiographers who left the profession (n=19), those who emigrated (n=29) and those who were employed in KwaZulu-Natal (KZN) (n=300). The results revealed that of the 348 participants, 221 (63 %) responded. The ages ranged from 19 to 60 (mean 39) years. The common negative occupational risk factors found across the three categories of radiographers included headaches, neck pain and spasms, lower back pain, knee pain and painful feet. The negative psychosocial effects identified were; job dissatisfaction, anxiety, stress, insomnia, depression and a sense of isolation. The study revealed that the identified occupation-related risk factors resulted in negative physical and psychosocial effects that could contribute to the migration of KZN radiographers. The introduction of employee assistance programmes and improved reporting systems are recommended to reduce the negative impact of occupation-related factors on radiographers and thereby improve staff wellbeing and reduce migration.

Keywords: Radiography, workload, physical, psychosocial, migration
1 Introduction

Radiography is an allied healthcare profession with four separate disciplines, namely diagnostic radiography, radiotherapy, ultrasonography and nuclear medicine technology (Durban University of Technology, 2018). Radiographers, by virtue of the nature of the profession, face many occupational challenges during their working life, such as long working hours, a lack of radiation protection devices, cross-infection, poor salaries, ethical dilemmas due to patient demands, frequent disruptions by other departmental staff, and at times, accusing and angry patients (Mark & Smith, 2012; Rajan, 2014). The routine tasks in the radiography profession, such as long working hours in a stressful environment, can increase the likelihood of occupational related diseases, which may indirectly affect the patient (Erondu, Ugwu, & Umeano, 2011; Raj, 2006). The resultant effects of job dissatisfaction, occupational stress and job burnout were found to be possible causes of resignations amongst employees in Germany (Skirbekk, 2004). Literature from Nigeria also indicates that occupation-related morbidity may result in diseases, which can also lead to migration, and in turn result in shortage of radiographers (Luo et al., 2016; Ugwu, Ahammad & Nwobi, 2008). These occupational-risk factors and the resulting negative physical and psychosocial effects were also found by Gam (2015) to be experienced by radiographers in KwaZulu-Natal (KZN) where similar working environments and conditions prevail. These negative effects are further exacerbated by financial constraints and lack of maintenance of expensive radiology equipment in the public health care system (Gam, 2015).

Data received from the KZN Department of Health Human Resources (HR) office, highlighted that in 2010 there were 7,255 radiographers employed nationally to serve all nine provinces in the country (personal communication HR Manager, KZN Department of Health). According to the Manager, the number of radiographers employed in KZN had not changed from 2011 to 2016, with an average of 582 employed, and an average of 77 vacant posts in the country (email communication from HR Manager, KZN Department of Health). Some posts in KZN public hospitals were frozen during this time period due to financial constraints, thus reducing the number of posts available in radiography to meet patient demands (Erasmus, 2015). The ever-increasing workloads in understaffed hospitals were thus not balanced by the employment of more radiographers. Occupational challenges such as staff shortages and poor working conditions may cause negative physical and psychosocial effects such as job burnout, stress, physical and mental fatigue. These may place employees at risk of making avoidable clinical errors which impact directly on the quality of healthcare and ultimately on the patients (Ugwu et al., 2008). If not managed effectively, the occupational risk factors may also impact negatively on the professional’s desire to remain in their place of employment (Erondu, Ugwu, & Umeano, 2011).

In the context of this study occupational risk factors would be those due to the daily work activities in the radiography profession in KZN. Healthcare professionals are known to experience conflicts between physicians, discrimination, high workloads, dealing with deaths in families and terminally-ill patients (Mark & Smith, 2012). These occupational risk factors are also known characteristics of the radiography profession in South Africa and could be resulting in negative physical and psychosocial effects, that prompt radiographers to change their workplace, leave the country or change
professions. KZN is one of the provinces that has experienced critical staff shortages in the public sector due to this “brain drain” (Thambura & Amusa, 2016). Radiographers, in their quest for more favourable working conditions and environments, have changed from public service to private sector, left South Africa for countries such as Australia, United Kingdom and Saudi Arabia, as well as switched their profession (Thambura, Swindon & Amusa, 2014).

It was necessary to address the issues leading to the migration of KZN radiographers in order to improve the quality of healthcare, and the health and well-being of radiographers. Therefore, this study aimed at identifying the occupational risk factors associated with the migration of KZN radiographers in order to provide input on mechanisms to be put in place in order to enhance radiographic service delivery, improve staff wellbeing and reduce migration from KZN.

2 Methods

2.1 Research design

This study was a quantitative, descriptive survey with a cross-sectional design (Kumar, 2011).

2.1.1 Target population and sample selection

The participants from the four disciplines of the radiography profession were targeted and grouped according to; those who had left the profession; those who had emigrated; and those who were still working in KZN (public and private sectors). A convenience sampling method was used to reach a maximum number of participants (Kumar, 2011). In order to maintain confidentiality and protect personal information, the recruitment of participants who had left the profession and those who had emigrated, was achieved through colleagues, known mutual friends, and lecturers who had previously taught them. Those who were still employed in KwaZulu-Natal were approached personally by the researcher at their workplaces after obtaining the relevant permission. The latter group of 300 participants was selected from a representative sample of public and private workplaces throughout KZN.

2.2 Data collection and instrumentation

Primary data were collected using a self-designed questionnaire, which contained closed and open-ended questions. Three separate questionnaires were compiled for each category of group of participants, however the questions relevant to this paper were common to all. The questionnaires comprised of two sections, the first section included questions on demographic information such as age, gender, work experience and type of workplace. The second section contained questions related to working hours, occupation-related clinical symptoms experienced and overall impressions of the profession. See appendix 1 for the questions.

A pilot study was conducted to ensure reliability and content validity. This was achieved using a small group of radiographers who were then excluded from the study. The questionnaires were amended to address the inputs from the pilot study group. Content validity was also ensured by verifying the relevance of the contents with radiographers who had more than twenty years’ experience in the profession and with
an academic background. The supervisor, co-supervisor (both experts in the field of study) and a statistician reviewed and critiqued the questionnaires to ensure face validity. Relevant changes were made to the questionnaires.

The questionnaires were made available online to the participants who had emigrated and those who had left the profession via a link sent to their emails. The completed questionnaires were tracked, and follow-up reminder emails were sent to the participants. The researcher personally delivered the questionnaire to the hospitals in KZN, waited for the radiographers to complete them during break time and then collected the questionnaires.

2.3 Ethical considerations
Ethics approval was obtained from the Durban University of Technology’s Institutional Research Ethics Committee (reference number REC 37/12) and the KZN Provincial Health Research Ethics Committee (reference number HRKM123/12).

Access to the online questionnaire was gained after participants had read the disclaimer on the email link which provided information about the study and conditions for consent. Participation therefore indicated that the participant had provided consent. Questionnaires for those working in KZN included an information and consent letter. Signed consent was obtained from these participants. Participants’ responses were kept anonymous and confidential and only the researcher had access to the completed questionnaires. The ethical principles of autonomy, beneficence, non-maleficence and justice were observed to protect the participants. Relevant permission was obtained from the various KZN health district offices, the hospital and private practice CEOs and the radiography managers at each radiography department.

2.4 Data analysis
The data were analysed using SPSS version 23.0. Descriptive statistics using frequency, cross-tabulation and bar graphs were used to present the data graphically.

3 Results
Presented in this section are the results for the age and gender, hours worked in a week, negative physical effects experienced by radiographers and the negative impressions of radiography profession.

The largest group of participants between 25 and 29 years of age (41.9%; n=39) were participants currently working at KZN, whilst the greatest number of all participants (n=65) were between 30-39 years of age and the smallest group of all the participants was in the age category ≥ 60 (n=6).

In the category of participants who had left the profession, 81.2% (n= 13) were female whilst all emigrant participants were female. Amongst the participants working in KZN, 82.9% (n = 157) were female and 17.1% (n=32) were male. The total number of female participants across the three categories was 186, which was just over five times that of their male counterparts (n=35).
Table 1. Age and gender representation of participants in the three groups (n=221)

<table>
<thead>
<tr>
<th>Age</th>
<th>Left profession</th>
<th>Emigrants</th>
<th>Currently working</th>
<th>TOTAL (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (%; n)</td>
<td>Female (%; n)</td>
<td>Total (%; n)</td>
<td>Male (%; n)</td>
</tr>
<tr>
<td>19-24</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>0.0</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>25-29</td>
<td>0.0 (0)</td>
<td>23.1 (4)</td>
<td>23.1 (4)</td>
<td>0.0</td>
</tr>
<tr>
<td>30-39</td>
<td>66.7 (2)</td>
<td>7.7 (1)</td>
<td>74.4 (3)</td>
<td>0.0</td>
</tr>
<tr>
<td>40-49</td>
<td>0.0 (0)</td>
<td>61.5 (7)</td>
<td>61.5 (7)</td>
<td>0.0</td>
</tr>
<tr>
<td>50-59</td>
<td>33.3 (1)</td>
<td>7.7 (1)</td>
<td>41.0 (2)</td>
<td>0.0</td>
</tr>
<tr>
<td>≥ 60</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Total % (n)</td>
<td>18.8 (3)</td>
<td>81.2 (13)</td>
<td>100.0 (16)</td>
<td>0.0 (0)</td>
</tr>
</tbody>
</table>

3.1 Hours worked per week in KwaZulu-Natal

The total number of hours worked in a week are represented in Figure 1.

![Figure 1. Hours worked by radiographers per week](image)

The majority of the participants (n=7; 57.1 %) who had left the profession worked 41-60 hours per week, while the minority of this group (n=6; 42.9%) worked between 31 and 40 hours. Most of the emigrant participants (n=11; 68.8%) worked 31-40 hours, whereas four (25%) had worked between 41 and 60 hours a week. It was noted that 112
(63.6%) of the radiographers working in KZN worked more than 40 hours a week, while 64 (36.4%) worked more than 60 hours per week.

3.2 Negative physical effects experienced by radiographers

The frequency of the negative physical effects of work-related activities experienced by radiographers is presented in Figure 2.

![Figure 2](negative-effects.png)

**Figure 2.** Negative physical effects associated with work-related activities.

Among the participants who had left the profession, (n=7; 43.7%) indicated “other” factors such as painful feet, hernia due to lifting patients, and the loss of eyesight (which could be associated with the effects of radiation), were related to their work. Headaches, lower back pain, neck pain and spasms were indicated by three (18.8%) of the participants to be related to their work. Half of the emigrants, (n=8; 50.0%) stated other factors being muscle spasms, a painful body and physical stress, while seven (43.8%) stated that they experienced headaches, and one (6.3%) experienced lower back pain.

Amongst those who were working at KZN, (n=68; 35.9%) radiographers working in KZN experienced lower back pain (n=48; 25.5%), experienced headaches, (n=39; 20.8%) suffered neck spasms, and (n=15; 8.2%) identified knee pain, while (n=18; 9.6%) stated other factors, such as pulmonary tuberculosis due to poor ventilation, sleeplessness, immunosuppression, wrist, thumb and shoulder pain, as well as psychological and physical strain to be possible work-related symptoms.

3.3 Negative impressions of the profession

The negative features of radiography, as perceived by the participants, are indicated in Figure 3.
Figure 3. Negative perceptions of the radiography profession

Five participants who had left the profession (31.3%) stated that radiography made demands at odd/unsociable times, while four (25%) stated that radiography has radiation hazards. One (6.3%) participant mentioned that radiography has a high workload and is a difficult career to study. Three participants (18.7%) identified factors such as poor remuneration, demoralisation from peers and understaffing as negative features of radiography, compared to the careers they had since moved to.

Four (25%) of the emigrants identified other negative features such as radiation hazards, high dependency on other professions in decision-making, high workload, lack of career and professional development, and poor remuneration, while three (18.8%) highlighted the unsociable call-out times and three (12.5%) indicated that it was costly to open a private practice.

Forty (17.3%) of the currently working participants stated that it was difficult to open a private practice, while 38 (16.3%) mentioned calls at unsociable hours as challenging factors. Other factors identified were a high workload by 36 participants (15.4%), an over-dependence on other professions in decision-making by 34 (12.8%), and high stress levels by 28 (12.3%). When comparing radiography to careers that participants would consider changing to, 14 participants (5.9%) highlighted radiography’s higher level of social isolation, while five (2.1%) mentioned its high degree of difficulty as a career. Eight (3.4%) identified other factors, such as the high risk of nosocomial infections and poor remuneration.
4 Discussion

Migration is the movement of individuals from one place to another (Mohanraj & Manivannan, 2013). In this discussion, age and gender representation across the three categories of the participants, the weekly hours worked by radiographers, and the negative physical effects associated with the daily work activities in radiography are discussed in relation to migration.

4.1 Gender and age

There was gender disparity amongst the participants, with females dominating the profession (Table 1). This was extreme in the emigrant category, where all participants were female, and amongst radiographers working in KZN, where the number of females was almost five times greater than than their male counterparts in the profession. Radiography in South Africa is known to be dominated by females. The dominance of females in the profession may impact on productivity, due to factors such as maternity leave and extended leave to raise children. In South Africa, four consecutive months of maternity leave is permitted in terms of the Basic Conditions of Employment Act, 1997 revised in year 2002 (Basic Conditions of Employment Act No.11 of 2002). Similarly, the World Health Organisation (WHO) advises that a pregnant female radiation worker should be accorded alternative working conditions in order to protect the fetus from receiving a radiation dose exceeding 1 millisievert (mSv) which is the maximum amount of radiation that a fetus may be exposed to during the 9 months of pregnancy (Astor et al., 2005). These factors combined may reduce the number of active, practicing radiographers in the workplace, causing an increased workload and stress for the remaining staff as the same workload will then be shared between fewer radiographers that remain. This may then result in dissatisfaction, resignations, career exiting and migration. The profession therefore, needs to address the gender inequality through rigorous marketing strategies that target and attract males to radiography.

In the category of radiographers who were working in KZN, the majority of participants were aged 30 to 39 years, while the emigrants were between 25 and 29 years. It can be deduced that most radiographers had left South Africa soon after graduating and completing their compulsory community service responsibilities as they fall within this younger age group (25 –29 years). Similarly, in a study conducted in 2008, it was noted that the majority of radiographers that had emigrated from Nigeria were also young (Ugwu et al., 2008). Emigration at a young age drains off the professionals who are highly productive at workplaces, which then results in a shortage of radiographers once the majority of the working age group retires. More than half of the three categories of participants in this study were in the 30 to 39 year age group and older. This could possibly be explained by the migration of many KZN radiographers in the 25 to 29 year age group as they seek better working environments and lifestyles in other countries, other professions or other health sectors.

Countrywide, emigration in the healthcare system has resulted in an unequal distribution of human resources between the public and the private hospitals, as well as between rural and urban. By 2015, 70-80% of trained South African health professionals had left the public sector (Econex, 2015). This is evidenced by the decreased number of radiographers in the KZN public sector (Erasmus, 2015). Table 1
shows that majority of the respondents were between 30 and 39 years of age, and due to the belief, that productivity decreases after the age of 50 (Skirbekk, 2004), it would appear that there is a possibility of a future crisis if measures are not put in place to address migration. Therefore, it would seem that productivity within the KZN radiography profession is at risk of decreasing as the younger professionals continue to emigrate or leave the profession.

4.2 Negative features of the radiography profession

Contrary to radiography being their career of choice, radiographers who had emigrated, as well as those who had left the profession, identified occupation-related factors such as poor remuneration, overdependency on other professions, high workloads and understaffing as factors that had motivated radiographers in KZN to consider leaving the profession. Radiography departments are often understaffed, but are still expected to offer high quality services, which leads to negative psychosocial effects such as dissatisfaction and high anxiety levels amongst staff (Ugwu et al., 2008; Rutter & Lovegrove, 2008). Vosper, Price and Ashmore (2005) found in 2005 that radiography graduates in the United Kingdom would not recommend radiography as a career due to having to deal with ungrateful patients and insufficient staff numbers in departments, even though there were adequate jobs available at that time (Vosper et al., 2005). Similarly, a comprehensive report compiled in Northern Ireland as far back as 2002, described radiography as a career lacking opportunities for professional progression, resulting in skills mix (taking on of job tasks other than the normal duties of a radiographer in order to meet the job demand of an organisation) and high workload (Northern Ireland Department of Social Services and Public Safety, 2002; Buchan and Dal Poz, 2002). Similar results were apparent in this current KZN study.

The radiography profession in KZN was highlighted as being stressful, having great social isolation (negative psychosocial effect) and being a difficult career to study due to the stressful academic clinical and theoretical components that are not found in other professions that radiographers have opted for. Other occupational risk factors identified were radiation hazards, a high risk of contact with nosocomial infections, and a lack of adequate remuneration. It has been shown that a high workload and job dissatisfaction tend to trigger negative psychosocial effects (Vosper et al., 2005). Radiographers have been found to experience high stress and anxiety levels due to long working hours, operating heavy equipment that produces harmful radiation, and dealing with ill and stressed patients. It has been found that demanding work schedules and call-outs at unsociable hours are additional to the normal clinical stressors in radiography (Rutter & Lovegrove, 2008; Ugwu et al., 2007). These conditions expose the radiographer to extreme fatigue and the risk of infertility due to the harmful effects of accumulated radiation (Kiah & Stueve, 2012).

There is a need to enhance the image of the profession through improved working hours that will reduce social isolation and exposure to the harmful effects of accumulated radiation. Job satisfaction may motivate radiographers to remain in the country instead of seeking these skills in other countries. This could assist in decreasing the occupation-related risk factors that result in a negative image of the radiography profession.
4.3 Hours worked
A high number [36.4% (n=69)] of radiographers who were working in KZN had worked more than 60 hours per week, whereas the radiographers who had left the profession and some of those who were working in KZN had only worked up to 60 hours (Figure 1). Radiographers working in KZN felt that they were compelled to work long hours due to the critical staff shortages. Employees should ideally not be required to work longer than the scheduled shift, especially in the medical field, as they are required to make important decisions that impact on patients' lives (Naicker et al., 2009). The Amended Basic Conditions of Employment Act, 1997 (Basic Conditions of Employment Act No.11 of 2002) states that normally no employer should expect an employee to work more than 45 hours per week or more than eight hours in any one day if the employee works more than five days a week. For shift workers such as radiographers, however, the employer should not permit or require an employee to work more than ten hours overtime in a week, or twelve hours in a day (Department of Labour South Africa, 2004). However, the majority of the radiographers in this study claimed to be working between 41 and 60 hours per week, while others indicated that they worked more than 60 hours per week. It is very possible however, that some of the radiographers who were working in KZN could have worked consecutive night duties (12 hours per shift) which is a known and common practice in some institutions.

The nature of radiography requires that radiographers work long hours, which is a source of occupational stress (Mark & Smith, 2012). These extended working hours could cause radiographers to experience extreme fatigue and exhaustion, resulting in dissatisfaction with their jobs. Low job satisfaction is strongly related to stress which can cause psychosocial effects, such as medical unfitness, general unhappiness, anxiety, excessive alcohol intake, divorce and even suicide (Ugwu et al., 2008). The high stress levels in KZN radiography departments could be related to the extended time spent on duty, resulting in dissatisfaction, fatigue, low productivity and poor quality service delivery.

4.4 Physical symptoms associated with daily work activities in radiography
Radiography is known to be a physically demanding profession that requires strength and places great physical stress on the body. Radiographers are required to move patients across beds, position them, carry heavy image receptors and operate large, heavy equipment. The profession also involves ethical dilemmas, frequent interruptions by other departmental staff members as well as dealing with angry patients (Mark & Smith, 2012). This places great psychological stress on radiographers and could result in stress-related illness.

Occupation-related risk factors were high among radiographers who were working in KZN (35.9% had lower back pain, 20.8% had neck spasm, and 8.2% had knee pain). Similarly, headaches (43.8%) were common among radiographers who had emigrated (Figure 2). It is evident that the physical effects experienced by the KZN radiographers occurred mostly at pressure points, such as the knees, lower back, feet and hands. Constant stress and strain of the upper back, such as on the trapezius, rhomboids major and minor, levator scapula and some scalenei muscles, could be caused by the perpetual manipulation of heavy imaging equipment (Vosper et al., 2005). Similarly, the action of repeated lifting of patients onto the examination table could be associated with stress on
the weight-bearing points of the body, such as the lower back and knees (Vosper et al., 2005). Increased stress at the pressure points (knees, feet and lower back) could indicate an increased workload among radiographers working in KZN (Ugwu et al., 2008). Body mechanics is a term relating to the correct body alignment, movement and body balance during the movement of patients and lifting of heavy objects, which minimises the chances of injury at place of work (Ehrlich & Coakes, 2017). For example, bending and twisting the back while lifting a weight is a common cause of back pain due to incorrect body mechanics (Ehrlich & Coakes, 2017). The same authors advise radiographers to work at a comfortable height when lifting a weight and to do this by bending the knees, keeping the back straight, and maintaining the correct posture. Radiographers should avoid lifting heavy weights where possible, and should rather roll or push where possible (Ugwu et al., 2007). The pain in the knees, lower back, feet and hands could be exacerbated by poor body mechanics, high workload and prolonged working hours. These effects could be reduced if the radiographers use appropriate accessories provided in the examination rooms when moving patients, apply the correct lifting techniques that they are taught in their training and call for assistance when dealing with large patients.

The psychosocial effects resulting from stress are recognised as some of the major health hazards of the century and present as diverse conditions, such as psychosomatic diseases and behaviour changes (Ugwu et al., 2008). It could be deduced that the stress mentioned by radiographers working in the KZN radiography departments may be contributing to psychosomatic diseases, which in turn negatively impact on productivity and wellbeing.

It is noted that the factors associated with radiographers who emigrated and those who left the profession were also prevalent amongst radiographers that were working in KwaZulu Natal. Working more than forty hours in week, calls at unsocial hours, radiation hazards, headache and lower back pain were factors that were found to be common across the three groups of participants and should be addressed to limit further staff shortages. Further research is suggested to analyse the current state in the radiography profession with a specific focus on the negative perceptions identified in this study.

5 Limitations of the study

Accessibility to a larger sample size of emigrants was found to be a limitation in this study. The researcher relied on the contacts that the university, colleagues, provided to contact radiographers that had emigrated. Some of the emails sent were undelivered, possibly due to changed contact details that were not updated at HPCSA. Additionally, this research was conducted in KZN and therefore the findings may only be generalised to this province. A study using a larger sample size from a greater geographic area is suggested. The nature of the data collection tool used may have led to some subjectivity depending on the emotional state of mind of the respondents at that time. A repeat study in KZN may yield different results if the occupational challenges in the province are thought to have changed or deteriorated since the original data was collected.
6 Conclusion

Occupational risk factors such as prolonged working hours and heavy workloads, are evident amongst radiographers working in the KZN province and could have resulted in symptoms such as neck spasm and painful knees. These could very likely have been precipitated by understaffing and compromised working conditions. This needs urgent attention in order to reduce migration resulting from the effects of occupational risk factors. It is imperative to implement strategies to address the extent and severity of the migration of radiographers. Budgets and resources need to be prioritised to improve the overall working conditions in radiography departments, especially those in the public-sector. A similar study may be conducted in other healthcare professions as migration is not limited only to the radiography profession, but others as well (Naicker et al., 2009), which ultimately impacts on the quality of the holistic service received by patients. Scientific data can be used to motivate for change and this study thus hopes to initiate some change in the radiography profession in KZN.

7 Recommendations

The following recommendations should be considered in light of the findings of this research:

- The introduction of employee assistance programmes relating to health education regarding coping strategies such as physical exercise, time management, work schedule management and social interaction at the workplace.

- A health and safety officer should be appointed/contracted in each department to regularly evaluate the employees’ safety and wellbeing and implement interventions by means of relevant employee assistance programmes, such as counselling services.

- Radiographers’ voices need to be heard through effective dialogue at a departmental level with their heads/managers. A reporting system could be introduced where radiographers submit their challenges in writing (into a locked ballot-type box) and then meet regularly with senior staff to discuss possible solutions which can be communicated to the institution’s management for consideration in the strategic plans.

- Education institutions need to target males in the marketing and recruitment strategies for their radiography training programmes.

Conflict of interest

The authors declare no conflict of interest
References


APPENDIX 1
QUESTIONNAIRE

Instruction:
- This questionnaire must be completed by radiographers working in private and government hospitals and those who had emigrated but had worked at KwaZulu Natal Province in South Africa.
- Fill in the blank spaces and/or place a circle around the number/letter of the most appropriate answer/s.

Section A
1. State your gender? A) Male B) Female
2. State is your age? ..........................................
3. Have you ever worked in a KZN public hospital? A) Yes B) No
4. Have you ever worked in a KZN private practice? A) Yes B) No
5. Did you ever leave the public hospital to work in private? A) Yes B) NO

Section B
6. Did you meet your expectations in your radiography profession? A) Yes B) No
7. How would you compare the following profession impression between radiography and other professions you aspire to switch to? (you may choose more than one answer).
   a) Radiography has higher stress conditions.
   b) There are radiation hazards.
   c) Radiography has a higher workload.
   d) Call is at odd/unsociable times.
   e) It is expensive to open a private radiography practice.
   f) Radiography has a high dependency on other professions like radiologists to give reports
   g) There is more social isolation in radiography.
   h) Other (be specific) ..........................................
8. Do you often have to work overtime to complete your work? A) Yes B) No
9. How many hours do you work in a week? .....................
10. If you are dissatisfied with your current job, what are the reasons? (You may select more than one answer).
   a) Pay is discouraging
   b) Radiation hazard
   c) High stress levels at work
   d) Night calls and working weekends
   e) Poor teamwork
   f) Demoralisation from the peer in other professions
   g) Others (specify) ..........................................
11. Which of these symptoms (if any) do you experience and would associate with your work routine? (You may select more than one answer.) a) Headache
    b) Lower back pain
    c) Neck pain Spasm
    d) Knee pain
    e) Others (specify) ..........................................

Thank you for taking the time to complete this questionnaire. Your input is very valuable.
Field observation

An observational examination of houses built under the “Breaking New Ground” housing policy of South Africa

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Abstract

The aim of the study was to examine the physical condition of houses built under the “Breaking New Ground” scheme and the environment that surround the residential areas. The Breaking New Ground housing plan seeks to provide housing to low-income groups in South Africa. The housing structures were examined in accordance with the “Breaking New Ground” housing policy, the Constitution of South Africa and the Freedom Charter. The study was qualitative in nature and an observational method was used to collect data. The study examined the physical condition of 45 housing units and their surroundings. The observational examination indicated that most of the residential units had structural defects and the environment was not conducive to the promotion of health and wellbeing among housing beneficiaries and their families. The design and aesthetic appeal of the houses was distorted by poor workmanship as they presented with inherent flaws. It was observed that the location of some of the housing clusters was isolated and far from places of work and the transport network was not efficient. Recommendations include improved quality control, aesthetic appeal and durability of housing units constructed under the Breaking New Ground housing scheme in South Africa.

Keywords: Low-cost housing, observation, breaking new ground, South Africa

1 Introduction

The housing shortage in South Africa is a problem that is difficult to resolve as the demand for houses exceeds supply. Research focusing on assessment of the quality of low-income residential schemes is needed in South Africa. Studies on location of housing schemes and amenities available to people who occupy new houses are essential in assisting housing policy makers and developers in South Africa. The constitution of South Africa states that everyone has the right to have access to adequate shelter (Constitution of South Africa, 1996). The demand for housing is high but the provision of housing by municipal authorities cannot cope with the demand. It is commonplace for workers in urban areas to devise informal means of providing shelter
for themselves. Informal settlements spring up when workers build tin structures on municipal land on the periphery of towns and cities without permission (Goebel, 2007). Municipal authorities and government jointly devise plans to provide sustainable low-cost housing. Statutory instruments are put in place to facilitate the development of housing projects to alleviate the accommodation shortage in towns and cities. One such statutory instrument is the Comprehensive Plan for Sustainable Human Settlement which is commonly referred to as the “Breaking New Ground” (BNG) housing plan (Department of Human Settlements, 2004). The housing plan seeks to provide quality and affordable housing to low-income earners (Department of Human Settlements, 2004). However, some of the houses might have housing quality problems relating to the aesthetic appeal, durability, space design and utilisation, and the location of residential areas might not be conducive to the needs of workers or community members.

1.1 Poor housing quality and associated health problems

Housing developers and construction companies are expected to construct standard houses in physical environments that are not polluted or marginalised in order to promote health and wellbeing of occupants. The quality of a house is associated with the health and subjective wellbeing of its occupants (Nicola, Bravo, & Sarmiento, 2018). Poorly constructed houses present health challenges to occupants. The physical environment in which the houses are constructed may cause health and safety problems. It implies that individuals living in dilapidated buildings or unhealthy buildings are prone to developing health problems and their subjective wellbeing is more likely to be low (Baker, Lester, Bentley& Beer, 2016). Occupants of defective houses may present with health complaints such as nausea, dizziness, headaches, eye problems, nose or throat irritation, skin itching, dry cough, fatigue, hoarseness of voice, sensitivity to odours, difficulty in concentration or the development of allergies, (Joshi, 2008). Other building-related ailments include cough, chest pain, shortness of breath, nosebleed, cancers, pregnancy problems such as miscarriages, humidifier fever caused by inhaling droplets of water heavily contaminated with microorganisms that cause respiratory complications, asthma and extrinsic allergic alveolitis (Joshi, 2008). Biological contaminants of buildings include bacteria, fungus and moulds and these develop from poor design of buildings or lack of maintenance. Poor waterproofing installation and poor moisture content check affect ceilings, walls, floors and roofs (Othman, Jaafar, Harun, & Ibrahim, 2015). The contaminants breed in stagnant water that accumulates in drainpipes, ducts, ceiling and carpets (Joshi, 2008). Biological contamination caused by sludge in water tanks emits odour in the house and wastewater treatment emits an unpleasant smell in the house and surrounding areas (Liu, Yang, Li, & Zhang, 2017). Ventilation reduces health complaints associated with buildings such as sensation of dryness of mouth and throat, difficulties in thinking clearly and it improves air quality, freshness of air, task performance and occupants generally feel better (Wargocki, Wyon, Sundell, Clausen, & Fanger, 2000). Chemical pollutants such as dust, concentrations of lead, polychlorinated biphenyls, organochlorine insecticides, and polycyclic aromatic hydrocarbons are correlated with the age of the house (Whitehead et al., 2015). Health ailments reported by occupants of new buildings could be caused by poor design of the buildings, prevailing environmental diseases in the area or structural failure threat.
Homeowners who are house-proud are happy to invite guests to their houses. Housing beneficiaries would be expected to like their houses and regard them as home. They would speak well of their houses and would be satisfied with the condition of their houses. Home owners make their properties look beautiful and plant flowers to adorn them. In as much as there is human-computer interaction, human-machine interaction, there is human-building interaction which is a subjective interactive experience between a house owner and the property. Human-building interaction (HBI) is enhanced through the construction of comfortable houses that adapt to the needs of occupants and the houses are decorated to improve quality of life (Langevin, Wen, & Gurian, 2015). The aesthetic appeal of a house builds a bond between the housing beneficiary and the property. The aesthetic appeal is enhanced through landscape design to accommodate gardens, lawns, shrubs, fruit trees, and keeping the environment surrounding the residential area clean. Having a house lawn is regarded as an essential element by homeowners without even quantifying the symbolic, ecological or aesthetic significance of the lawn (Ignatieva, Eriksson, Eriksson, Berg, & Hedblom, 2017). Housing quality is associated with improvement in quality of life, general happiness and improved housing tenure (Henwood, Matejkowski, Stefancic, & Lukens, 2014).

1.2 Housing durability

Low-cost housing projects are constructed by contractors who are paid by government. In most cases, the materials used to build low-cost housing are cheap to keep the prices of houses low and affordable. Consequently, the houses built with cheap materials are not durable and sustainable (Olotuah and Taiwo, 2013). The houses are designed for low-income groups without financial resources to buy houses on the open market. The cost of building the house should be lower than the amount paid by government to the contractor for the project to be economically viable. Poor workmanship causes housing failure (Marshall, Worthing, & Heath, 2014). New housing schemes could show defects related to foundation failure, poor structural design, sagging roofs or sinking foundations due to the movement or warping of the subsoil under pressure (Marshall et al., 2014). In South Africa, it is not uncommon to find recently constructed structures collapsing in a storm or showing defects that make the house unsafe for human habitation (Lindeque, 2017). Some of the badly constructed houses leak during the rainy season while others have failing ceilings, loose floor tiles and breaking floors. Cracks that develop in new houses are a result of inadequate artisan skills that threaten the lifespan of a house (Buys & le Roux, 2013). Urban decay is caused by fast collapsing building structures resulting in abandoned buildings. The market value of a defective house depreciates, thus contributing towards urban decay and decline in economic value of residential investment (Ismail, Che-Ani, Tawil, & Yahaya, 2014). In South Africa, some of the low-cost houses are left incomplete and housing beneficiaries would have to look for builders they pay to complete some aspects of the houses left incomplete by the contractors (Damba-Hendrik, 2017). Beneficiaries of deformed houses could sell or move out of the houses. The houses might be rented out to tenants who might pay rent that is below market value or the monthly premium required by the bank or municipality as the cost of living in the house (Charlton & Meth, 2017).

Accountability among building contractors during the construction of low-cost housing could be deemed low, due to the lack of skilled inspectors to assess compliance and professionalism of the contractors (Estate Agency Affairs Board of South Africa, 2017).
Othman & Mydin (2014) posit that 90% of building failures occur due to problems that are encountered at the design and construction stages. Contractors might not adhere to building standards and they might use unqualified personnel to construct the houses. Typical problems that could cause building failure include, among others: poor communication between architects and builders, inadequate information provided to bricklayers, failure to check the requisite information on housing standards to be followed, inadequate checks and controls, lack of technical expertise, lack of skills and inadequate feedback resulting in recurring errors (Othman & Mydin, 2014). In South Africa, there is poor housing delivery partly due to the shortage of housing construction specialists and engineers, and there is also a shortage of inspectors in the construction industry to supervise housing development projects (Jones, 2018).

1.3 Housing space standards
Housing space standards are followed when contractors build low-cost houses. The housing standards for a BNG house in South Africa are: the house should be 40m$^2$, and it should have two bedrooms, a separate bathroom with a toilet, shower, and hand basin, a combined living area, a kitchen with a wash basin and a ready-board electrical installation where electricity is available in the residential area (Langeberg Municipality, 2015). The internal and external standards are adhered to when low-cost houses are constructed. Municipalities and financial institutions investing in the housing project check for housing space standards compliance to ensure sustainable housing development. Housing space standards vary according to income levels from one country to the other (Gallent, Madeddu, and Mace, 2010). Low-cost housing has reduced living and sleeping space. Limited internal space accommodates small family sizes. In South Africa, overcrowding is a common feature among low-income communities as a large number of people without shelter squeeze into the limited housing space available (Govender, Barnes, & Pieper, 2011). Housing external space is congested in South Africa when unapproved backyard shacks are built or outbuildings are erected on the premises (Govender et al., 2011).

1.4 Location of residential areas
Many new housing schemes are located out of the central business district (CBD) on the periphery of towns and cities. Workers who are beneficiaries of the new houses are exposed to crime, unreliable transport system and environmental pollution (Meth & Buthelezi, 2017). New homeowners in South Africa complain of poor transport network, lack of amenities such as schools, clinics, roads and shopping malls (Lemanski, 2010). Some of the housing schemes are closer to informal settlements where crime rate is high and the environment is generally polluted (Meth, 2017). Garbage is not dumped in designated areas in some places. Sanitation is poor with reference to the provision of clean water, piped water and sewerage systems. Some of the residents fetch water from rivers, bath or wash clothes in rivers. Consequently, the rivers and dams near residential areas are heavily polluted (Cox, 2012). The chaotic movement of people from informal settlements to new residential areas exposes residents to crime, veld fires and health risks. Residents who move from informal settlements to take up ownership of the new houses might engage in violent behaviour or related undesirable behaviours that typically occur in crowded places and high-density residential areas (Meth, 2017). Some residential areas might not have access to reliable electricity supply; it might be dark at night, thus compromising the safety of
residents at night. Some of the housing clusters are located on abandoned farms without reliable piped water supply or reliable communication network such as having a landline, information and communication technology facilities (ICT), internet reception or reliable mobile phone reception (Sithole et al., 2013).

1.5 Background summary

Poorly built houses present many challenges to occupants, which is why it is necessary to make these observations and identify common issues in the BNG project. It is apparent in this background survey of literature that low-quality houses may be hurriedly constructed and inhabitants are at risk of experiencing difficulties living in defective housing structures. Studies of this nature are needed in South Africa to shed more light on the plight of beneficiaries of new housing projects. Decision markers or policy makers in the housing sector need to reconsider issues of quality and safety in housing provision for low-income groups in South Africa.

The study observed the physical condition of low-cost houses built under the BNG housing scheme in South Africa. The observational examination focused on the appearance of the houses and potential health and safety risks posed by defective houses and the environmental condition. There are few observational studies on housing quality conducted in South Africa hence this study provides an insight into the quality of low-cost houses constructed in South Africa. The research question focused on the observable physical condition of the housing structures, the environment in which the houses were built and implications on health and safety of communities.

It is posited that if these aspects of housing standards are not achieved in the BNG housing scheme, there could be negative implications for those who take ownership of the houses such as exposure to unhygienic conditions, lack of access to social amenities and diminished well-being of the housing occupants.

2 Method

2.1 Research design

An observational approach was used to assess the physical and environmental conditions of the houses built under the BNG housing scheme. Observational methodologies including the use of observational diaries are essential in infrastructural assessment research (Mayo, 2010).

2.2 Sampling procedure

Purposive sampling was used to identify housing clusters built under the BNG housing scheme. The housing sampling in each of the three clusters was demarcated according to streets. A total of 45 houses were observed, 15 in Springfontein, Free State Province, 15 in Joe Slovo, Eastern Cape Province, and 15 in Plettenberg Bay, Western Cape Province.

2.3 Instrument

An observational examination checklist was developed for the purpose of this study. The BNG housing plan provides guidelines on the nature of houses to be constructed. The BNG housing standards that formed the observational examination checklist were:
\`the BNG house is 40 m\textsuperscript{2} in size with two bedrooms; a separate bathroom with a toilet, shower and hand basin; a combined living area and kitchen with wash basin; and a ready-board electrical installation where electricity supply is available in the township to qualifying households earning less than R3 500 a month\` (Langeberg Municipality, 2015). The checklist indicated the requirements that housing contractors were required to follow during the construction of the houses. In addition, in order to assess the physical condition of the houses, the observational examination checklist included the physical appearance and condition of the veranda, roof, ceiling, walls, plastering, painting, floors, plumbing and water system, windows, ventilation system, electrical connections, doors, lawns and pavements. The checklist included the location of social amenities, shopping malls, road networks and condition of the physical environment.

An observational diary developed for the purpose of this study was used to record notes about the observed physical condition of the houses and environmental condition of the residential areas. The observation included the aesthetic appeal of the houses. Aesthetic appeal is a subjective assessment of the beauty of a house. This included the subjective assessment of the physical attractiveness of the housing units in such a way that would make the housing beneficiaries like their properties, get attracted to their properties and develop an attachment to their houses and residential environment. The data collected on the physical condition of the houses and environmental condition were used to make subjective inferences about potential health and safety risks. An observational diary is a case-based approach that helps to stimulate analytical and creating thinking by maintaining an ongoing record of the activities and time spent observing real life situations (Mayo, 2010).

2.4 Procedure
Permission to observe the physical condition of the houses was given by house owners or occupants. The purpose of the study was explained to house owners or tenants. The observational examination checklist was used to assess the physical condition of the houses and the environment surrounding the residential cluster. The physical examination involved getting into the yard, entering the house and observing the inside space and outside area of the house. Aesthetic appeal was part of the observational criteria used to assess housing attractiveness and quality.

2.5 Data analysis
Thematic analysis was used to analyse observational data collected. The thematic areas that were derived from the observational checklist were analysed in relation to housing quality and safety. The method allowed the researcher to identify main physical and environmental conditions that affected the new housing units. The triangulation method was used to validate themes that were based on the observational checklist. Triangulation is used in data analysis to validate findings from various angles or perspectives.

2.6 Ethical considerations
Ethical clearance was obtained from Nelson Mandela University before data collection. The privacy of occupants was guaranteed and occupants were informed that the physical examination of the inside and outside areas of their houses could be intrusive and they had to prepare and make their houses ready for the observational examination.
3 Results

The results are presented in relation to the thematic areas that were contained in the checklist. The themes are: housing structure appearance, potential health and safety hazards, transport network, public amenities, recreational facilities and environmental conduciveness presented in Table 1. The housing clusters presented as case studies were drawn from Springfontein in the Free State, Plettenberg Bay in the Western Cape and Joe Slovo in the Eastern Cape.

The condition of the houses in Case Study 1 may have presented health and safety hazards as shown in Table 1. It was observed that the houses did not have enough space for occupants. A two-bedroom house is not enough to accommodate children and relatives. It was observed that the standard house according to the BNG housing plan is not sensitive to the gender of children and the need for separate rooms for boys and girls. It was observed that most of the houses had no ceiling and there was dust collecting through the roof. There was evidence of dust within house which may place occupants at risk of respiratory diseases. It was observed that dusty and noisy surroundings affected house occupants as they were forced to clean the rooms and windows often. The houses had no veranda and there was no shade outside to protect housing occupants from the sun. It was observed that some of the houses had no security fence and that may have made house occupants vulnerable to burglary. It was observed that the free movement of people and animals through the yard may have exposed housing occupants to theft of household belongings and communicable diseases.

It was observed that houses in this area had damp walls causing moisture-laden air to build up inside the house. Damp houses cause breathing difficulties. Dampness is associated with diseases such as dysentery, diarrhoea, pneumonia, or cholera. It was noted that moisture in the wall caused the paint to peel off. It was noted that poor quality paint peeled off easily. It was observed that the appearance of the houses in this area was marred by damp walls and rough walls with peeling off paint. The bad smell emanating from the damp painted walls presents a variety of risks to housing occupants, including sick building syndrome. It was noted that social amenities and commercial opportunities were needed in the area in compliance with the BNG housing policy and to improve the wellbeing of residents.

The housing structural defects observed may present a health and safety threat to the occupants. It was observed that housing defects affected the aesthetic appeal of the houses. Environmental pollution affected the aesthetic appeal of the landscape. It was observed that poorly constructed roofs could collapse or the houses could collapse under stress. Poorly fitted electrical connections may have posed a fire hazard. It was observed that the backyard shacks could cause hazards such as fire outbreaks that could engulf a number of backyard shacks and the unhygienic environment could lead to the outbreak of diseases such as typhoid, dysentery or cholera in the housing cluster. Unsurfaced roads may expose residents to dust-related diseases. It was observed that the poor road network made it difficult for workers to commute to work during peak hours. It was observed that the presence of slums or informal settlements near the new residential area exposed homeowners to crime, environmental pollution and communicable diseases.
Table 1. Case study 1: Condition of housing structures and the surrounding environment.

<table>
<thead>
<tr>
<th>Housing aspects</th>
<th>Observation</th>
</tr>
</thead>
</table>
| 1. Housing structure and appearance | Each house consisted of two bedrooms; a lounge; kitchen; passage, and toilet.  
It was noted that the houses were built between 2010 and 2014.  
The houses were constructed using face-brick walls with internal plastering and roofed with zinc sheets.  
The windows, doors and floors still appeared in good condition.  
The houses had no internal ceiling or veranda.  
It was observed that most of the houses had outbuildings or backyard structures to accommodate the extended family or tenants.  
Most of the houses had no perimeter fencing. |
| 2. Transport network             | It was observed that the housing development is approximately 120 kilometres (km) outside of Bloemfontein, Free State, and 4km from the nearest town.  
It was observed that most of the residents used public transport such as minibuses or taxis owned by private associations.  
It was observed that there were no surfaced roads and pavements in the area.  
It was observed that the unsurfaced roads and pavements raised dust during the dry periods.  
It was noted that water puddles and mud formed in wet conditions. |
| 3. Public amenities               | It was observed that places of work, schools and clinics were within reach but there was no hospital.  
Residents are required to travel to other towns including Bloemfontein City to access hospitals.  
The emergency response provided by the municipal authority is 70 km away. |
| 4. Recreational facilities        | There were a few fenced sports grounds. It was observed that the sports grounds were dry and not watered often.  
There were very limited grassed areas or lawns, mostly scorched by the sun.  
There were no parks in the area for residents’ recreation.  
There were no cinemas as part of social amenities in the residential area or town. |
| 5. Environment and people         | Driving into the central business district (CBD) to access the housing project was problematic as the researcher struggled to distinguish if the township was separated from the CBD due to the haphazard movement of people, land use plan, location of buildings and congestion of living and business spaces.  
It was observed that the residential area was overcrowded. |
### Table 2. Case study 2: Housing condition and the environment

<table>
<thead>
<tr>
<th>Housing aspects</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Housing structure appearance</strong></td>
<td>Houses in this project consist of two bedrooms, a lounge, separate kitchen, passage and toilet with a shower. They have roof tiles and a fully fitted ceiling. The windows are made of aluminium. It was observed in most houses that the walls were damp and paint was flaking off. It was observed that the housing structures did not conform to the National Home Builders Registration Council (NHBRC) standards regarding low-cost houses as dampness is one of the reasons for which housing structures are condemned and demolished before they are completed. It was observed that the houses were not adequately damp-proofed to prevent walls from absorbing water. It was observed that dampness affected the aesthetic appeal of the houses. It was observed that damp walls emitted an unpleasant smell that affected housing occupants. It was noted that most of the houses were completed in 2010 and early 2011. Most of the houses in this area were fenced.</td>
</tr>
<tr>
<td><strong>2. Transport network</strong></td>
<td>The residential area is located adjacent to the N2 highway. The housing cluster is not close to the central business district (CBD). Shops and major shopping malls are far away. It was observed that the location of the housing cluster was not in conformity with the BNG housing policy and the Freedom Charter which stipulate that new housing developments must be close to social amenities. It was observed that roads in this area were surfaced.</td>
</tr>
<tr>
<td><strong>3. Public amenities</strong></td>
<td>It was observed that there were no social amenities in the area, residents had to go to other towns for services. There were no places of work in the area, residents had to go to other towns for work which contradicts the BNG policy.</td>
</tr>
<tr>
<td><strong>4. Recreational facilities</strong></td>
<td>There were no recreational facilities in the area.</td>
</tr>
<tr>
<td><strong>5. Environment and people</strong></td>
<td>It was noted that most of the houses had floor tiles and they had modern kitchens.</td>
</tr>
</tbody>
</table>
Table 3. Case study 3: Housing condition and the environment

<table>
<thead>
<tr>
<th>Housing aspects</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Housing structure appearance</td>
<td>The houses have two bedrooms.</td>
</tr>
<tr>
<td></td>
<td>The houses have roof tiles.</td>
</tr>
<tr>
<td></td>
<td>It was observed that the walls of some of the houses were not plastered.</td>
</tr>
<tr>
<td></td>
<td>The inside partitioning walls were poorly built.</td>
</tr>
<tr>
<td></td>
<td>It was observed that the houses were in a bad condition and the finishing was poor.</td>
</tr>
<tr>
<td></td>
<td>All the houses had a fitted ceiling and veranda</td>
</tr>
<tr>
<td></td>
<td>It was observed that criss-crossing electrical wires were not properly connected to the main electric box to rooms, outbuildings and appliances, such as stoves, fridges and entertainment gadgets.</td>
</tr>
<tr>
<td></td>
<td>In some houses, furniture was crammed in the lounge.</td>
</tr>
<tr>
<td></td>
<td>It was observed in most houses that there was hardly any space to move due to the small size of the lounge.</td>
</tr>
<tr>
<td></td>
<td>It was observed that the walls had cracks in some of the houses.</td>
</tr>
<tr>
<td></td>
<td>It was observed that some of the houses had backyard shacks.</td>
</tr>
<tr>
<td>2. Transport network</td>
<td>The roads were not surfaced and cars drove slowly due to potholes on the rough gravel roads.</td>
</tr>
<tr>
<td>3. Public amenities</td>
<td>There were no schools in the area.</td>
</tr>
<tr>
<td></td>
<td>The housing project was located close to a shopping mall with banks, shops, and fast food outlets.</td>
</tr>
<tr>
<td>4. Recreational facilities</td>
<td>There were no recreational facilities in the area</td>
</tr>
<tr>
<td>5. Environment and people</td>
<td>Black marks of burnt tyres were observed on the roads and half burnt tyres and posters with messages about housing demands were strewn on the streets.</td>
</tr>
<tr>
<td></td>
<td>It was observed that protesters made the roads and streets dirty.</td>
</tr>
<tr>
<td></td>
<td>It was noted on posters that residents took to the streets demanding houses for their dependents and adult children.</td>
</tr>
<tr>
<td></td>
<td>Rocks were put on the roof of shacks to support shaky roofs against heavy winds and thunder storms.</td>
</tr>
<tr>
<td></td>
<td>Tools, equipment and broken furniture were kept on the roof in congested houses and backyard shacks.</td>
</tr>
<tr>
<td></td>
<td>It was observed that various unconventional or unapproved objects and materials were used to repair leaking roofs.</td>
</tr>
<tr>
<td></td>
<td>It was observed that adult children lived in the backyard shacks.</td>
</tr>
<tr>
<td></td>
<td>It was observed that informal settlements or slums in the surrounding environment were not demolished as opposed to the provisions of the BNG policy and Freedom Charter.</td>
</tr>
<tr>
<td></td>
<td>It was noted that as government built the low-cost houses to end informal settlements, more shacks and other illegal structures were constructed on the premises to accommodate more occupants without shelter.</td>
</tr>
<tr>
<td></td>
<td>Some of the houses were in a state of disrepair and not renovated.</td>
</tr>
</tbody>
</table>
4 Discussion

The houses that were examined had structural defects that made them less attractive to owners and potential buyers. The aesthetic appeal was marred by the numerous defects and incomplete work noticeable on the housing units. The houses had cracks and some aspects of the houses were left incomplete by the contractors. Affect for the house and the house owner’s health and safety could be affected by faults and substandard finishings (Baker et al., 2016). The defects may have exposed occupants to building-related health complaints such as respiratory diseases or injury incurred in the house (Joshi, 2008). The observational examination of the environment surrounding the residential areas indicated that residents were exposed to health and safety risks (Meth, 2017). Although the BNG housing scheme is a fairly new project since most of the houses under the scheme were constructed between 2010 and 2014, the houses observed were not durable and workmanship was poor. It was observed that some of the houses had major structural faults. The cracks weaken the strength of the houses and some of the houses could collapse and harm occupants in extreme weather conditions such as the occurrence of a violent storm or heavy rains. The results of this study confirm previous findings which indicate that low-cost houses built in South Africa are not strong and they show poor workmanship which compromises occupants’ health and safety (Buys, & le Roux, 2013). Most of the houses observed had cracks and some were not plastered inside. If a housing structure has faults, its life span is bound to be shorter. Durability of a housing structure is considered in collateral assessment for mortgage lending and house pricing. If a house owner loses interest in a defective house, chances are that the owner would invest less in maintaining the house in anticipation that the house could be repossessed or it could be sold to pay off debt (Melzer, 2017). The abandoned house would contribute towards the degeneration and running down of residential areas. A deformed housing structure is a financial liability to the house owner. The BNG housing plan regards housing development as a form of investment for which a return on investment is expected by both the project sponsors and beneficiaries (Department of Human Settlements, 2004). The physical appearance of the houses showed that the houses lacked maintenance. Neglected houses have a low housing occupancy tenure and a high vacancy rate (Henwood et al., 2014).

It was observed in this study that some of the houses had damp walls and flaking paint on walls. The National Home Builders Registration Council (NHBRC) regards dampness as grounds for demolishing new housing structures under construction by building inspectors (Estate Agency Board of South Africa, 2017). House dampness is a health and safety risk associated with the sick building syndrome (Joshi, 2008). Odour, respiratory infections, asthma attacks, allergies or fever are health complaints associated with the sick building syndrome (Joshi, 2008). In this study, houses with damp walls had a bad smell. Ventilation is needed to improve air quality but the housing beneficiaries were a low-income group who could hardly afford to install air-conditioning facilities (Wargocki et al., 2000). It was observed that the rooms were congested as there was no enough space to accommodate belongings. The results were in tandem with previous studies which showed that there was overcrowding in new residential areas for low-income groups (Govender et al., 2011). It was noticed that dust came from inside walls that were not plastered, rough floors, cracks and incomplete ceilings in some of the houses. This indicates that occupants may be vulnerable to
diseases associated with dust such as pneumoconiosis caused by breathing insoluble dust, tuberculosis or dry cough (Brewer, 2013). Criss-crossing electrical wires were observed in some of the houses. Improper or illegal connections to access electricity endanger housing occupants by exposing them to fire hazards or electrocution. The observed improper or illegal connections to access electricity may cause explosions that could destroy the housing structure (Lewis, 2017). It is common in South Africa that housing beneficiaries without enough financial resources to pay for electricity could device illegal and unsafe means to access electricity (Mzini & Lukamba-Muhiya, 2014). Qualified and certified electricians are required to tube or wire the houses and housing units should be inspected for compliance but due to the shortage of qualified electricians, electrical technologists and electrical engineers in South Africa, house owners might not adhere to the housing standards governing the distribution and consumption of electricity. Similarly, improper or illegal connections to access piped water are reported in residential areas in South Africa.

Even though the Freedom Charter of South Africa and the BNG housing policy state that new residential developments should be close to communication networks such as road, rail and telecommunication systems, it was observed that most of the new housing developments have poor communication networks. Infrastructural development in new residential areas lacked sustainable information and communication technology facilities (ICT), residents had to travel to shopping malls and the central business district (CBD) in town for services (Sithole et al., 2013). It was observed that most of the roads were not surfaced and they had potholes. Potholes damage residents’ cars, increase insurance claims and hinder development when investors and service providers shun new residential areas (Zikhali, 2017). Potholes affect road safety as they cause accidents. Potholes are a common feature in residential areas that are poorly serviced in South Africa (Lemanski, 2010; Mbonyane & Ladzani, 2011).

It was observed that public amenities such as hospitals were not available in new residential areas. Ambulance service was poor and centrally located away from the new residential areas. An unreliable ambulance service makes it difficult for communities to access health services. The clinics in the area would not be able to handle complicated injuries or diseases that require referral to hospital. In some places, it was observed that there were no schools or clinics. The findings confirm that the new housing development does not comply with the Freedom Charter and BNG housing policy in some housing clusters. It was observed in this study that public amenities such as hospitals, schools, crèches, playing fields and social centres which should be made available to new residential communities were not consistently provided (Freedom Charter, 2017). The construction of social and economic infrastructure in new residential areas is mandatory according to the BNG housing policy (Department of Human Settlements, 2004).

The provision of recreational facilities is contained in the BNG housing policy. The development of primary municipal facilities such as parks, playgrounds and sport fields is mandatory (Department of Human Settlements, 2004). Recreational facilities help communities to relax and improve mental health and wellbeing (Colman, 2015). In this study, it was observed that sporting fields, grounds, parks, gardens and lawns were
neglected. There was inadequate sentimental attachment to house lawns, parks and gardens among residents and local authorities (Ignatieva et al., 2017).

An observational examination of the surroundings of new residential developments showed that the areas were overcrowded. Some of the houses did not have a fence. New homeowners erected illegal structures in their backyard to accommodate tenants and members of the extended family. The congestion could cause a fire hazard if occupants in the backyard shacks used paraffin stoves and candles due to lack of access to electricity in the main house. It was observed that overcrowding compromised the provision of water and sanitation services in new residential areas (Govender, et al., 2011). Overcrowding is a strain on municipal services as residents get more than what was budgeted for the area. It was also observed that instead of demolishing informal settlements in accordance with the Freedom Charter and BNG housing policy, the informal settlements mushroomed alongside the new residential developments thus compromising government’s ability to provide low-cost housing for the poor.

5 Implications for occupants and policy makers

The implications for house occupants is that due to shortages of low-cost houses in South Africa, housing beneficiaries tend to accept the allocated houses as shelter which is a basic need for humanity with limited alternatives. Allocating poorly built and poorly located low-income houses to the poor has social, health, economic and general constitutional implications for which beneficiaries of the BNG housing plan may seek redress. Housing policy makers and housing administrators should routinely inspect new houses to maintain the health and safety standards as stipulated in the BNG housing policy.

6 Limitations of the study

The limitations of the study are that the observational study did not include the interviewing of house owners. The research design only required the researcher to focus on observational data relating to the physical appearance of the housing units and the surrounding environment. The findings could be subjective as inferences were made in relation to potential housing health and safety risks that could affect occupants. There is no causal link or cause-and-effect relationship between what was observed and events that affected housing occupants. This observational study did not establish a causal relationship between housing quality and health and safety of occupants.

7 Conclusion and recommendations

The provision of low-cost housing is a noble cause for which government, municipal authorities and financial institutions collaborate to achieve the national goal. However, the companies that are contracted to construct the houses tend to maximise profit and neglect housing quality, health and safety. It was evident following the observations in this study, that the main issues across the visited housing clusters observed were poor housing quality and environmental degradation. Contractors might work under pressure to deliver the houses with minimal supervision resulting in beneficiaries incurring costs associated with incomplete work. The poor workmanship increases the cost of maintaining the house and affects the beneficiary’s ability to pay monthly instalments to
the financiers of the housing project. It is posited in this study that the aesthetic appeal, human-building interaction, and health and safety of occupants would be compromised when housing structures develop faults. Future studies could focus on on-site strategies of monitoring health and safety standards in the construction houses and development of landscapes for low-income groups as quality control and quality assurance measures.

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References


An assessment of psychosocial and health risks associated with shift work in a South African manufacturing context

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Abstract

Shift work is a necessity to ensure continuous and optimized operations in different occupational scenarios. However, there are numerous adverse effects associated with working shifts. This study is aimed at evaluating the psychosocial and health risks associated with working shifts in a manufacturing context in South Africa (SA). A cross sectional design using a modified form of the validated Standard Shift Work Index (SSI) questionnaire was used to collect quantitative data. Most participants were considered to be in good health, however they reported health complaints relating to swollen feet, weight gain, loss of appetite and gastrointestinal disorders. In addition, participants reported that their domestic lives were somewhat affected (45%) and their social lives were adversely affected (47%) by working shifts. Shift work experience (11 to 20 years) was also found to be significantly associated with more time for both social (OR = 0.10; 95% CI = 0.03; 0.30) and domestic activities (OR= 0.25; 95% CI = 0.11; 0.57; p < 0.05) compared to those with less experience. This may be attributed to the healthy worker survivor effect; it is likely that shift workers with longer working experience have developed practical coping strategies to mitigate some of the problems related to shift work.

Keywords: Shift work, health effects, psychosocial effects, disorders

1 Introduction

Shift work ensures continuous operations and optimization of production in industry and has significant economic benefit. However, schedules that include shift work and extended hours are often unsuitable for some workers (Ulhoa et al. 2015; Kecklund et al. 2016). According to the most recent European Working Conditions Survey (2015), an estimated 21% of the workforce is involved in shift work.

In South Africa (SA), the Basic Conditions of Employment Act (BCEA), No.75 of 1997 regulates working times and defines shift/night workers as those employees who are required to work before 06:00 or after 23:00 at least five times per month, or 50 times per annum. Approximately 21% of the South African workforces are shift workers with
an estimated 23% of all industries involved in shift work (Adler, 1991; Statistics South Africa, 2012). These industries include the mining, health, petrochemical and manufacturing industries (Visser, 1999). Most recent surveys indicate that approximately 80% of the manufacturing and mining companies use a shift system which would indicate that shift work and working irregular hours are essential to support the South African economy (Sieberhagen et al. 2011). The BCEA definition for shift work will be used for the current study.

Shift work, particularly night shift, has been reported to disrupt the circadian rhythm (James et al. 2017) which refers to the natural internal process that regulates the sleep-wake cycle (Potter et al. 2016). Circadian misalignment results from a mismatch between the internal circadian timing and the signals from the external environment and behaviours (McHill & Wright, 2017). It may also lead to sleep loss and excessive sleepiness during night shift (Smith & Eastman 2012). Shift work requires wakefulness to occur during the night and sleep to occur during the day. Shift workers obtain less sleep during the day because the circadian clock is promoting wakefulness (McHill & Wright, 2017).

A growing body of medical evidence links the circadian disruption with many other health-related and psycho-social impacts on workers (Akerstedt et al. 2002; Knutsson, 2003; Dembe et al. 2006; Williams, 2008). Health effects associated with shift work include a reduction in the quality and quantity of sleep, complaints about fatigue, anxiety, depression, heart related problems, gastrointestinal disorders, increased risk of spontaneous abortion, low birth weight and prematurity (Wong, 2001). Kiviamki et al. (2001) reported that the use of alcohol and cigarettes, reduced physical activity, and increased weight gain were common amongst shift workers. In addition, in June 2019 the International Agency for Research on Cancer classified night shift work as a probable human carcinogen (IARC, 2019). When these factors are combined with sleep deprivation and stress, the immune system is weakened, resulting in increased morbidity (Mullington et al. 2010). Due to irregular working hours, shift workers spend less time with families as they are often too tired to enjoy recreational and social activities, which adversely affects personal relationships and family life (Shu-Yu et al. 2014).

Previous research from developing countries has shown a positive association between shift work and health and psychological effects (Eldevik et al. 2013; Richter et al. 2016). However, there are limited studies evaluating the effects of shift work in the South African manufacturing context. Worker efficiency is directly linked to mechanical systems, with limited flexibility, and requires that the worker remain alert at all times. This study aimed to evaluate the psychosocial and health effects associated with working shifts in a manufacturing context in South Africa.

2 Materials and methods

2.1 Study design

A cross sectional study was conducted from September 2014 to February 2015 in a biscuits manufacturer in KwaZulu-Natal. A convenient sampling approach was used and all consenting permanent shift workers were included. The study was approved by
Durban University of Technology’s Institutional Research Ethics Committee (IERC) and all participants provided written informed consent. Gatekeepers permission was issued by the company under study.

2.2 Study sample

All employees on shift work (n=200) comprising of production operators and supervisors, engineering personnel (including fitters and artisans) and logistics employees (stores controller, forklift drivers) were invited to participate. Individuals were eligible if they were more than 18 years of age and employed on a permanent basis on shift work. Workers fixed on day shift such as executives and administrative staff and contract workers were excluded from the study. The participants worked on a weekly rotating three-crew schedule. They worked twelve hours in a day, six days a week on a cycle of rotation followed by five rest days. Weekends were normally their off days, but employees mostly worked overtime on these days. There was a 30 minutes break during each shift.

A month schedule is as follows:

OONNNNOOODDDDDDDOOOOONNNNNNN

(O = Off work, N = Night shift and D = Day shift.)

2.3 Data Collection

2.3.1 Instrument

The instrument used for data collection was a modified form of the validated Standard Shift Work Index (SSI) questionnaire. The SSI questionnaire is a well-established, self-report instrument, with good psychometric properties that has been used to assess the impact of shift work on the health of the individual (Barton et al. 1995; Tucker & Knowles, 2008). Before the administration of the SSI questionnaire, floor meetings with the supervisors were held to provide information and to encourage participation. Moreover, information flyers written in both English and isiZulu were posted on all communication boards.

The questionnaire consisted of a total of 50 items comprising of the following components: 1) general biographical information; 2) domestic circumstances: marital status, partner’s work pattern and the present shift pattern of the participant; 3) shift details; 4) quantity of sleep and fatigue; 5) health aspects; 6) work performance; 7) psychological aspects; and 8) social aspects. The SSI was modified to meet the company’s requirements; for example, the sleep evaluation category was modified for the company’s 2-shift system instead of 3-shift system. The questions included in the health category focused on cardiovascular and gastrointestinal disorders, both of which have a high incidence among shift workers. Participants rated the frequency of health symptoms using a four-point response option: “almost never”, “quite seldom”, “quite often” and “almost always”. The options were scored 1-4 respectively and a higher score on each scale was associated with poorer physical health. Participants were asked to confirm if they had experienced any of 19 health-related conditions since beginning shift work. These conditions included chronic back pain, gastritis, gastric or duodenal ulcer, gall stones, sinusitis, bronchial asthma, heart attack, high blood pressure,
hypercholesterolaemia, diabetes, kidney stones, cystitis, depression, eczema, arthritis, haemorrhoids, varicose veins, anaemia and headaches. The effect of shift work on social and domestic activities was included. Participants were asked if they were satisfied with the amount of time spent on social and domestic activities using a three-point response option: “not at all”, “somewhat” and “very much”. Participants manually completed questionnaires during their spare time but within office hours. Once completed, they were given back to supervisors.

2.4 Statistical Analysis
STATA version 12 (Statacorp) was used for data analysis. Frequency distributions of categorical variables and summary statistics of continuous variables were calculated. The SSI analysis scale developed by Barton et al. (1995) was used. The “physical health” variable was determined using two subscales, measuring cardiovascular and gastrointestinal disorders, both known to have a high incidence in shift workers; and 2 general screening questions were included concerning diseases suffered and medicine consumption since starting shift work. Participants were asked to indicate on a yes/no response option whether they had experienced any of the listed diseases, or had regularly taken any of the listed medications since beginning shift work. Responses were scored accordingly to the SSI and a higher score was associated with poorer physical health. Frequency tables and graphs were used to represent univariate and bivariate variables. Bivariate associations between categorical variables were done using the Pearson’s Chi-squared test and Fischer’s Exact test where applicable. Multivariate regression modelling was done using a backward stepwise method with the inclusion of relevant covariates. Odds ratios and 95% CI were calculated and p values < 0.05 were considered statistically significant.

3 Results
Demographic characteristics of the study population are presented in Table 1. The response rate was 76% (156/200), however, 7 participants were excluded due to incomplete answers. The total sample (N=149) comprised 87 males (54%) and 62 women (46%) with 78 (52%) of participants between the ages of 20-30 years old. Very few employees over the age of 41 worked shifts. There were more males than females employed as operators, general workers and supervisors.
Table 1. Demographic characteristics of the study population stratified by gender (N= 149)

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
<th>Male (n %)</th>
<th>Female (n %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td>78 (52)</td>
<td>42 (54)</td>
<td>36 (46)</td>
</tr>
<tr>
<td>31-40</td>
<td>53 (36)</td>
<td>32 (60)</td>
<td>21 (40)</td>
</tr>
<tr>
<td>41-50</td>
<td>13 (9)</td>
<td>8 (62)</td>
<td>5 (38)</td>
</tr>
<tr>
<td>51-60</td>
<td>5 (3)</td>
<td>5 (100)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Civil Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/Living with partner</td>
<td>49 (33)</td>
<td>31 (63)</td>
<td>18 (37)</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>5 (3)</td>
<td>2 (40)</td>
<td>3 (60)</td>
</tr>
<tr>
<td>Widowed</td>
<td>3 (2)</td>
<td>2 (67)</td>
<td>1 (33)</td>
</tr>
<tr>
<td>Single</td>
<td>92 (62)</td>
<td>52 (57)</td>
<td>40 (43)</td>
</tr>
<tr>
<td>Job Class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator</td>
<td>72 (48)</td>
<td>46 (64)</td>
<td>26 (36)</td>
</tr>
<tr>
<td>General Worker</td>
<td>56 (38)</td>
<td>25 (45)</td>
<td>31 (55)</td>
</tr>
<tr>
<td>Supervisor</td>
<td>10 (7)</td>
<td>9 (90)</td>
<td>1 (10)</td>
</tr>
<tr>
<td>Manager</td>
<td>3 (2)</td>
<td>2 (67)</td>
<td>1 (33)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (5)</td>
<td>4 (50)</td>
<td>4 (50)</td>
</tr>
</tbody>
</table>

Almost 73% (109/149) of participants worked rotational shift work with nights and 33% (50/149) had been working shifts for over 10 years (Table 2). About 60% (71/119) of workers reported working 1 to 5 hours of paid overtime per week, and 17% (20/119) estimated working 17 to 20 hours of overtime per week. The most common reason for shift work cited was “part of my job,” while 25% of participants preferred shift work because of the higher rate of pay.

Table 2. Employee details of shift work patterns (N=149)*.

<table>
<thead>
<tr>
<th>Shift Pattern</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift pattern</td>
<td></td>
</tr>
<tr>
<td>Rotating without nights</td>
<td>24 (16)</td>
</tr>
<tr>
<td>Rotating with nights</td>
<td>109 (73)</td>
</tr>
<tr>
<td>Daytime</td>
<td>16 (11)</td>
</tr>
<tr>
<td>Average nights worked per year</td>
<td></td>
</tr>
<tr>
<td>1 to 30</td>
<td>27 (22)</td>
</tr>
<tr>
<td>31 to 60</td>
<td>59 (48)</td>
</tr>
<tr>
<td>61 to 90</td>
<td>18 (14)</td>
</tr>
<tr>
<td>91 to 120</td>
<td>11 (9)</td>
</tr>
<tr>
<td>120 plus</td>
<td>9 (7)</td>
</tr>
<tr>
<td>Estimated number of years working shifts</td>
<td></td>
</tr>
<tr>
<td>1 to 5 years</td>
<td>51 (34)</td>
</tr>
<tr>
<td>6 to 10 years</td>
<td>50 (33)</td>
</tr>
<tr>
<td>11 to 20 years</td>
<td>41 (27)</td>
</tr>
<tr>
<td>21 to 30 years</td>
<td>2 (3)</td>
</tr>
<tr>
<td>31 to 40 years</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Participants’ hours of paid overtime per week</td>
<td></td>
</tr>
<tr>
<td>1 to 5 hours</td>
<td>71 (60)</td>
</tr>
<tr>
<td>6 to 10 hours</td>
<td>24 (20)</td>
</tr>
<tr>
<td>11 to 20 hours</td>
<td>20 (17)</td>
</tr>
</tbody>
</table>
More than 20

Participants' hours of unpaid overtime per week
1 to 5 hours 139 (94)
6 to 10 hours 1 (1)
11 to 20 hours 5 (4)
More than 20 hours 2 (1)

Participants who prefer daytime shift to night
Definitely yes 14 (9)
Probably yes 38 (25)
Maybe 19 (13)
Probably not 47 (32)
Definitely no 31 (21)

#Reasons for working shifts
It is part of my job 97 (34)
It is the only job available 57 (20)
Shift work is convenient 55 (21)
Shift work provides higher pay rates 69 (25)

# More than one reason was provided for working shifts

Figure 1. Frequency of health conditions reported by participants since beginning shift work (n=149).

The frequency of various health-related symptoms was determined using scale which was scored as follow: almost never (1), quite seldom (2), quite often (3) and almost always (4). Individual scores were added together and a higher score was associated with poorer physical health (Table 4). Most participants (46%) were considered “healthy” in terms of physical health. Swollen feet (15%), weight gain (12%), loss of appetite (12%) and gastrointestinal disorders (12%) were amongst the health complaints experienced by participants in this study (Figure 1).
Table 3. Perceived sleep after working night shift and sleep disturbance rate.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal estimated hours of sleep (n=134)</td>
<td></td>
</tr>
<tr>
<td>Less than 5 hours</td>
<td>9 (7)</td>
</tr>
<tr>
<td>5 to 8 hours</td>
<td>69 (51)</td>
</tr>
<tr>
<td>More than 8 hours</td>
<td>56 (42)</td>
</tr>
<tr>
<td>Estimated hours of sleep needed after night shift (n=149)</td>
<td></td>
</tr>
<tr>
<td>Less than 5 hours</td>
<td>4 (3)</td>
</tr>
<tr>
<td>5 to 8 hours</td>
<td>92 (61)</td>
</tr>
<tr>
<td>More than 8 hours</td>
<td>54 (36)</td>
</tr>
</tbody>
</table>

Most participants had adequate sleep, 51% (69/134) participants estimated that they got between 5 to 8 hours on average after working night shift, with 42% (56/134) sleeping more than 8 hours (Table 3). 54% (81/149) of participants reported minimal or no impact of shift work on concentration levels at work. Female shift workers (57%) disliked shift work compared to male counterparts (43%).

Table 4. Psychosocial and health effects of shift work on employees stratified by gender (N = 149).

<table>
<thead>
<tr>
<th>Variable</th>
<th>n%</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>51 (38)</td>
<td>32 (63)</td>
<td>19 (37)</td>
</tr>
<tr>
<td>Somewhat</td>
<td>21 (15)</td>
<td>16 (76)</td>
<td>5 (23)</td>
</tr>
<tr>
<td>Very much</td>
<td>63 (47)</td>
<td>33 (52)</td>
<td>30 (47)</td>
</tr>
<tr>
<td>Domestic Effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>46 (33)</td>
<td>30 (65)</td>
<td>16 (34)</td>
</tr>
<tr>
<td>Somewhat</td>
<td>62 (45)</td>
<td>37 (60)</td>
<td>25 (40)</td>
</tr>
<tr>
<td>Very much</td>
<td>28 (22)</td>
<td>15 (54)</td>
<td>13 (46)</td>
</tr>
<tr>
<td>Physical Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>66 (49)</td>
<td>39 (59)</td>
<td>28 (41)</td>
</tr>
<tr>
<td>Satisfactory health</td>
<td>39 (29)</td>
<td>23 (58)</td>
<td>17 (42)</td>
</tr>
<tr>
<td>Poor health</td>
<td>31 (22)</td>
<td>18 (59)</td>
<td>13 (41)</td>
</tr>
<tr>
<td>Participants’ feelings regarding night shift</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like</td>
<td>86 (58)</td>
<td>51 (59)</td>
<td>35 (41)</td>
</tr>
<tr>
<td>Dislike</td>
<td>61 (42)</td>
<td>26 (43)</td>
<td>35 (57)</td>
</tr>
<tr>
<td>Effect of night shift on participant’s concentration at work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse effect</td>
<td>55 (37)</td>
<td>34 (62)</td>
<td>21 (38)</td>
</tr>
<tr>
<td>No effect</td>
<td>34 (23)</td>
<td>23 (67)</td>
<td>11 (33)</td>
</tr>
<tr>
<td>Minimal effect</td>
<td>47 (31)</td>
<td>20 (43)</td>
<td>27 (57)</td>
</tr>
<tr>
<td>I do not know</td>
<td>13 (9)</td>
<td>10 (67)</td>
<td>3 (23)</td>
</tr>
<tr>
<td>Is night shift loads heavier than day shift loads? N=147</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>16 (11)</td>
<td>11 (69)</td>
<td>5 (31)</td>
</tr>
<tr>
<td>Agree</td>
<td>34 (23)</td>
<td>18 (53)</td>
<td>16 (47)</td>
</tr>
<tr>
<td>Disagree</td>
<td>56 (38)</td>
<td>27 (48)</td>
<td>29 (52)</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>41 (28)</td>
<td>26 (63)</td>
<td>15 (37)</td>
</tr>
</tbody>
</table>
Table 5 shows the results from multiple logistic regression analysis evaluating the association between gender and work experience among shift workers with limited time for social and domestic activities and poor health status. Models were adjusted for marital status and job class. Experience with working shifts was protective as longer shift work experience (i.e. 11-20 years) was significantly associated with better health status (OR=0.18; 95% CI = 0.06; 0.46; p < 0.05). Shift work experience (11 to 20 years) was also found to be significantly associated with more time for both social (OR = 0.10; 95% CI = 0.03; 0.30) and domestic activities (OR= 0.25; 95% CI = 0.11; 0.57; p < 0.05) compared to those with less experience. There were no significant associations when these outcomes were stratified by gender.

Table 5. Multivariate logistic regression of psychosocial and health related outcomes by sex and shift work experience (n=152)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Limited time for Social activities</th>
<th>Limited time for domestic activities</th>
<th>Poor health status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Female</td>
<td>1.13</td>
<td>1.46</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>1.49 - 2.58</td>
<td>0.61 - 3.37</td>
<td>0.57 - 2.18</td>
</tr>
<tr>
<td>Shift work experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 10 years</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>11 - 20 years</td>
<td>0.10*</td>
<td>0.25*</td>
<td>0.18*</td>
</tr>
<tr>
<td></td>
<td>0.03 - 0.30</td>
<td>0.11 - 0.57</td>
<td>0.06 - 0.46</td>
</tr>
<tr>
<td>More than 20 years</td>
<td>0.12</td>
<td>0.33</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>0.09 - 1.64</td>
<td>0.04 - 2.51</td>
<td>0.02 - 1.79</td>
</tr>
</tbody>
</table>

p < 0.05 was considered statistically significant
4 Discussion

This study evaluated the psychosocial and health risks associated with working shifts in a manufacturing context in South Africa. Most participants were considered to be in good health, however they reported health complaints relating to swollen feet, weight gain, loss of appetite and gastrointestinal disorders. In addition, participants reported that their domestic lives were somewhat affected (45%) and their social lives were adversely affected (47%) by working shifts. Longer shift work experience was significantly associated with better health status and more time for both social and domestic activities compared to those with less experience. This may be attributed to the healthy worker survivor effect; it is likely that shift workers with longer working experience have developed practical coping strategies to mitigate some of the problems related to shift work (Knuttson, 2004; Neophytou et al. 2014). The shift workforce comprised of younger, single workers (<40 years) and surprisingly 34% of participants preferred night shift to day shift. This may be attributed to both the higher pay and convenience associated with shift work. Many participants accepted shift work as a responsibility of employment.

The results that young and single workers were generally more likely to work shifts are consistent with previous research (Reid & Dawson, 2001; Gander & Signal, 2008). According to a report published by the European Agency (2007), younger people (18 to 24 years) are more involved in shift work, weekend work and irregular hours than older workers. A study conducted in 2013 in England also found that shift work was most common between ages 16-24 years, and declined with age for both men and women (Health Survey, England 2013). Similar data for developing countries is very limited. Our results showed that older workers with more shift work experience reported good health and were able to cope with their domestic and social lives. Older workers are mostly likely to have fewer social and domestic pressures such as attending to small children and attending social gatherings. Older workers might have also gained more experience of coping and they also seem to require less sleep than their younger counterparts (Harrington, 2001).

It is surprising to note that 34% of participants preferred night shift to day shift in this study. Reasons for workers preferring shift work included higher pay and convenience. Many participants (34% or 97) accepted shift work as a responsibility of employment. Since the South African unemployment rate is reportedly 27.1% it is likely that employees are limited in choice and opportunity for alternate employment (Statistics South Africa, 2018).

Gastrointestinal disorders were not commonly reported in this study, which was in contrast to previous research. Several studies have described increased gastrointestinal disorders in shift workers (Knutson, 2003; Caruso et al. 2004). Segawa et al. (1987) conducted a study of Japanese employees in factories, schools and banks and found that gastric ulcers were more than twice more likely to occur among shift workers than day workers. A review study by Knutsson and Boggild (2010) also found a positive association between gastrointestinal disorders and shift work. From the 20 studies reviewed, they found that the risk of having gastrointestinal disorders was 36% higher when one was involved in night shift for an extended time. Participants in this study had
extensive experience in working shifts (33% had worked between 6-10 years and 33% had worked between 11-40 years). Experienced workers may have developed better coping strategies compared with less experienced and younger workers. From occupational studies, the healthy worker survivor effect describes a continuing selection process so that those who are more experienced tend to be healthier over time. The healthy worker survivor effect generally attenuates an adverse effect of exposure (Abou El-Soud et al. 2014). In addition, they tend to self-select to a certain extent and remain in employment, while those unable to cope with shift work leave the industry (Korompeli et al. 2014).

Many employees working shifts have been reported to have a shorter average amount of sleep, increased daytime sleepiness and low concentration levels (Lombardi et al. 2012; Violanti et al. 2012). Complaints usually relate to inability to sustain long quality sleep during the day after night shift due to disturbances. Contrary to previous studies, participants in this study reported adequate hours of sleep after night shift. Only 8% reported less than 5 hours sleep on average per night. Approximately 37% of participants reported adverse effects on concentration levels during night shift. Low levels of concentration in the workplace may lead to impaired performance which may result in increased work-related injuries. Workers in the current study are on a 12-hour shift, and the reduced alertness level could be attributed to fatigue and tiredness due to long working hours. A study conducted by Kazemi et al. (2016) on 60 petrochemical control room operators found similar results. They concluded that long working hours per shift resulted in fatigue, irregularities in the circadian rhythm and induced cognitive performance decline (Kazemi et al. 2016). Sleep deprivation can make people tired and this can result workers making mistakes. Indeed some of the most catastrophic industrial accidents in history have occurred during night shift, due to human error (Horwitz, 2004; Engleman & Douglas, 2005). These include the Chernobyl and Three Mile Island disasters.

Domestic chores, shopping, children’s homework and not spending time with their spouse because of shifts were reported to lead to family dysfunction by several studies (Harrington, 2001; Wilson, 2002; Rosa & Colligan, 1997). Approximately 45% of the participants in this study reported a moderate adverse effect on their domestic lives due to shift work. Research conducted by Barnett and Gareis (2007) concluded that regular contact between shift workers and their school-age children are severely reduced during a week of evening shifts. This may be exacerbated for workers employed on permanent afternoon shifts. For households with children where both the mother and father are employed full time, it is generally more difficult to achieve work-life balance and this is even more challenging when both the parents work shifts. There is very little research investigating work-life balance for shift workers in South Africa. A study was conducted by Kisting et al. (2016) to explore complex issues around working time organization and its effects on the health care services sector in South Africa. The study found that working schedules of health care workers who are single parents clashed with their family responsibilities. Furthermore, the schedules often prevented them from seeing their children on working days (Kisting et al. 2016). Men and women in this study reported an almost equal adverse effect/disruption to their domestic and social lives. This was unexpected as it was perceived that women, especially those in African communities, are generally expected to look after children and run the household, in
addition to work. In most cases there is insufficient time for domestic and social activities. A Turkish study of 243 female nurses found that overtime, work demands and rotating shifts lowered life satisfaction and caused family conflicts. The nurses reported difficulty in meeting family responsibilities and attending social events (Soares et al. 2012). However, our study showed that both genders were affected adversely in terms of domestic and social impact. An estimated 47% (63) participants felt shift work had a negative effect on their social lives. Working shift schedule often means one is out of sync with normal daily life activities of friends and family. This may lead to employees experiencing one or more of these challenges: missing important events like birthday parties, social isolation or loneliness for you or your partner and difficulty making social and family plans (Shen & Dicker, 2008).

In this study, regression analysis showed that longer shift work experience (11 to 20 years), was also significantly associated with better health status and with more time for domestic and social activities. Shift workers with longer working experience have developed practical coping strategies to mitigate some of the problems related to shift work and this may attenuate adverse effects related to shift work, which alludes to the healthy worker survivor effect. According to Burch and colleagues (2009), long term health and well-being of employees on shift work depend on their ability to adapt to the impact of their schedule. However, not all studies have supported this. Rouch et al. (2005) and Pati et al. (2001) have suggested that older shift workers have more pronounced difficulties and health issues compared with younger shift workers.

There were some limitations in the current study. These included the fact that only permanent employees who were currently involved in shift work were interviewed. It may have been worthwhile to include employees who had been previously employed on shifts but left because of negative experiences.

5 Conclusion

Our study is one of the few available on shift work in a manufacturing context in South Africa. Results suggest that longer work experience on shifts was associated with better health and psychosocial outcomes. Since the healthy worker survivor effect may attenuate adverse effects, it is important for future research to include adequately matched healthy control groups as a means of comparison. We recommend that employee involvement in shift scheduling could be of great benefit to both employer and employee. Whilst it is impossible to meet the needs of all employees concerned, input from all stakeholders is important. Employee wellness programmes is a cost effective intervention that may promote healthy lifestyles through education and awareness programmes on health, diet and exercise, personal responsibilities and time management.

Conflict of Interest Disclosure

The authors declare that there is no conflict of interest.
References


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