Evaluation of multi-level intervention strategies for a psychologically healthy construction workplace in Nigeria

Abstract

Purpose- The need to improve the mental health of construction personnel has increased owing to high rates of mental health problems. Hence, a proper evaluation of a mix of implementable intervention strategies in the workplace will assist in achieving good mental health. Although there are recommendations in occupational health literature on strategies that can be adopted, it is unknown how those strategies fit appropriately into the construction industry. **Design/Methodology**- Drawing from the context of developing countries with Nigeria as a case study, data was collected using the quantitative technique. A questionnaire survey consisting of 31 intervention strategies was administered to a purposive sample of 45 experts in the Nigerian construction industry. The data collected were analyzed using mean score analysis and fuzzy synthetic evaluation. **Findings-** The study revealed that strategies focused on boosting *employee morale and engagement* and *interpersonal relationship* offer higher chances of improving mental health among construction personnel. The study showed that implementing job crafting and sculpting may benefit the industry. The analysis showed that the overall criticality of the intervention strategies to the Nigerian construction workplace is high, suggesting that if implemented, the mental health of construction personnel can be improved. **Conclusion**- The study provides an initial understanding of the most critical multi-level intervention strategies to enhance good mental health among construction personnel in Nigeria and the global construction industry. These findings serve as a guide to policymakers and advocate the implementation of strategies to adopt for a psychologically healthy construction workplace in developing countries.

Keywords: psychologically healthy workplace; intervention strategies; mental health; construction personnel; developing countries.

1. Introduction

Mental ill-health risk factors such as excessive work pace, financial insecurity, inflexible work schedules, poor interpersonal relationship, work-life imbalance (Love et al., 2010; Ibem et al., 2011; Boschman et al., 2013; Bowen et al., 2014; Roche et al., 2016; Kotera et al., 2020) are prevalent in the construction industry. These risk factors relate to job demand, job control, job support, workplace injustice, welfare, and socio-economic status, work hazard, family, and coping mechanism (Chan et al., 2020). At the individual level, continuous exposure to these risk factors leads to job dissatisfaction, and poor mental health symptoms like depression and anxiety (Milner et al., 2015; Kotera et al., 2020), reduced work performance with a ripple effect on organization cost and performance. At the organization level, the risk factors and related poor mental health causes absenteeism, presenteeism, low productivity, high safety claims, and employee turnover (Rajgopal, 2010; Milner et al., 2015; Nwaogu et al., 2019; Kotera et al., 2020). The ripple effect of protracted poor mental health includes suicidality and eventual suicide (Milner et al., 2015; Burki, 2018).

Furthermore, the economic cost of poor mental health affects individuals, organizations, and nations. For example, employers in some countries like Australia are liable to pay compensation claims to sick workers (Nwaogu et al., 2019), since by law employers are saddled with the responsibility of reducing risk related to health and safety (see Reis et al., 2015; Kotera et al., 2020). In the construction industry, health and safety had mainly focused on injury prevention because of the vast interface between man, methods, and machine. However, in recent times, the scope seems to be getting wider with studies emphasizing that there is no health and safety without mental health (see Bryson and Duncan, 2018).

In the construction industry, to ensure the health and safety of on-site personnel, each project is bonded by legislation to have a health and safety manual and plan. The plan is preventive in form, detailing all health and safety risks, their sources, and outlines best

measures to prevent a casualty (Reis et al., 2015). The health and safety plan outlines the medical examinations of personnel's physical and mental health, required setbacks, fire safety measures, installation of workplace signals, and accidents (Reis et al., 2015). Although the plan is expected to contain the medical examination of on-site personnel as a strategy for accident prevention, it does not detail measures to ensure good mental health among personnel.

With increasing poor mental health among construction personnel, it will be expedient to ensure that the health and safety manual and plan detail workable strategies to be implemented on every construction project to ensure good mental health and well-being. Ensuring good mental health and well-being holds the potential to reduce injury, near misses, and accident prevention (see Siu et al., 2004; Bryson and Duncan, 2018). For instance, it has been observed in a developed country like Australia that for every death lost to a fatal workplace accident construction industry, six are lost to suicide (Gullestrup, 2019).

Like other countries, in Nigeria, the health and safety plan is required before construction projects are approved. However, the plan is focused on improving the physical working conditions for injury and accident prevention (see Dodo, 2014), without outlining strategies that can eliminate other mental distress risk factors. Consequently, the lack of strategic move to prioritize mental health and well-being of construction personnel by adopting measures to reduce work-related stress in Nigeria (see Ibem et al., 2011; Ojo et al., 2019), have resulted in reported feelings of depression, hopelessness, and anxiety (see Oladinrin et al., 2014). Likewise, in South Africa, work stress levels are posing a concern to personnel's health and productivity within the sector (Bowen et al., 2014).

In an effort to improve mental health among the workforce, studies are springing up globally to draw the attention of the industry to the need to reduce mental ill-health risk factors (e.g., Boschman et al., 2013; Bowen et al., 2014; Sunindijo and Kamardeen, 2017; Bowen et al., 2018; Bryson and Duncan, 2018; Langdon and Sawang, 2018; Ajayi et al., 2019; Kotera et

al., 2020). Most of these studies have been influential; however, there remains dearth on research into strategies to mitigate common mental health problems. In order to advance the body of research, the purpose of this study was to determine strategies to improve mental health in the construction industry of a developing country like Nigeria from the viewpoint of an integrated approach to mental health.

This aim was achieved by adopting two objectives: (i) identify and evaluate the strategies that can create a psychologically healthy and safe workplace; (ii) assess the criticality of the strategies on mental health using the fuzzy set theory. The knowledge of the strategies that hold the highest criticality will inform researchers about interventions to subject to further testing and their strength in mitigating stress determined within the construction industry. This was done by researching the best mix of strategies to reduce work stress and related depression, hopelessness, and anxiety that personnel experience, from the context of the construction industry in developing countries. This study is significant because implementing measures to mitigate poor mental health holds benefits to both employees and employers. On the individual level, the benefits include good mental health and well-being, job performance, and retention. In contrast, on the organization level, the benefits include reduced worker's compensation claims and increased productivity.

2. Literature review and Conceptual framework

2.1. Literature review

Although evidence shows that strategies to improve mental health are available in other sectors (e.g., Joyce et al., 2010; Tan et al., 2014; Joyce et al., 2016; Pignata et al., 2017; Havermans et al., 2018; Pignata et al., 2018), solutions are unique to work context (LaMontagne et al., 2014), as the one-size-fits-all interventions do not apply to mental health problems (Rebar and Taylor, 2017). For instance, job redesign measures in the construction industry for on-site personnel may differ from those in the health sector. Similarly, given the nature of the construction

industry, the combination of strategies necessary to make the construction workplace psychologically healthy and their importance will vary from those needed for other industries and countries. This further emphasizes the need for context-specific solutions. Within the construction industry, there have been a few standalone intervention studies (either secondary or primary intervention strategies) on mental health problems.

For instance, Gullestrup et al. (2011) adopted a multimodal secondary intervention to mitigate suicide among the tradesmen in the construction industry of Australia. Using a compressed working week strategy, Lingard et al. (2007) achieved increased work-life balance and productivity within the Australian Construction Industry. Yip and Rowlinson (2009) reported mild effectiveness against burnout sources (emotional exhaustion, cynicism, and professional efficacy) using a reduced workweek and scheduled Saturday off-work strategy within the Hong Kong Construction Industry. However, Lingard et al. (2007) and Yip and Rowlinson (2009) did not provide for non-work factors that can cause or worsen mental ill-health to which only primary intervention may be ineffective.

Taking those studies further, Ajayi et al. (2019) examined strategies necessary to mitigate stress within the UK construction industry. Most of the strategies in Ajayi et al. (2019) focused on administration and project coordination and did not consider an integrated approach to mental health management. For instance, Ajayi and colleagues did not emphasize strategies such as mental health awareness and building resilience. From the viewpoint of Ajayi et al. (2019), it could be thought that only work factors can cause stress. However, the causes of mental ill-health are work and non-work-related (Bartley, 2004; Joyce et al., 2010). Therefore, calling for the need to reinforce robust strategies such as employee assistance programs that can act as a resource to mitigate and prevent both work and non-work stressors. Although there exists research on occupational stress and mental health in the construction industry, empirical

125 evidence on strategies required to improve the mental health of on-site construction personnel
126 remain insufficient.

127 Furthermore, all the previous studies considered the construction industry in a
128 developed context. Additionally, most of the studies in other occupational settings as well as
129 construction industry are not multi-leveled strategies, to which Pignata et al. (2017) and Pignata
130 et al. (2018) have emphasized that a standalone secondary or primary intervention is not
131 adequate for stress mitigation and mental health management. Therefore, this present study
132 adds to the body of knowledge by considering multi-level strategies targeted towards mitigating
133 and preventing work and non-work mental ill-health risk factors in the construction industry
134 from the context of a developing country.

135 **2.2. Conceptual framework**

136 The study uses the Job Demand-Resources (JD-R) model as it is a heuristic and flexible
137 model that can be adapted to different work settings (Schaufeli and Taris, 2014; Bakker and
138 Demerouti, 2017). The model incorporates personal characteristics (i.e., psychological
139 resources), demands, and resources. Job demand is the physical, psychological, social, or
140 organizational aspects of the job, which requires physical efforts or skills and associated with
141 physiological or psychological cost (Bakker and Demerouti, 2007; Pignata et al., 2017). Job
142 demand is categorized into three, namely, challenges, threats, and hindrances demand (Pignata
143 et al., 2017). They include high levels of workload, time pressure, role conflict, role
144 overload, bullying, and harassment (Schaufeli and Taris, 2014; Pignata et al., 2017). Job
145 resources refer to those things or components that mitigate job demand and aid the achievement
146 of job goals, personal development, thus, fostering work engagement, and performance
147 (Pignata et al., 2017). They can be located at the organization or task level (e.g., career
148 opportunities), the organization of the work, interpersonal relations, and task level (Bakker and
149 Demerouti, 2007). Going by Pignata et al. (2017), concerning the construction industry, job

resources refer to strategies that can be implemented in the construction workplace to ameliorate the effect of job demand, foster motivation, and work satisfaction

The JD-R proposes that job resources buffer the impact of job demand, where the resources can take the form of several components depending on the characteristics that can facilitate different job goals. A potential of job resources is the ability to alter organizational properties, change the perception about stressors, and reduce the negative health response (Bakker and Demerouti, 2007). Although the buffering ability of job resources depends on the type of stressor targeted, they influence work engagement and motivation in the face of the stressor (Bakker and Demerouti, 2007). Therefore, this study draws on the JD-R model to determine the best strategies that should be employed to effectively reduce stress for mental health promotion in the construction industry.

2.3. Explanation of terms

The strategies can be primary, secondary, and tertiary. Primary interventions are designed to prevent the development of work-related mental health problems, as they are designed to eliminate or reduce the sources of stress; thus, directed to the source of the work (LaMontagne et al., 2014; Pignata et al., 2017). Secondary interventions are directed towards the employees (LaMontagne et al., 2014) and aim to reduce stress in employees by modifying the response to job stressors (LaMontagne et al., 2014; Pignata et al., 2017). Tertiary interventions are reactive in nature, as they involve responding to developed mental health problems by treating affected employees or rehabilitating them (LaMontagne et al., 2014).

Adopting an integrated approach to mental health is an effective strategy for mental ill-health prevention (LaMontagne et al., 2014). However, the strategies in place to reduce job stress must be multi-leveled (i.e., directed at the individual and organization) to improve the health and morale of employees (LaMontagne et al., 2007; Pignata et al., 2017). An integrated approach to mental ill-health prevention in the workplace consists of primary, secondary, and

tertiary interventions (LaMontagne et al., 2014). When considering the levels at which the interventions can be targeted to reduce job stress and improve mental health, the categorization by DeFrank and Cooper (2013) and Pignata et al. (2017) was adopted. Thus, the intervention strategies identified from literature are grouped as individual level, organization level, and individual/organization level interface (see Table 2).

The strategies directed at the individual level are focused on managing how an employee copes with stress without considering the source of the stress (DeFrank and Cooper, 2013); they include secondary and tertiary intervention strategies. Strategies directed at the organizational level are mostly primary intervention strategies; they look into the areas of the organization that may produce stress to the employees, such as the physical characteristics of the job, shift schedule, job training, and health (DeFrank and Cooper, 2013). Thus, strategies directed at the organization level include maximizing the person-environment fit through modification of job roles, organizational variables, job redesign, and training (DeFrank and Cooper, 2013). The strategies directed towards the individual and organization level are aimed at improving both the objective and subjective characteristics of the job that may cause stress and strain (DeFrank and Cooper, 2013).

3. Research methodology

3.1. Questionnaire design

This study solicited experts' data by tapping into the rich technical know-how and expert judgment of construction practitioners occupying decision influencing positions in the construction industry of Nigeria. Several strategies were identified from occupational health literature (e.g., Hlanganipai and Mazanai, 2014; LaMontagne et al., 2014; Tan et al., 2014; Enns et al., 2016; Sinclair et al., 2017; LaMontagne et al., 2018; Pignata et al., 2018; VanAntwerp and Wilson, 2018) and used to develop a draft questionnaire which passed through content validity with a panel of five experts (see Figure 1). The panelists included four

occupational health psychologists and one construction professional. Two of the psychologists have over 20 publications and serve as directors in Construction Health Research Institutes. All the panelists were sourced based on the relevance of their publications to construction health and safety. The draft questionnaire underwent a 3-stage review, and by the end of the extensive analysis, a list of 31 strategies was retained (see Table 2).

The first stage of the review consisted of one construction professional and one occupational health psychologist that has researched mental health in the construction industry. Upon receiving feedback from the first stage and redeveloping the questionnaire, the new draft was sent to another panel consisting of three occupational health psychologists. The feedback from the second round was used to improve the quality of the intervention strategies in the questionnaire. The new draft was then sent out to the panelists in the second stage for any further review or approval. The draft from the second stage received some comments, which were improved. To ensure rigor, the approved draft questionnaire from stage two was sent out to the expert reviewers in the first stage for their review. Upon subsequent approval, the final questionnaire underwent pilot testing.

The finalized questionnaire was arrived at based on feedback and suggestions from the panelists. Consequently, the questionnaire was pilot surveyed among ten construction practitioners. The pilot study participants included members of professional construction bodies in Nigeria as well as the Chartered Institute of Building (CIOB) and the Royal Institute of Chartered Surveyors (RICS). The practitioners were asked to comment on their understanding of the questions and time required to complete the survey. All participants indicated that the questionnaire took approximately seven minutes to complete. They also reported their satisfaction with the study aim and the completeness of the survey questions.

The questionnaire was divided into two parts, namely Part A and B. Part A solicited demographic questions, while Part B consisted of the strategies proposed for achieving a

psychologically healthy and safe construction workplace for on-site personnel. Part B required the respondents to indicate their level of agreement to the strategies using a four-point Likert scale: 1 = I strongly disagree; 2 = I disagree; 3 = I agree; 4 = I absolutely agree.

Insert Figure 1 here

3.2. Survey participants

The survey respondents consist of expert construction practitioners involved in health and safety, relation-building, and policy-making in the construction workplace. Therefore, a basic requirement for getting the appropriate experts was to liaise with the professional bodies in the Nigerian construction industry. The professional bodies which usually has its members in key professions on the construction site were contacted. Those organizations include the Nigerian Institute of Building (NIOB), Nigerian Institution of Civil Engineers (NICE), Nigerian Institute of Architects (NIA), and Nigerian Institute of Quantity Surveyors (NIQS). In order to increase the relevance of the findings, the respondents to be recruited had to meet four criteria: (i) must be an industry practitioner; (ii) occupy corporate, or fellow membership position; (iii) occupy a management position in a construction firm or own a construction firm; (iv) must be involved in health and safety planning and management in the Nigerian construction industry.

The professional organizations were contacted and briefed on the intention of the research. Thereafter, the study was advertised among suggested members of the professional organizations. A total of 45 respondents who met the criteria, and gave their informed consent to participate in the survey formed the survey respondents. Therefore, purposive sampling was adopted for this study. All participants had over 29years of experience, and included Presidents of the professional bodies, Managing Directors, Head of health and safety, operations, and human resource managers. A total of 45 duly filled questionnaires were retrieved from the experts. Although the subject of making the workplace psychologically healthy and safe seems

a general concern that can be answered by any construction professional, it is not, considering the complexity of the construction workplace. In order to arrive at a realistic mix of strategies that can be implemented, the opinion of practitioners who have moved up the ladder, and presently occupying critical decision influencing positions with regards to construction planning, health, and safety in the construction industry proved most reasonable.

The 45 responses are considered adequate following the central limit theorem, which holds that a sample size of 30 is sufficient for statistical analysis (Darko et al., 2017; Chan and Adabre, 2019). Likewise, 45 responses were adequate considering previous research, which has employed expert opinion in decision and policy-making in the construction industry studies. For example, Darko and Chan (2018), Ameyaw and Chan (2016), and Darko et al. (2017) were based on 33, 40, and 43, respectively.

3.3. Data collection

The questionnaire was used to elicit experts' opinions from construction practitioners. An expert refers to a person with the skills or knowledge exhibited by leadership positions in professional organizations or occupying such positions, presenting in conventions or recognized by journal publications (Darko et al., 2017). Therefore, for this study, an expert refers to a person with the skills and pedigree related to decision making (i.e., policy making) roles in the construction workplace.

4. Data analysis and results

4.1. Mean score ranking of the strategies

The relative significance of the strategies was determined using their mean score and standard deviation (SD) ranking. Usually, this statistical method is widely employed in quantitative studies to assess the importance of a list of measures or factors (Ameyaw and Chan, 2016). In a case where two or more strategies had the same mean, the strategy with the lowest standard deviation is ranked highest (see Darko and Chan, 2018). The mean value ranges from

1 to 4, with 4 representing a highly important strategy. Hence, the closer a mean value is to 4, the more likely it is to eliminate stress, increase the perception of job satisfaction and good mental health.

Overall, celebrating employee success ranked the first strategy (mean = 3.64), followed by providing employees with competence training (mean = 3.64). This is consistent with Pignata et al. (2017) that found celebrating success as a perceived strategy to reduce work-related stress. Likewise, Haynes and Love (2004) recommended that competence training is needed to help employees in the construction industry cope better with technological changes to eliminate mental ill-health risk factors such as fear of failure and job insecurity. However, the criticality of the strategies is determined by subjecting the result of the mean score to the Fuzzy Synthetic Evaluation (FSE).

4.2. Kruskal-Wallis Test

An analysis of the mean in Table 1 was performed using the Kruskal-Wallis test, to determine whether the opinions on the strategies differed among the professional groups. As shown in Table 2, the ρ value of 26 strategies except for five strategies (ST11, ST12, ST8, ST10, ST15) was greater than 0.05, suggesting that there was no statistically significant difference in opinions for the 26 strategies. However, the difference in views for ST11, ST12, ST8, ST10, ST15 were statistically significant (i.e., ρ value less 0.05), meaning that the professionals differed in their opinion on the strategies. ST11 and ST12 are related to job redesign strategies while ST8, ST10, ST15 are workplace justice focused. Likewise, in Sunindijo and Kamardeen (2017), work stressor causing workplace injustice (i.e., bullying, harassment, unequal policies) were statistically significant among the groups.

Insert Table 1 here

4.3. Fuzzy synthetic evaluation (FSE) technique

FSE is an objective evaluation approach based upon using the fuzzy set theory to quantify the linguistic facet of given data for effective decision making (Zhao et al., 2016). FSE is a multi-decision making evaluation technique used to remove uncertainty, imprecise data related to decision making involving different players (Ameyaw and Chan, 2016). The FSE has been adopted in several academic fields, including construction risk management (see Ameyaw and Chan, 2016; Zhao et al., 2016; Wu et al., 2017), and health management (see Sadiq and Rodriguez, 2004). Usually, the opinions of respondents on the level of impact of any factor are contemplated as subjective (Owusu et al., 2019). However, by applying FSE, such subjectivity can be eliminated. Since FSE as the potential to objectify the opinions of the experts, it was employed in this study to determine the strategies that will best improve the mental health of construction personnel. As shown in Ameyaw and Chan (2016), and Owusu et al. (2019), the procedure for carrying out FSE in strategy assessment involves the steps outlined below (see also Fig. 2):

(i) Build the principal factors/strategies

(ii) Set up an assessment index system

(iii) Determine the membership grade of the variables (first level)

(iv) Calculate the weighing functions of the variables

(v) Building the multi-criteria and multi-level FSE model

(vi) Estimate the overall importance index of the STCs

Insert Figure 2 here

4.3.1. Build the principal factors/strategies

The 31 strategies were categorized into seven constructs following an exploratory factor analysis reported in another study using the developed questionnaire. The strategy constructs (STCs) are detailed in Table 2. The strategies are grouped into constructs as they serve two

main functions in the FSE: (i) input variables necessary for the improvement of mental health in the workplace; (ii) determine the most critical strategy constructs that should be considered during the decision making.

4.3.2. Set up an assessment index system

From the seven constructs, an evaluation system needed to calculate the index was set up, with the STCs as the first level index system, represented as $v_{stc} = (v_{STC1}, v_{STC2}, v_{STC3}, v_{STC4}, v_{STC5}, v_{STC6}, v_{STC7})$ (Ameyaw and Chan, 2016; Owusu et al., 2019) and each individual strategies (STs) as the second level index system. The first and second system are the input variable for the FSE. The second level index system are represented as:

$v_{STC1} = \{v_{ST11}\ v_{ST12}\ v_{ST13}\ v_{ST14}\ v_{ST15}\ v_{STC16}\ v_{ST17}\ v_{ST18}\}$

$v_{STC2} = \{v_{ST21}\ v_{ST22}\ v_{ST23}\ v_{ST24}\ v_{ST25}\ v_{ST26}\}$

$v_{STC3} = \{v_{ST31}\ v_{ST32}\ v_{ST33}\ v_{ST34}\}$

$v_{STC4} = \{v_{ST1}\ v_{ST42}\ v_{ST43}\}$

$v_{STC5} = \{v_{ST51}\ v_{ST52}\ v_{ST53}\ v_{ST54}\}$

$v_{STC6} = \{v_{ST61}\ v_{ST62}\ v_{STC63}\}$

$v_{STC7} = \{v_{ST71}\ v_{ST72}\ v_{STC73}\}$

4.3.3. Determine the membership grade of the variables ST and STC (first level)

In fuzzy set theory, the degree of membership within a given fuzzy set ranges between 0 and 1, describing the degree to which the element belongs to the fuzzy set (Owusu et al., 2019). Following Ameyaw and Chan (2016) and (Owusu et al., 2019), the linguistic term used to examine the input variables (i.e., strategies) against the criticality was determined using the 4-point rating system from very low (1) to very high (4) based on respondents' level of agreement with each strategy. The grading system for estimating the degree of probability of criticality based on the strategies is represented by V = (1,2,3,4), where v_1 = very low, v_2 =

low, v_3 = high, v_4 = very high. Given this rating scale, the membership function of any given ST, v_{STin}, is obtained using equation (1) below:

$$MF_{v_{STin}} = \frac{x1_{STin}}{v_1}, \frac{x2_{STin}}{v_2}, \frac{x3_{STin}}{v_3}, \frac{x4_{STin}}{v_4} \quad (1)$$

Where: n represent the nth strategy of a particular STC *i* (i = v_{STC1}, v_{STC2}, v_{STC3}, v_{STC4}, v_{STC5}, v_{STC6}, v_{STC7}); $x1_{STin}/v_1$ is represented as a percentage, and $x_{j_{STin}}$ (j = 1,2,3,4). Therefore, upon substitution, the membership function for any given strategy (ST), will be written as given in Equation 2 (Eq. 2):

$$MF_{v_{STin}} = (x1_{STin}, x2_{STin}, x3_{STin}, x4_{STin}) \quad (2)$$

As earlier stated, $MF_{v_{STin}}$ ranges between [0,1] and must sum up to one, indicating a unity. Therefore, $\sum_{j=1}^{4} x_{j_{STin}} = 1$ (3)

Hence, using ST30 as a typical example, based upon the ratings of the experts (i.e., 0.02%, 0.00%, 0.67%, 0.31%) and substituting into Eq. (1), we get:

$$MF_{ST30} = MF_{STC1_1} = \frac{0.02}{\text{very low}}, \frac{0.00}{\text{low}}, \frac{0.67}{\text{high}}, \frac{0.31}{\text{very high}} \quad (4)$$

The MF is thus, written in the form of Equation (3) as $MF_{v_{STin}}$=(0.02, 0.00, 0.67,0.31). The remaining membership function for the STs was calculated in the same way, as shown in Eq. (2) and (3).

Insert Table 2 here

4.3.4. Calculate the weighing functions of the variables for the STs and STCs

The normalized mean method was used to derive the individual weighting of the variables within the strategy construct. Thus, the individual weighting of the ST and STC was gotten using the formulae as shown in (Owusu et al., 2019):

$$w_i = \frac{M_i}{\sum_{i=1}^{4} M_i}, \; 0<w_i<1, \text{ and } \sum_{i=1}^{n} w_i = 1 \quad (5)$$

Where, w_i is the weighting function of a strategy (ST) or strategy construct (STC) i; M_i represents the mean score of a specific ST or STC i derived from responses of the experts contained in Table 1. The set of weighting function is given as:

$$W_i=(w_1, w_2, w_3, \ldots\ldots\ldots w_n) \quad (6)$$

Using ST30 as a typical example of how to determine the weightings of each strategy within a strategy construct, we consider substituting the mean values as appropriate into Eq. (5). It is important to note that ST30 is the same as $STC1_7$; upon applying Eq. (5), Eq. (7) is obtained:

$$w_{ST30}= w_{STC1_7}= \frac{3.27}{3.27+3.27+3.36+3.42+3.42+3.44+3.53+3.47}= \frac{3.27}{27.18}= 0.120 \quad (7)$$

The weightings of the remaining STs within each STCs are obtained by following the procedure described in Eq. (5) and (7) (see Table 3), can be put in the form of Eq. (6) and checked to ensure that $\sum_{i=1}^{n} w_i =1$.

$W_{STC1_{1-8}}= (0.130, 0.128, 0.127, 0.126, 0.126, 0.124, 0.120, 0.120)$

$\sum_{i=1}^{8} w_i =0.130+0.128+0.127+0.126+0.126+0.124+0.120+0.120= 1.00$

Given that the summation of the mean values of all STCs (v_{STC1} = 27.18, v_{STC2} = 20.35, v_{STC3} = 13.04, v_{STC4} = 10.51, v_{STC5} = 13.57, v_{STC6} = 9.4, v_{STC7} = 10.49), is 104.54 (see Table 2). Thereafter, the mean of each STC i was normalized using Eq. (5) and (7).

$$w_{STC1}= \frac{27.18}{27.18+20.35+13.04+10.51+13.57+9.4+10.49}= \frac{27.18}{104.54}= 0.260$$

Similarly, $w_{STC2}= \frac{20.35}{27.18+20.35+13.04+10.51+13.57+9.4+10.49}= \frac{20.35}{104.54}= 0.195$

The same procedure was carried out to arrive at the weighing function of the remaining STCs (w_{STC3}=0.125, w_{STC4}=0.101, w_{STC5}= 0.130, w_{STC6}=0.090, w_{STC7}=0.100) (see Table 2). Also, the summation of all normalized weighing equals unity.

4.3.5. Building the multi-criteria and multi-level FSE model

This stage entails the determination of the STCs' criticality in making the construction workplace a psychologically healthy and safe place. Going by Eq. (2), the membership functions (MFs) of the STs under each STC can be written as given in Eq. (8), where the elements are represented by $x_{j_{STin}}$:

$$R_i = \begin{vmatrix} MF_{V_{i1}} \\ MF_{V_{i2}} \\ MF_{V_{i3}} \\ \cdots\cdots \\ MF_{V_{in}} \end{vmatrix} = \begin{vmatrix} x_{1v_{i1}} & x_{2v_{i1}} & x_{3v_{i1}} & x_{4v_{i1}} \\ x_{1v_{i2}} & x_{2v_{i2}} & x_{3v_{i2}} & x_{4v_{i2}} \\ x_{1v_{i3}} & x_{2v_{i3}} & x_{3v_{i4}} & x_{4v_{i4}} \\ \cdots\cdots & \cdots\cdots & \cdots\cdots & \cdots\cdots \\ x_{1v_{in}} & x_{2v_{in}} & x_{3v_{in}} & x_{4v_{in}} \end{vmatrix} \quad (8)$$

Using STC1 "stress control focused" in Table 2 as an example. In fuzzy matrix form, the elements are represented as shown in Eq. (8). Recall that $MF_{V_{STi1}} = MF_{STC1_7} = MF_{ST30}$, so we have:

$$R_i = \begin{vmatrix} MF_{ST31} \\ MF_{ST14} \\ MF_{ST24} \\ MF_{ST4} \\ MF_{ST7} \\ MF_{ST25} \\ MF_{ST30} \\ MF_{ST29} \end{vmatrix} = \begin{vmatrix} 0.02 & 0.00 & 0.40 & 0.58 \\ 0.02 & 0.04 & 0.38 & 0.56 \\ 0.05 & 0.00 & 0.42 & 0.53 \\ 0.00 & 0.04 & 0.58 & 0.42 \\ 0.00 & 0.00 & 0.49 & 0.47 \\ 0.02 & 0.02 & 0.54 & 0.42 \\ 0.02 & 0.00 & 0.67 & 0.31 \\ 0.02 & 0.02 & 0.62 & 0.34 \end{vmatrix} \quad (9)$$

The FSE is made up of 3 levels of membership functions, starting from the third level to first level. The computations in this aspect are aimed toward achieving the second level of the FSE model. The fuzzy matrix is denoted by D_i and deduced by multiplying the weighing function set $W_i=\{w_1, w_2, w_3, \ldots\ldots\ldots w_n\}$ (see Eq. 6) of the STs within a STCs and the membership functions (obtained using Eq. 9) of the STs under each STC.

So, $D_i = W_i \bullet R_i$ (10)

$$\left(d_{in}, d_{in}, \ldots\ldots, d_{in}\right) = \left(w_{i1}, w_{i2}, \ldots\ldots\ldots, w_{in}\right) \bullet \begin{vmatrix} MF_{V_{i1}} \\ MF_{V_{i2}} \\ MF_{V_{i3}} \\ \cdots\cdots \\ MF_{V_{in}} \end{vmatrix}$$

Equivalent to:

412 $$\left(d_{in,}\ d_{in,}\ldots\ldots,\ d_{in}\right)=(w_{i1,}w_{i2,}\ldots\ldots\ldots,w_{in})\bullet\begin{vmatrix} x_{1v_{i1}} & x_{2v_{i1}} & x_{3v_{i1}} & x_{4v_{i1}} \\ x_{1v_{i2}} & x_{2v_{i2}} & x_{3v_{i2}} & x_{4v_{i2}} \\ x_{1v_{i3}} & x_{2v_{i3}} & x_{3v_{i4}} & x_{4v_{i4}} \\ \cdots\cdots & \cdots\cdots & \cdots\cdots & \cdots\cdots \\ x_{1v_{in}} & x_{2v_{in}} & x_{3v_{in}} & x_{4v_{in}} \end{vmatrix}$$

413 $$=(d_{i1},\ d_{i2},\ d_{i3},\ \ldots\ldots\ldots,\ d_{in}) \quad (11)$$

414 $$D_{STC1}=(0.130,\ 0.128,\ 0.127,\ 0.126,\ 0.126,\ 0.124,\ 0.120,\ 0.120)\ *\begin{vmatrix} 0.02 & 0.00 & 0.40 & 0.58 \\ 0.02 & 0.04 & 0.38 & 0.56 \\ 0.05 & 0.00 & 0.42 & 0.53 \\ 0.00 & 0.04 & 0.58 & 0.42 \\ 0.00 & 0.00 & 0.49 & 0.47 \\ 0.02 & 0.02 & 0.54 & 0.42 \\ 0.02 & 0.00 & 0.67 & 0.31 \\ 0.02 & 0.02 & 0.62 & 0.34 \end{vmatrix}$$

415 $$=(0.02,\ 0.02,\ 0.51,\ 0.46)$$

416 Where d_{in} represent the grade alternative, V_i regarding a given STC *i*, and "•" is the fuzzy
417 composition operation (Ameyaw and Chan, 2016). Adopting the same approach, the
418 membership function of the remaining STCs at the second level were derived (see Table 3).
419 The next step is to determine the criticality level (CL) of each of the STCs. In order to achieve
420 that, the formulae below (Eq. 12) is adopted:

421 $$CL_i=\sum_{i=1}^{4}(D_{in}*V)=(d_{i1},\ d_{i2},\ d_{i3},\ d_{i4})*(1,\ 2,\ 3,\ 4) \quad (12)$$

422 where $1 \le CL_i \le 4$

423 Following eq. (11), the criticality index (CL) for each seven STCs is derived (see Table
424 3). The CL of STC1 to STC3 is worked as an example, as shown below:

425 $CL_{STC1}=(0.02,\ 0.02,\ 0.51,\ 0.46)*(1,\ 2,\ 3,\ 4)$

426 $=((0.02*1)+(0.02*2)+(0.51*3)+(0.46*4))$

427 $CL_{STC1}=3.43$ for the stress control focused strategy.

428 $CL_{STC2}=(0.01,\ 0.05,\ 0.47,\ 0.47)*(1,\ 2,\ 3,\ 4)$

429 $CL_{STC2}=3.40$ for healthy coping and individual resilience-focused strategy

430 $CL_{STC3}=(0.02,\ 0.12,\ 0.46\ 0.40)*(1,\ 2,\ 3,\ 4)$

431 $CL_{STC3}=3.24$ for job demand and satisfaction focused strategy

4.3.6. Estimate the overall criticality index of the STCs

To arrive at the overall criticality index of the STCs, the weighted mean method was used for three reasons: (i) it reserves the performance effect of the strategies and their constructs, (ii) it has an upper limit of one as a result of the normalization of the weightings of the strategies and their constructs, (iii) wide use in fuzzy multi-criteria decision making evaluation (Ameyaw and Chan, 2016; Owusu et al., 2019). Going by Owusu et al. (2019), the weighted mean method is derived using the formulae shown in Eq. 13:

$$d_{in} = \sum_{i=1}^{m} w_{in} x_{kv_{in}}, n = 1, 2, 3, \ldots, k) \quad (13)$$

The fuzzy matrix for $\bar{R}$, for evaluating the overall criticality level of the strategies in achieving a psychologically healthy and safe workplace is formed from the obtained evaluation matrixes, D_i(i=1, 2, 3, 4, 5, 6, 7):

$$\bar{R}_i = \begin{vmatrix} D_{STC1} \\ D_{STC2} \\ D_{STC3} \\ D_{STC4} \\ D_{STC5} \\ D_{STC6} \\ D_{STC7} \end{vmatrix} = \begin{vmatrix} d_{11} & d_{12} & d_{13} & d_{14} \\ d_{21} & d_{22} & d_{23} & d_{24} \\ d_{31} & d_{32} & d_{33} & d_{34} \\ d_{41} & d_{42} & d_{43} & d_{44} \\ d_{51} & d_{52} & d_{53} & d_{54} \\ d_{61} & d_{62} & d_{63} & d_{64} \\ d_{71} & d_{72} & d_{73} & d_{74} \end{vmatrix} \quad (14)$$

Where, D_{STC1} to D_{STC7} refers to the membership function of the STCs recorded at the second level (see Table 3). To achieve the aim, $\bar{R}_i$ is then normalized using Eq. (10, 11), with the weighing function set of ($\bar{W}$= {w_i, w_2, w_3, w_4, }) for the STCs.

Insert Table 3 here

$$\bar{D} = \bar{W}_i \bullet \bar{R}_i$$

$$= (w_1, w_2, w_3, w_4, w_5, w_6, w_7) \bullet \begin{vmatrix} d_{11} & d_{12} & d_{13} & d_{14} \\ d_{21} & d_{22} & d_{23} & d_{24} \\ d_{31} & d_{32} & d_{33} & d_{34} \\ d_{41} & d_{42} & d_{43} & d_{44} \\ d_{51} & d_{52} & d_{53} & d_{54} \\ d_{61} & d_{62} & d_{63} & d_{64} \\ d_{71} & d_{72} & d_{73} & d_{74} \end{vmatrix} \quad (15)$$

$$\bar{D} = (\acute{D}_1, \acute{D}_2, \acute{D}_3, \acute{D}_4)$$

Where, $\bar{D}_i=(\acute{D}_1, \acute{D}_2, \acute{D}_3, \acute{D}_4)$ is the membership function for all the strategies at the first level.

$$\bar{D} = (0.260, 0.195, 0.125, 0.101, 0.130, 0.090, 0.100) * \begin{vmatrix} 0.02 & 0.02 & 0.51 & 0.46 \\ 0.01 & 0.05 & 0.47 & 0.47 \\ 0.02 & 0.12 & 0.46 & 0.40 \\ 0.00 & 0.01 & 0.47 & 0.52 \\ 0.02 & 0.16 & 0.51 & 0.31 \\ 0.05 & 0.12 & 0.46 & 0.37 \\ 0.01 & 0.03 & 0.40 & 0.56 \end{vmatrix}$$

$$\bar{D} = (0.02, 0.07, 0.48, 0.44)$$

Finally, to derive the integrated criticality level of the strategies in creating a psychologically healthy and safe construction workplace (see Tables 3), we use Eq. (16) below:

$$CL_{overall}= \sum_{i=1}^{4} (\bar{D}_i * V)= (\acute{D}_1, \acute{D}_2, \acute{D}_3, \acute{D}_4)*(1, 2, 3, 4) \quad (16)$$

where $1 \leq CL_i \leq 4$

$CL_{overall}=(0.02, 0.07, 0.48, 0.44)*(1, 2, 3, 4)$

$CL_{overall}=3.36$

Insert Table 4 here

5. Discussion

The overall criticality level of the strategies based on the FSE technique is 3.36, implying that improving the psychological health of on-site construction personnel using these strategies is essential, and hold promising results. As shown in Table 4, *employee morale and engagement-focused* strategies and *interpersonal relationship-related* strategies are considered very important, with the highest index of 3.51. The indexes and ranking indicate the policies that need to be implemented or strengthened in making the construction workplace psychologically healthy and safe. Table 4 also shows the type of intervention strategy and level at which they are directed.

5.1. Employee morale and engagement-focused strategies: STC4 = 3.51

With a criticality level of 3.51, as shown in Tables 3 and 4, this construct was deduced to be very critical to improving the psychological health of on-site construction personnel in

Nigeria. The construct covers "*celebrating employees' success," "giving constructive feedbacks instead of reprimanding,"* and "*promoting employees' embedded life interest."* These strategies received a high mean score, resulting in the construct been the most important needed to be implemented in efforts to create a psychologically healthy and safe workplace. The construct consists of variables that can boost morale, increase job satisfaction, and engagement level. For instance, *promoting embedded life interest* has been reported as an intrinsic motivator with the capacity to enhance the autonomy need of employees, increase job satisfaction, reduce job turnovers and increase performance (VanAntwerp and Wilson, 2018). The strength of enhancing *deeply embedded life interests* lies in incorporating what an employee enjoys doing into his or her job role (VanAntwerp and Wilson, 2018). Considering that intrinsic motivators increase mental health and improve performance, to tap into the benefits of this strategy, the job roles of construction personnel can be reimagined.

As moves to boost the morale of the employee and its related benefits, it is essential to enforce policies of *"giving constructive feedbacks to subordinates instead of reprimanding"* and *"celebrating employees' success."* Celebrating employees' success can take the form of recognition or intangible rewards such as appreciation from a supervisor, line manager, and colleagues (Pignata et al., 2017). The need to adopt these strategies is essential, considering the influence of generational gaps and motivation on the perception of stress. This finding is consistent with Bryson and Duncan (2018) and Pignata et al. (2017). As emphasized by Bryson and Duncan (2018), the way supervisors communicated feedbacks caused more stress to younger construction personnel resulting in increased absenteeism. Thus, subordinates require supervisors to express feedback in a supportive way free of reprimands.

5.2. Interpersonal relationship related: STC7 = 3.51

With a criticality index of 3.51, this construct ranks very high, as shown in Table 4. This construct corroborates earlier studies on the need to promote interpersonal relationships

(Brockman, 2014; Loudoun and Townsend, 2017) by reinforcing specific strategies that are essential. The strategies include "*ensuring swift resolution*," "*increasing cooperation between supervisors and subordinates*," "*supporting improved relationships at work*" (see Table 3). For instance, Brockman (2014) asserted that ensuring swift conflict resolution in the construction industry offers some economic advantage over leaving conflict unresolved or resolving them later. Strengthening interpersonal relationships in the workplace may offer therapeutic effects to improve health. Havermans et al. (2018) found that a supportive organizational culture that provides a feeling of unity reduces the stress level of employees. Similar to the findings of Migowski et al. (2018), in the construction industry, to effectively enhance interpersonal relationships, bottlenecks such as difficulty in information sharing, bureaucracy in workplace leadership, and unsupportive culture need to be eliminated.

5.3. Stress control focused

This construct is underlined by six strategies directed at reducing both work and non-work related stress and offers high criticality (see Table 4). The strategies are detailed in Table, ST14, ST29, ST30, and ST31 are employee assistance programs (EAPs); ST25, ST7, ST ST24 are related to stress management process, while ST4 relates to mental health literacy. This construct offers mental ill-health preventive and reactive ability. Effective implementation of EAPs has proved to be effective in cushioning the occurrence or effect of non-work related stress (Saju et al., 2019). Job insecurity, financial problems, inability to career development, low social-economic status, and marital challenges are identified risk factors for mental ill-health in the construction industry (Chan et al., 2020). Similarly, this study found that strategies to reduce the mentioned risk factors are expedient and corroborates with the recommendations of Chan et al. (2020) as well as Liang et al. (2018) on the need for detailed training on stress-coping.

Considering that construction companies are economically volatile as they depend on the availability of projects, modules on financial literacy should be incorporated into stress management training. In contrast, as regards financial needs, the aid provided can include offering financial credit, and contingency contribution scheme (Richard, 2009). Additionally, due to the risk that comes with an improperly planned retirement, there is a need to enlighten employees on a variety of available retirement schemes to drive satisfaction benefits and productivity (Marcellus and Osadebe, 2014). Thus, echoing Horwitz et al. (2019), a sustainable retirement plan integrating financial psychology and employee engagement sponsored by the employer should be encouraged in the construction industry of Nigeria.

5.4. Healthy coping and individual resilience-focused

Strategies related to healthy coping and individual resilience ranked fourth, implying that the criticality level of the construct is high (see Table 4). Five strategies underline the construct (see Table 2). It is apparent that there is a need for secondary interventions to enhance mental health awareness, appropriate stress-coping, and resilience among personnel in the construction industry. This construct echoed Ajayi et al. (2019) and Bryson and Duncan (2018) that posited the need to curb stigma as a strategy to prevent mental ill-health in the construction workplace. The fear of stigma, lack of support from supervisors, and colleagues in the working population decreases appropriate help-seeking among persons experiencing mental health problems (Moll, 2014; Bryson and Duncan, 2018; Havermans et al., 2018). Promoting anti-stigma and stimulating helping behaviors towards people suffering from mental health problems are strategies proven to mitigate mental ill-health among the working population (Bryson and Duncan, 2018).

Individual resilience negatively impacts psychological stress among construction personnel (Chen et al., 2017). The chances of developing mental health problems are dependent on the level of an individual's resilience (Horn et al., 2016; Black et al., 2017). Interestingly,

resilience can be acquired through resilience training (Burke, 2019), with benefits such as cognitive coping skills, enhancing appropriate lifestyle modifications, and reduction of burnout (Chen et al., 2017). Thus, in the construction industry of Nigeria, enhancing resilience among personnel will be a good target for indicated interventions. Enhancing individual resilience in the workplace can be achieved through a number of interventions, namely cognitive-behavioral therapy, workplace coaching, and workplace physical activity (Glozier and Brain and Mind Centre, 2017).

While physical activity forms part of a wellness program, it is more than just fitness (Brown et al., 2011); it can take several forms of activities to enhance personal effectiveness, improve the quality of life, and organizational productivity. Considering the health and well-being challenges in the construction workplace (Lingard and Turner, 2017; Chung et al., 2018; Nwaogu et al., 2019), wellness programs which may benefit the industry include physical activity and nutrition, cardiovascular health components, a-day walking activity, repetitive stress-injury prevention program, and tobacco-free workplace (see Berry et al., 2011).

As regards *providing competence training,* Havermans et al. (2018) deduced competence training as a viable way for employees to cope with stress, set boundaries, and deal with changes. When considering the increase in the application of technology in the construction industry, appropriate competence training is needed to help personnel cope with changes and trends in technological applications relevant to their jobs (Ganah and John, 2015), such as the use of 5D to 8D Building Information Modelling, unmanned aerial system (UAS), industrialized building components and safety instruction systems.

5.5 Job demand and satisfaction focused

This construct was identified to be critical in making the construction workplace in Nigeria psychologically healthy and safe (see Table 4). It is underlined by four strategies, namely *better planning of work tasks and shifts, allow regular breaks for rest, hire more*

personnel to reduce the workload, and *conduct employee satisfaction surveys*. The strategies in this component are mainly secondary interventions that can be directed to the individual level for work stress prevention. This finding echoed Havermans et al. (2018), on the need of organizational measures that allow better planning of work tasks, and hiring of more personnel. Furthermore, organizations should undertake regular employee satisfaction surveys to identify areas of improvement and development (Havermans et al. 2018).

In the construction industry, high job demand arising from work pressure, working in excess of 85 hours per week, budget-related deadlines, high volume of work due to staff shortage and work contact (working outside working hours) are identified risk factors for mental health problems (see Ibem et al., 2011; Boschman et al., 2013; Oladinrin et al., 2014; Sunindijo and Kamardeen, 2017; Bowen et al., 2018). Therefore, implementing the strategies in this construct could help mitigate job demand related risk factors in the construction workplace.

5.6 Job redesign and control focused

"Job redesign and control related strategies" ranked the sixth in criticality (see Table 4). The strategies in this construct offer opportunities for redesigning jobs in the construction workplace. They include *flexible work schedule*, *flexibility to design job roles and tasks (ST12)*, and *work and life balance through compressed working week arrangements (see Table 2)*. Construction personnel have yearned for the possibility of adopting flexible work arrangements in the industry (Ajayi et al., 2019; Ojo et al., 2019). As means to achieve job satisfaction and good mental health in the technological age, there is a need to consider adopting flexible work arrangements (FWA) such as a result-only work environment, flexi-term contract, self-scheduling and flexitime intervention among construction industry personnel (Nwaogu et al., 2019). This arrangement can provide employees with a sense of job control, especially in those

FWA that provide employees with the opportunity to determine their work schedule, such as self-scheduling (Joyce et al., 2010).

Compressed working week (CWW), a type of FWA involves an increase in the hours worked per day while reducing the number of days worked to five days (Lingard et al., 2007; Joyce et al., 2010). The CWW affords employees an improved work-life balance (Lingard et al., 2007; Joyce et al., 2010). Improving work-life balance can reduce adverse health or organizational effects arising from high job demand and work-life imbalance (Joyce et al., 2010). In implementing CWW, weekend work hours can be eliminated by changing from a 9-hour Mondays to Fridays work schedule obtainable in the Nigerian construction industry to a 10-hour schedule. Adopting these forms of FWA could help increase job satisfaction, improve mental health, reduce worker's compensation claims, and increase productivity for construction organizations.

Strategy ST12 is known as job crafting and characteristic of increasing the perception of job control among employees. In job crafting, employees are allowed to make changes to their tasks and relationships boundary without jeopardizing productivity, allowing them to create significance out of their job (Wrzesniewski and Dutton, 2001; Burke, 2019). Redesigning jobs by adopting job crafting will help improve job satisfaction, engagement, individual resilience, and thriving (Burke, 2019). In an effort to make the workplace psychologically healthy and safe while improving job control, jobs in the construction workplace can be redesigned by implementing the strategies in this construct.

5.7 Workplace (organisational) justice-focused

This construct consists of four strategies aimed at eliminating organizational injustice in the construction workplace. They include: *policies to eliminate bullying, harassment, reduce threatening of staff with disengagement when they make mistakes and promoting equality irrespective of gender and age* (see Table 2). The strategies in this component are mainly

621 secondary interventions. Measures of workplace injustice such as bullying, harassment, gender
622 and age discrimination, have been reported as mental ill-health risk factors in the construction
623 workplace (see Bowen et al., 2014; Kamardeen and Sunindijo, 2017; Sunindijo and
624 Kamardeen, 2017; Chan et al., 2020). Therefore, necessitating the need for measures to
625 eliminate workplace injustice. This calls for implementing or strengthening policies in the
626 construction workplace that will promote organizational justice and related benefits such as
627 fostering job satisfaction, reduction in burnout and sleep problems (Topbaş et al., 2019;
628 Gluschkoff et al., 2017).

629 Finally, threatening staff with disengagement when they make mistakes predicts job
630 insecurity and poor mental health (Shin and Hur, 2019). Thus, ensuring organizational justice
631 through promoting civility can act as a resource in the construction workplace to improve
632 mental health and well-being.

633 **6. Limitations and Further research**

634 A limitation of this study is that only the opinions of construction industry experts in a
635 developing economy, particularly Nigeria, were sought. However, the result of this study can
636 inform on intervention strategies that hold promising benefits in the improvement of mental
637 health among the construction workforce. These intervention strategies should be subjected to
638 scrutiny on applicability in other countries to aid comparability and advance the decision-
639 making process in the construction industry. This research offers insights into intervention
640 strategies whose effect on health and safety in the global construction industry can be simulated
641 using modeling techniques, particularly the agent-based model and system dynamics. Further
642 studies will benefit from exploring how best to achieve *employee morale and engagement-*
643 *focused interventions* and *job redesign and control strategies (particularly affording site*
644 *employees' a flexible work schedule, giving employees some flexibility to design their job roles*
645 *and tasks*) considering the labor-intensive culture in the construction industry.

It will also be needful to determine the criticality of the strategies in improving mental health from the perspective of on-site construction personnel. The result of such a study can be compared with that from the expert group to achieve conclusive research. Furthermore, the most promising intervention strategies can be implemented in the construction workplace using a cluster-randomized controlled trial approach and their effect on mental health assessed on a pre and post-intervention basis.

7. Conclusion

This study examined strategies that need to be implemented within the Nigerian construction workplace to improve the mental health of on-site personnel. In the study, 31 intervention strategies relevant to eliminate stress and promote good mental health were identified from occupational health literature and subjected to experts rating. The strategies were grouped into seven major groups following an exploratory factor analysis. The subjective responses were objectified by analyzing the data using FSE. FSE was used to examine the criticality of the strategies and their constructs (groupings) on making the construction workplace psychologically healthy and safe to personnel. This study serves as an initial screening of the most critical strategies for achieving good mental health of construction personnel.

This study revealed that *employee morale and engagement-focused* and *interpersonal relationship-focused strategies* offer better criticality in enhancing the mental health and well-being of construction personnel in the construction industry of Nigeria and other developing countries. This study provides two significant contributions to the body of knowledge in the global construction industry. Firstly, providing a list of multi-level intervention strategies that can be explored in the construction workplace to make it psychologically healthy and safe. Secondly, it provides decision-makers in the construction industry on practical approaches to adapt and reinforce in the industry to improve the mental health of personnel.

Considering that the construction industry is a major source of employment and gross domestic product to any nation, putting measures in place to improve the mental health of construction personnel becomes a priority with promising benefits to both employees, employers and the society. The benefits on the individual level include good mental health and well-being, and increased job performance, with reduced worker's compensation claims, and increased productivity on the organization level.

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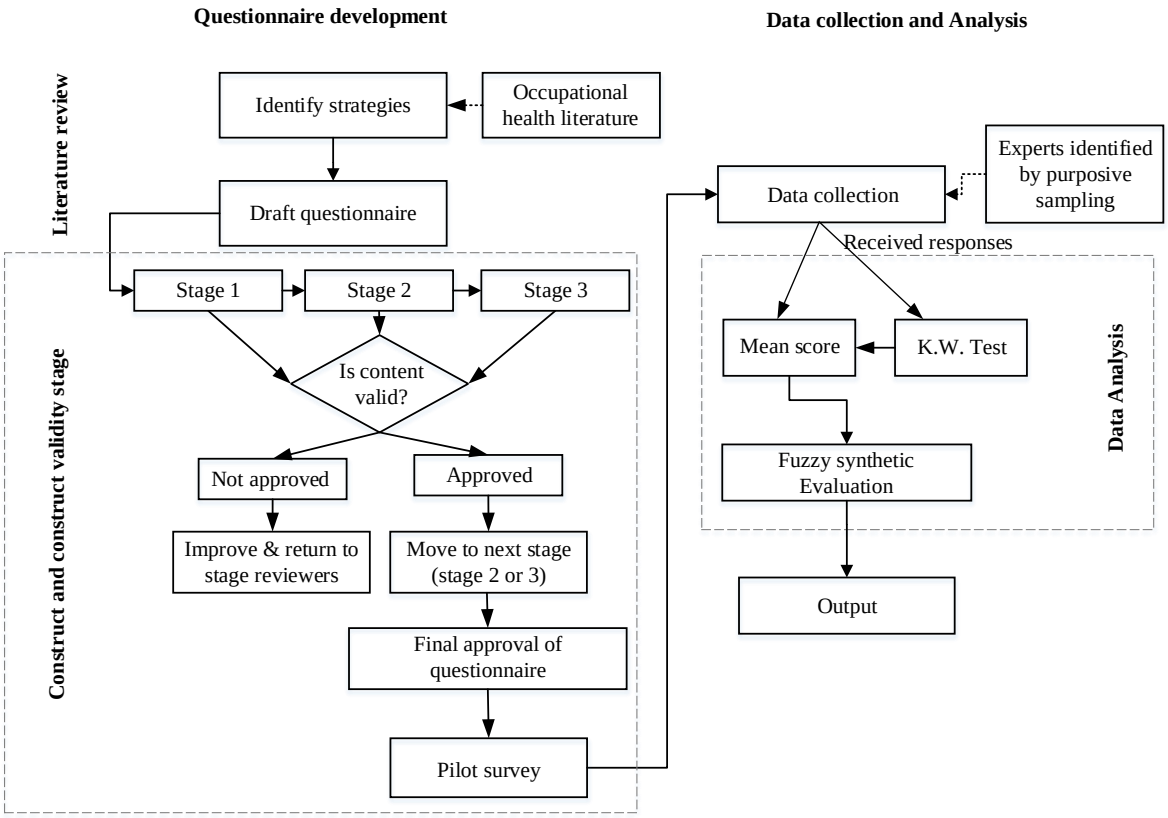

K.W- Kruskal-Wallis H test

Fig. 1. Research methodology framework

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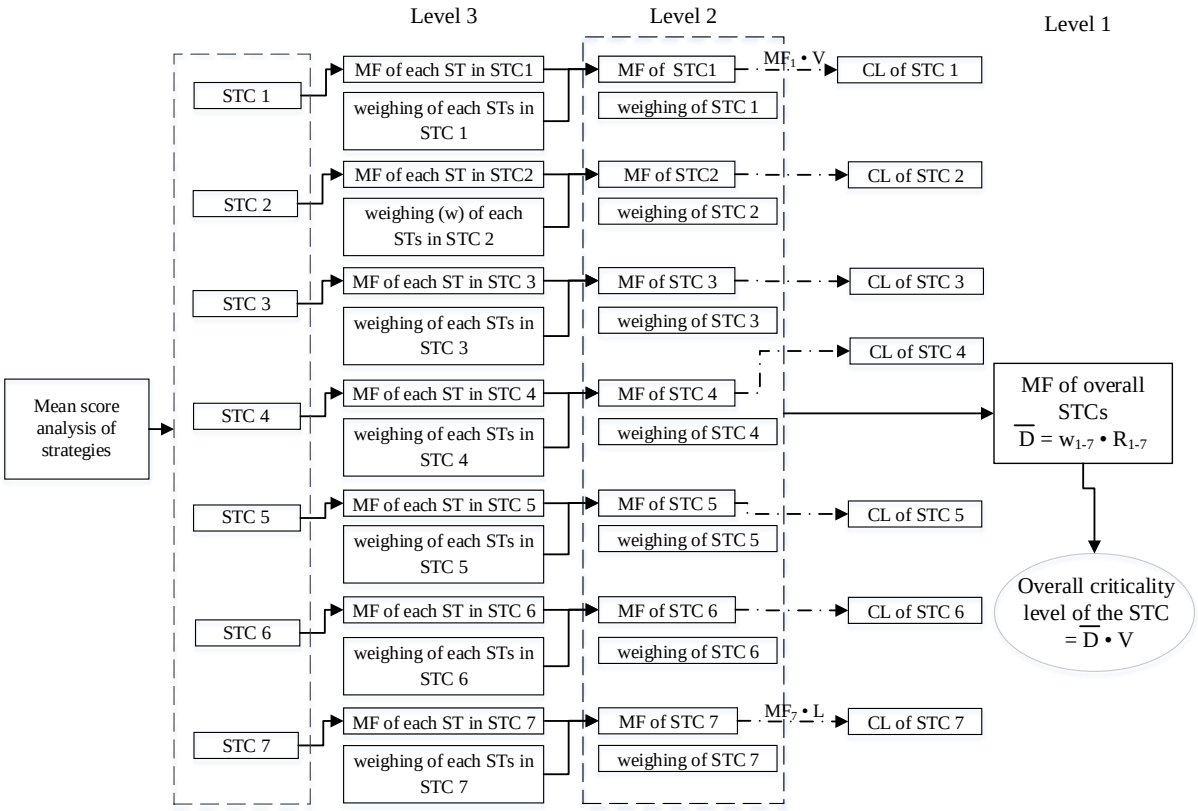

881 MF- Membership function; CL – Criticality level

882 Fig. 2. A schematic diagram of the Fuzzy Synthetic Evaluation process

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Table 1. Ranking of the strategies needed to make the construction workplace psychological safe and healthy

Code	All respondents			NIOB			NICE			NIQS			NIA			
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	ρ value
ST18	3.64	0.484	1	3.58	0.507	3	3.58	0.515	3	3.87	0.354	2	3.67	0.516	20	0.500
ST26	3.64	0.484	2	3.63	0.496	1	3.50	0.522	6	3.63	0.518	12	4.00	0.000	1	0.228
ST17	3.60	0.539	3	3.58	0.607	4	3.67	0.492	2	3.50	0.535	20	3.67	0.516	21	0.895
ST31	3.53	0.625	5	3.58	0.769	2	3.33	0.492	11	3.63	0.518	14	3.67	0.516	12	0.329
ST2	3.49	0.506	6	3.37	0.496	8	3.33	.492	20	3.75	0.463	5	3.83	0.408	11	0.068
ST1	3.49	0.549	7	3.32	0.582	10	3.50	0.522	6	3.75	0.463	9	3.67	0.516	18	0.243
ST28	3.49	0.695	8	3.26	0.872	17	3.50	0.522	5	3.75	0.463	3	3.83	0.408	9	0.243
ST11	**3.47**	**0.505**	**9**	**3.37**	**0.496**	**7**	**3.33**	**0.492**	**18**	**3.50**	**0.535**	**22**	**4.00**	**0.000**	**2**	**0.040[a]**
ST9	3.60	0.625	4	3.37	0.761	6	3.75	1.712	1	3.63	0.518	14	4.00	0.000	4	0.310
ST14	3.47	0.694	10	3.21	0.713	20	3.58	0.793	4	3.75	0.463	4	3.67	0.516	22	0.105
ST8	**3.44**	**0.659**	**11**	**3.32**	**0.820**	**14**	**3.17**	**0.389**	**23**	**3.75**	**0.463**	**8**	**4.00**	**0.000**	**5**	**0.008[a]**
ST24	3.44	0.725	12	3.26	0.933	15	3.42	0.515	8	3.75	0.463	6	3.67	0.516	17	0.395
ST4	3.42	0.499	13	3.53	0.513	5	3.25	0.452	21	3.25	0.463	30	3.67	0.516	24	0.200
ST7	3.42	0.583	14	3.32	0.671	12	3.33	0.492	19	3.63	0.518	15	3.67	0.516	23	0.414
ST19	3.42	0.621	15	3.32	0.749	11	3.42	0.515	10	3.63	0.518	13	3.50	0.548	25	0.746
ST21	3.42	0.657	16	3.26	0.733	16	3.42	0.669	9	3.88	0.354	1	3.33	0.516	27	0.112
ST16	3.40	0.580	17	3.32	0.478	9	3.33	0.651	13	3.38	0.744	27	3.83	0.408	6	0.226
ST27	3.40	0.654	18	3.26	0.806	18	3.33	0.492	16	3.63	0.518	11	3.67	0.516	15	0.414
ST23	3.38	0.650	19	3.21	0.713	19	3.33	0.651	17	3.62	0.518	18	3.67	0.516	19	0.293
ST25	3.36	0.645	20	3.16	0.688	24	3.33	0.651	12	3.62	0.518	17	3.67	0.516	16	0.185
ST5	3.33	0.739	21	3.16	0.898	23	3.25	0.622	22	3.50	0.535	24	3.83	0.408	10	0.217
ST10	**3.29**	**0.727**	**22**	**3.05**	**0.780**	**27**	**3.00**	**0.603**	**26**	**3.75**	**0.463**	**7**	**4.00**	**0.000**	**3**	**0.001[a]**
ST30	3.27	0.580	23	3.16	0.688	21	3.33	0.492	14	3.13	0.354	31	3.67	0.516	13	0.182
ST29	3.27	0.618	24	3.05	0.705	26	3.33	0.492	15	3.38	0.518	25	3.67	0.516	14	0.390
ST15	**3.24**	**0.645**	**25**	**3.11**	**0.658**	**25**	**3.08**	**0.669**	**24**	**3.38**	**0.518**	**28**	**3.83**	**0.408**	**7**	**0.043[a]**
ST20	3.24	0.802	26	3.32	0.820	13	2.92	0.900	28	3.50	0.756	19	3.33	0.516	28	0.390
ST6	3.22	0.599	27	3.16	0.501	22	3.08	0.669	25	3.50	0.535	23	3.33	0.816	29	0.406
ST3	3.18	0.747	28	3.00	0.816	29	3.00	0.739	27	3.63	0.518	16	3.50	0.548	26	0.119
ST12	**3.02**	**0.812**	**29**	**2.84**	**0.602**	**30**	**2.67**	**1.073**	**29**	**3.38**	**0.518**	**29**	**3.83**	**0.408**	**8**	**0.009[a]**
ST13	2.96	0.952	30	3.00	0.882	28	2.58	0.900	31	3.50	0.535	21	2.83	1.472	31	0.189
ST22	2.82	0.806	31	2.68	0.749	31	2.67	0.778	30	3.38	0.518	26	2.83	1.169	30	0.151

[a] The Kruskal-Wallis H test result is significant at the significance level of 0.05 (p-value < .05)

899 Table 2. Mean score and Fuzzy Synthetic Evaluation Weightings of the Strategies

Code	Strategies (ST) and their Strategy Construct (STC)	Mean of ST	Total mean of STC	Weighing of STs W_{STi}	Weighing of STCs W_{STCi}	Level directed towards
	Stress control focused (STC1)					
ST31	Offer a sustainable retirement plan for employees	3.53		0.130		I
ST14	Put better education policies in place (e.g., subsidies for encouraging career development)	3.47		0.128		I
ST24	Conduct regular team meetings with personnel focused on addressing work stress	3.44		0.127		I
ST4	Promote mental health awareness through literacy programs	3.42		0.126		I
ST7	Provide practical stress management training	3.42		0.126		I
ST25	Promote communication about work stress without penalty	3.36		0.124		I
ST30	Provide aid for stressors such as financial challenges	3.27		0.120		I
ST29	Offer assistance to non-work stressors such as marital, family issues	3.27	27.18	0.120	0.260	I
	Healthy coping and individual resilience-focused (STC2)					
ST26	Provide employees with competence training	3.64		0.179		I
ST2	Introduce wellness programs to workplaces/site offices	3.49		0.171		I
ST1	Empower staff to be individually more resilient through resilience training	3.49		0.171		I
ST5	Stimulate helping behaviors towards people suffering from mental health problems through programs such as mental health first aid	3.33		0.164		I
ST6	Put measures in place for healthy exercise	3.22		0.158		I
ST3	Promote talks about anti-stigma (anti-stigma campaign)	3.18	20.35	0.156	0.195	I
	Job demand and satisfaction focused (STC3)					
ST21	Better planning of work tasks and shifts	3.42		0.262		I and O
ST20	Allow the taking of regular breaks to enable rest	3.42		0.262		I
ST23	Conduct employee satisfaction surveys	3.38		0.259		I and O
ST22	Hire more personnel to reduce the workload	2.82	13.04	0.259	0.125	I and O
	Employee morale and engagement-focused (STC4)					
ST18	Celebrate employee's success	3.64		0.346		O
ST11	Promote employees' deeply embedded life interest by designing job roles inline with employee's deeply embedded interest	3.47		0.330		O
ST16	Give constructive feedbacks instead of reprimanding	3.40	10.51	0.324	0.101	O
	Workplace (organizational) justice-focused (STC5)					
ST9	Create policies to eliminate harassment	3.60		0.265		I and O
ST8	Create policies to eliminate bullying	3.44		0.254		I and O
ST10	Promote equality policies irrespective of gender, and age	3.29		0.242		I and O
ST15	Reduce threatening of staff with disengagement when they make mistakes	3.24	13.57	0.239	0.130	I and O
	Job redesign and control focused (STC6)					
ST19	Offer employee's opportunities to balance work and life through compressed working week arrangement	3.42		0.364		O
ST12	Employees should be allowed some flexibility to design their job roles and tasks	3.02		0.321		O
ST13	The workplace should allow site employees' to a flexible work schedule	2.96	9.40	0.315	0.090	O
	Interpersonal relationship-related (STC7)					
ST17	Ensure swift resolution	3.60		0.343		O
ST28	Put in place measures that increase cooperation between supervisors and subordinates	3.49		0.333		I and O
ST27	Supporting improved relationships at work	3.40	10.49	0.324	0.100	I and O
	Total		104.54		1.000	

900 Notes: I - Individual; O - Organization.

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Table 3. Weightings and MF for the STs and STCs based on Fuzzy Synthetic Evaluation

Code	Weighing of STs	Weighing of STCs	MF of each ST at level 3	MF of each STCs at level 2	CL for STCs	MF of all STCs for level 1	Overall CL
						(0.02, 0.07, 0.48, 0.44)	3.36
STC1		0.260		(0.02, 0.02, 0.51, 0.46)	3.43		
ST31	0.130		(0.02, 0.00, 0.40, 0.58)				
ST14	0.128		(0.02, 0.04, 0.38, 0.56)				
ST24	0.127		(0.05, 0.00, 0.42, 0.53)				
ST4	0.126		(0.00, 0.00, 0.58, 0.42)				
ST7	0.126		(0.00, 0.04, 0.49, 0.47)				
ST25	0.124		(0.02, 0.02, 0.54, 0.42)				
ST30	0.120		(0.02, 0.00, 0.67, 0.31)				
ST29	0.120		(0.02, 0.02, 0.62, 0.34)				
STC2		0.195		(0.01, 0.05, 0.47, 0.47)	3.40		
ST26	0.179		(0.00, 0.00, 0.36, 0.64)				
ST2	0.171		(0.00, 0.00, 0.51, 0.49)				
ST1	0.171		(0.00, 0.02, 0.47, 0.51)				
ST5	0.164		(0.02, 0.09, 0.42, 0.47)				
ST6	0.158		(0.00, 0.09, 0.60, 0.31)				
ST3	0.156		(0.02, 0.13, 0.49, 0.36)				
STC3		0.125		(0.02, 0.12, 0.46, 0.40)	3.24		
ST21	0.262		(0.02, 0.02, 0.47, 0.49)				
ST20	0.262		(0.02, 0.16, 0.38, 0.44)				
ST23	0.259		(0.02, 0.02, 0.51, 0.45)				
ST22	0.259		(0.04, 0.29, 0.47, 0.20)				
STC4		0.101		(0.00, 0.01, 0.47, 0.52)	3.51		
ST18	0.346		(0.00, 0.00, 0.36, 0.64)				
ST11	0.330		(0.00, 0.00, 0.53, 0.47)				
ST16	0.324		(0.00, 0.04, 0.52, 0.44)				
STC5		0.130		(0.02, 0.16, 0.51, 0.31)	3.11		
ST9	0.265		(0.02, 0.47, 0.51, 0.00)				
ST8	0.254		(0.02, 0.02, 0.45, 0.51)				
ST10	0.242		(0.02, 0.09, 0.47, 0.42)				
ST15	0.239		(0.02, 0.05, 0.60, 0.33)				
STC6		0.090		(0.05, 0.12, 0.46, 0.37)	3.15		
ST19	0.364		(0.02, 0.00, 0.51, 0.47)				
ST12	0.321		(0.04, 0.18, 0.49, 0.29)				
ST13	0.315		(0.09, 0.20, 0.38, 0.33)				
STC7		0.100		(0.01, 0.03, 0.40, 0.56)	3.51		
ST17	0.343		(0.00, 0.02, 0.36, 0.62)				
ST28	0.333		(0.02, 0.04, 0.36, 0.58)				
ST27	0.324		(0.02, 0.02, 0.49, 0.47)				

ST = Strategies; STC = Strategy Construct; MF = membership function; CL = criticality level

Table 4. Criticality index of each STCs

Code	Strategies	Degree of Criticality		Intervention	
		Index	Linguistic	Type	Level directed towards
STC4	Employee morale and engagement-focused	3.51	Very high	Primary and Secondary	Organization
STC7	Interpersonal relationship-related	3.51	Very high	Primary and Secondary	Individual/Organization
STC1	Stress control focused	3.43	High	Secondary and Tertiary	Individual
STC2	Healthy coping and individual resilience-focused	3.40	High	Secondary	Individual
STC3	Job demand and satisfaction focused	3.24	High	Primary	Individual/Organization
STC6	Job redesign and control focused	3.15	High	Primary	Organization
STC5	Workplace (organizational) justice-focused	3.11	High	Primary	Individual/Organization
	Overall Criticality Level	3.36	High		