Conceptualizing the Dynamics of Mental Health among Construction Supervisors

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Abstract

Workplace health and safety within the construction industry has focused on physical safety. Over time, mental ill-health has become a crisis within the construction industry. Hence, attention is drawn to the need to look into employees' mental health because there is no health and safety without mental health. In order to combat the mental ill-health crisis, there is a need for the construction workplace to be psychologically safe. Although evidence on mental health in the Nigerian construction industry is limited, recent data suggest a high prevalence of depressive symptoms. Therefore, this study aims to create awareness of intervention strategies to alleviate mental health problems in the construction industry. A total of 174 survey data was collected from construction supervisors, and six project managers partook in expert discussions for the system dynamics model (SDM) development. Data were analyzed using descriptive analysis, univariate logistic regression, and SDM. Combined interventions were more impactful than single interventions in reducing and preventing the prevalence of mental ill-health because they cater to

clusters of risk factors that may be present at individual and organizational levels. The study suggests that risk factors related to job control and job support should be doubled to maintain their protective ability, while job demand should be reduced by at least half to mitigate mental ill-health prevalence effectively. System dynamics modeling offers human resource and labor managers an avenue for system-based decision-making within the construction industry. This study shows that significant policy improvements related to job control, job support, and working conditions are required, as minor changes will not be appropriate.

Keywords: Mental ill-health; Construction supervisors; System dynamics; Psychologically Safe Workplace

1.0. Introduction

Work stress has been conceptualized as a determinant of health and job performance among various professions, including construction professionals. Work stress has been deduced to lead to poor physical and mental health (Boschman et al., 2013;Sunindijo and Kamardeen, 2017;Jetha et al., 2017). The effect of poor mental health includes poor physical health, reduced job performance, presenteeism, safety non-compliance (Wang et al., 2016), inability to withstand continued stress, and suicidality (Chan et al., 2020;Wang et al., 2016;Sunindijo and Kamardeen, 2017;Hawton et al., 2013). The issue of mental ill-health has become an international menace (Liu et al., 2021). Rees-Evans (2020) signaled a prevalence of depression and anxiety among construction professionals at a rate of 70% and 87%, respectively. The construction industry impacts employment generation and economic growth in every nation (Carvajal-Arango et al., 2021). Despite the industry's importance to the economy, its workers are vulnerable to poor mental health and wellbeing from exposure to high job demand, low task autonomy, low job support (Campbell, 2006;Love et al., 2010;Boschman et al., 2013), work-family/life imbalance (Lingard

et al., 2007;Oyewobi et al., 2020), interpersonal conflict (Chen et al., 2017), bullying and harassment (Kamardeen and Sunindijo, 2017). Similarly, they are subjected to over-promotion, fear of failure (Sutherland and Davidson, 1989), low income (Carvajal-Arango et al., 2021), job insecurity, and financial insecurity (Langdon and Sawang, 2018;Haynes and Love, 2004).

Mental ill-health causes economic loss to construction organizations (Liu et al., 2021;Nwaogu et al., 2019) making it difficult to meet their economic benefit. Thus, employers will be expected to invest in mental health intervention programs based on the magnitude of productivity lost to mental ill-health symptoms. To underscore the problem of mental ill-health, organizations should establish a healthy culture that prevents work-related stress and aid mental ill-health identification and treatment (Goetzel et al., 2018). Some solutions (mostly single-levelled) that form the basis of interventions have been proposed within the construction industry. The solutions include primary interventions, such as a compressed workweek, 450 minutes workday per week (Yip and Rowlinson, 2009;Lingard et al., 2007), and secondary interventions (e.g., those to build individual coping strategies).

Evidence shows that sustainable mental health interventions should be multimodal to mitigate risk factors present at individual and organization levels. Sustainable mental health emphasizes that wellbeing is an essential aspect of mental health outcomes (Bohlmeijer and Westerhof, 2021a). It is realized with a range of interventions and treatment which targets dysfunctional and functional emotional, cognitive and behavioral patterns (Bohlmeijer and Westerhof, 2021b). Unlike single-level interventions, multimodal interventions offer mental health promotion within an integrated (i.e., holistic) approach. Therefore, to build a workplace where employees are satisfied, and their well-being and productivity are maintained, a mix of measures that satisfy an integrated approach to mental health should form the basis of policymaking.

A system perspective can be used to conceptualize perceptions of interventions required in the construction workplace to boost mental health among construction professionals engaged in site supervisory positions. Following Jetha et al. (2017), a systems-based view of interventions via system dynamics modeling can aid the understanding of the impact of multimodal intervention strategies on mitigating and eliminating mental ill-health among construction supervisors. This entails using a system dynamics model to simulate the impact of implementing multimodal intervention strategies on long-term stress and mental health-related outcomes in the construction workplace.

Therefore, this study attempts to understand intervention strategies that could be implemented to alleviate work stress and improve construction supervisors' mental health in Nigeria. The objectives to achieve the aim are (i) to identify intervention strategies that are most effective in building a workplace that promotes positive mental health; (ii) to demonstrate the essence of engaging multimodal intervention strategies and their priority. The study underscores the importance of multimodal interventions in the construction workplace. This study expands the existing knowledge on the state of mental health among construction professionals and intervention strategies that could become the basis of policymaking in the construction industry. Although this study focused on construction supervisors within Nigeria, the findings from the study provide some applicability to the construction industry of other countries.

2.0. Literature review

2.1. Risk factors for mental ill-health

Risk factors are stressors that significantly precede the probability of an unpleasant outcome (Offord and Kraemer, 2000;Kraemer et al., 1997;Franklin et al., 2017). Among the working population, mental ill-health risk factors include factors present at the workplace (i.e., work

93 factors) and/or outside the workplace (i.e., nonwork factors) (Wang et al., 2016). Chan et al. (2020)
94 outlined that in the construction industry, work-related risk factors include poor work conditions,
95 nature of work, low income, while nonwork factors include poor extended family relationships
96 and marital relationships. Chan et al. (2020) categorized the factors into seven: job demand, job
97 control, workplace injustice, job support, welfare, family, and coping behavior. *Job demand risk*
98 *factors* consist of stressors intrinsic to the job that involves physical or psychological efforts
99 (Michie, 2002;Bakker and Demerouti, 2017). They include work pressure, workload, and long
100 work hours. *Job control risk factors* relate to a worker's ability to influence their job (Battams et
101 al., 2014). They include autonomy and skill discretion. Low job control has been associated with
102 depression. However, high job control is a protective factor for mental ill-health and can mediate
103 high job demand (Battams et al., 2014).
104 *Work support risk factors* are related to social support and relationships within the team
105 environment. They include lack of support at work, interpersonal conflict, and poor cooperation
106 and relationships (Battams et al., 2014;Love and Edwards, 2005). *Family-related risk factors*
107 consist of stressors related to work-home conflict and family issues. Work overload, long work
108 hours, low income, and job insecurity can affect family and leisure times, causing a feedback
109 stressor from the home to work. The feedback can make it difficult to cope with work stressors,
110 thereby affecting the professional's mental health and performance at work (Michie, 2002). They
111 include past traumatic experiences, marital challenges, and fractured relationships with extended
112 families (Battams et al., 2014;Cheung and Yip, 2015). *Welfare and socio-economic risk factors*
113 consist of stressors from the job, which challenge the professional's welfare and socio-economic
114 status among their peers. They include low income, job insecurity, and under/over promotion.
115 *Work hazard risk factors* are related to working postures, workplace accidents, and mild sickness

arising from work intensity. They include occupational injury, musculoskeletal pains, bodily pain, and headache. *Workplace injustice risk factors* relate to acts of disrespect and inequality in the construction workplace, such as bullying, harassment, and discrimination. Workplace injustice has been observed to amplify low job control and work support (Bowen et al., 2014).

While a large percentage of the literature on stressors in the construction industry considered only work factors, others have emphasized the role of nonwork factors (Wang et al., 2016;Sunindijo and Kamardeen, 2017). Boschman et al. (2013), considering psychosocial work factors, examined the risk factors for depression and post-traumatic stress disorder (PTSD) among construction site supervisors and bricklayers in the Netherlands using univariate logistic regression. They also determined the prevalence rate of the common mental ill-health conditions. Sunindijo and Kamardeen (2017) evaluated the sources of stress in Australia's construction industry. They used correlation analysis to examine the relationship between the stressors and the onset of depression and anxiety among construction professionals.

Similarly, Rees-Evans (2020) examined the prevalence rate of depression and anxiety among construction professionals as well as the psychosocial factors that may influence them, with the majority of the respondents based in the United Kingdom. While the studies provide pivotal information within the construction industry, they neither considered the prevalence rate of depression or anxiety among construction professionals in Nigeria nor multimodal intervention strategies required within the construction industry. The one-size-fits-all does not apply to mental ill-health conditions because risk factors are context-specific owing to psychosocial, economic and cultural differences (Rebar and Taylor, 2017;Nwaogu et al., 2019). Hence, the need for this study.

To prevent mental ill-health symptoms, information on a range of risk factors highlights valuable treatment points (Franklin et al., 2017). Additionally, to effectively combat risk factors,

information on the potency of risk factors is essential. To determine the potency of a risk factor, the population is dichotomized into high and low-risk groups (Franklin et al., 2017). Therefore, following Boschman et al. (2013), this study used univariate logistic regression as a priori to determine work and nonwork mental ill-health risk factors among construction supervisors in Nigeria to identify where to direct effective interventions. To achieve the aim of this study, this study adapted the risk factors identified in Chan et al. (2020) 's review of existing literature (see Appendix I). Thus, it improves on Chan et al. (2020) by determining the risk factors for mental ill-health among construction professionals occupying site supervisory positions in the Nigerian construction industry.

The impact of a stressor may vary based on demographic characteristics such as years of experience and gender (Battams et al., 2014). Therefore, this study assesses if the risk factors vary based on years of experience and gender.

2.2. Mental Health Intervention

Mental health intervention refers to health support guided by psychological methods and theory initiated to prevent and treat persons with mental ill-health (Joyce et al., 2016). There are three categories (modes) of interventions: primary, secondary, and tertiary. The interventions are targeted at either the organization level, individual level, or the interface between both levels (Pignata et al., 2017). It has been deduced that the most effective intervention strategies initiated by firms are multimodal interventions (Pignata et al., 2017;Joyce et al., 2016).

2.2.1. Intervention strategies to improve mental health within the construction industry

Few studies have examined the strategies to implement or enforce in the construction workplace to improve mental health. The studies include Campbell and Gunning (2020), Lingard et al. (2007), and Nwaogu and Chan (2021). Lingard et al. (2007) examined the use of compressed working

week arrangements to improve work-life balance and mental health among construction workers in Australia. The study focused on improving work-life balance, thereby employing a single-mode intervention strategy. However, because risk factors for mental ill-health are clustered together (Nwaogu et al., 2019), multimodal intervention strategies are necessary to effectively prevent or reduce risk factors.

Campbell and Gunning (2020) deduced a mix of multimodal measures that construction companies in the UK can adopt to improve mental health and wellbeing from the perception of construction professionals. The strategies include zero bullying and harassment, promoting social interaction within communal areas at lunchtime, and improving work-life balance. However, the study did not examine the specific strategies employed to improve work-life balance. We must acknowledge that strategies to improve work-life balance includes flexible work schedules and compressed work arrangements, and their applicability would differ depending on the type of construction job. Similarly, Campbell and Gunning (2020) did not consider other job design strategies such as job crafting and job sculpting that form primary intervention strategies in the construction workplace. Likewise, given the effect of sociodemographic (e.g., income), cultural and economic differences, the strategies necessary in the Nigerian construction industry and perceived level of importance may differ from those required for the UK construction industry.

Nwaogu and Chan (2021) evaluated the importance and practicability of a mix of 31 multimodal strategies in mitigating mental ill-health to improve psychological safety in the Nigerian Construction industry. The experts considered in Nwaogu and Chan (2021) included construction professionals that have risen to top management positions and occupy critical decision-making roles in their firms. However, the study did not explore the perception of construction professionals who work in site supervisory positions. While construction professions

185 share similarities, significant differences exist in their job roles and design. Therefore, this study
186 explores the strategies among professionals who work in site supervisory positions to determine
187 their perception of strategies required to improve their mental health. Additionally, this study also
188 moves the conversation forward by estimating the impact of the intervention strategies on risk
189 factors over time.

190 **2.3. Theoretical background**

191 *2.3.1. Job Demand and* Resources *(JD-R) model*

192 This study employs the Job Demand-Resources (JD-R) as a guide to identify potential multimodal
193 strategies because, unlike the Job Demand-Control (JD-C) model, it is flexible and aids
194 adaptability to work settings (Bakker and Demerouti, 2017;Schaufeli and Taris, 2014). It
195 incorporates psychological resources and can be expanded to include personal demands. The job
196 resources comprise components within the workplace that help cushion the effect of job demand.
197 Job resources also increase intrinsic motivation when the measures meet employees' need for job
198 task autonomy, schedule, or competence training (Pignata et al., 2017). Job resources alter
199 organizational culture, change employees' perception of stressors, and mitigate adverse health-
200 related outcomes (Bakker and Demerouti, 2007;Nwaogu and Chan, 2021).

201 Bakker and Demerouti (2017) suggest that the role of demands and resources over a period
202 of time should be integrated into future research. However, the JD-R model cannot be used to
203 determine the interactions between the risk factors and intervention strategies with respect to time
204 (Veldhuis et al., 2020). Therefore, the JD-R model was used to identify multimodal strategies (job
205 resources) to consider for promoting mental health within the construction industry, while system
206 dynamics model was used to model the interactions over time. Following the JD-R, job sculpting
207 and job crafting strategies were identified as potential resources to boost intrinsic motivation

(VanAntwerp and Wilson, 2018). Competence training, resilience-building, and positive coping strategies were identified to boost personal resources. Other strategies considered include hiring more personnel to reduce workload (Nwaogu and Chan, 2021).

2.3.2. System Dynamic Modeling

System dynamics modeling (SDM) is a socio-technical systems-based methodology (Jetha et al., 2017). The socio-technical system considers a work unit or organization as a system made up of social and technical parts that must work together in non-linear ways (Appelbaum, 1997;Jetha et al., 2017). Like the social-technical system, system dynamics is grounded on the theory of non-linear channels and feedback control (Lu et al., 2019). The system dynamics model (SDM) aids the understanding of complex problems over time, thereby enhancing improved policy and decision making (Brittin et al., 2015;Vitharana and Chinda, 2019). System dynamics model helps researchers show practitioners the possible outcomes of health promotion policies or interventions on workplace stress over time (Jetha et al., 2017).

This study uses system dynamics (SD) to simulate the relative and combined impacts of the intervention strategies on risk factors over time. The SD modeling was used to examine the feedback relationship between individual, psychosocial, and organizational factors associated with work stress and poor mental health. The SDM included multimodal interventions (i.e., primary, secondary, and tertiary) within the system boundary to compare the single and combined effects of the interventions in mitigating or preventing the onset of poor mental health in the construction industry. With respect to this study, after the JD-R model was used to identify intervention strategies that would promote positive mental health, the system dynamics modeling was used to

model the interactions between the risk factors and the multimodal intervention strategies with respect to time.

3.0. Methodology

The study employed a pragmatic philosophical view involving quantitative and qualitative research methods. Thus, survey questionnaires and expert interviews were leveraged to collect the data. The survey questionnaire elicited information on mental health and intervention strategies.

3.1. Research instruments

The questionnaire had three sections: demographics, mental health status, and intervention strategies. The mental health status questions were adopted from two validated psychometric instruments: Generalized Anxiety Disorder-2 (GAD-2) and Patient Health Questionnaire-9 (PHQ-9).

3.1.1. Stressors' instrument

The stressor questions were developed by adapting stressors identified in previous literature (Chan et al., 2020;Sunindijo and Kamardeen, 2017;Chan et al., 2012;Campbell and Gunning, 2020;Park et al., 2016). A total of 37 sources of stress made up the stressor instrument (see Appendix I). In this section, respondents were required to indicate the frequency at which each item caused them stress on a four-point Likert scale: 1 = "never", 2 = "very little", 3 = "moderately", and 4 = "very great".

3.1.2. Intervention strategies instrument

The strategies instrument is measured on a four-point Likert scale and consists of 28 items adapted from Nwaogu and Chan (2021). According to Nwaogu and Chan (2021), the instrument was developed following a review of existing literature in occupational health, e.g., Enns et al. (2016) (see Appendix II).

3.1.3. Patient Health Questionnaire-9 (PHQ-9)

The PHQ-9 is a validated self-report questionnaire used to assess the presence of depression and the severity of each symptom (Li et al., 2017). Using a recall period of two weeks, the PHQ-9 evaluates the frequency of each symptom using a 4-point Likert scale with options, 0 = "not at all", 1 = "several day", 2 = "more than half the day" and 3 = "nearly every day". The total PHQ-9 score ranges from 0 to 27; based on cut-off points, respondents are categorized into five groups of depressive symptoms: minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19), severe depression (20-27) (Li et al., 2017;Kroenke et al., 2007). PHQ scores 5-9 indicate minor depression, and PHQ scores ≥ 10 indicate major depression (Choi et al., 2020;Adewuya et al., 2018).

3.1.4. Generalized Anxiety Disorder-2 (GAD-2)

GAD-2 is a validated brief of the GAD-7 questionnaire. It uses two questions to assess clinically significant anxiety symptoms (Hughes et al., 2018). The response options and recall period are the same as the PHQ-9. The GAD-2 score ranges from 0 to 6; a score ≥ 3 indicates clinically significant anxiety (Hughes et al., 2018;Nwaogu et al., 2021).

3.1.5. Face and Content Validity of questionnaire

The validity process involved two construction professionals and two occupational health psychologists, who serve in Professorial/Associate ranks and have publications in the subject area. The draft version of the questionnaire was sent to the construction professionals for their perusal. Thereafter, the improved draft based on the feedback from the construction professionals was sent to the occupational health psychologists. All feedback was used to improve the questionnaire further. An improved version of the questionnaire was sent out to all the reviewers for their perusal.

After the reviewers approved the questionnaire, the final version was pilot tested among fifteen construction supervisors who are members of the Nigerian Institute of Architects (NIA), Nigerian Institute of Building (NIOB), Nigerian Institute of Civil Engineering (NICE), and Nigerian Institute of Quantity Surveyors (NIQS). The construction supervisors were requested to indicate the appropriateness of the questions and duration taken to fill the questionnaire.

3.2. Sample Size

The number of supervisors to sample was estimated using the formula cited by Nwaogu et al. (2021) and Sunindijo and Kamardeen (2017):

$$\text{Sample size, } N = \frac{(t)^2 \, x \, (s)^2}{d^2} \quad \ldots\ldots (1)$$

$$N = \frac{(1.96)^2 \, x \, (1)^2}{(4 \, x \, 0.05)^2} = 96 \quad \ldots\ldots (2)$$

N is the sample size; t = the confidence level based and represented by 1.96; s = the estimated variance deviation of the Likert scale; d = the margin of error for the mean (i.e., 4, multiplied by the acceptable margin of error = 5%). Therefore, at least 96 construction supervisors were to be sampled, and only professionals engaged in on-site building production were surveyed. Hence, to survey the appropriate personnel and preserve the research quality, purposive sampling was adopted to recruit the respondents from NICE, NIOB, NIA, and NIQS.

3.3. Data collection

Using face to face medium, 550 copies of the questionnaire were administered to purposively identified construction supervisors on their project sites. Owing to work schedule, while some supervisors responded to the questionnaire immediately, a follow-up was required in most cases.

3.4. Data analysis

The data collected were analyzed using mean score, univariate logistic regression analysis, and system dynamics modeling (SDM). The SDM was performed in Vensim PLE software for

Microsoft (version 8.2), while the mean and logistic regression were performed using Statistical Package for Social Sciences (SPSS) version 26.0.

3.4.1. Mean score (MS)

Mean score, the commonly used descriptive statistics for quantitative analysis, was used to rank the stressors and intervention strategies to indicate their frequency of impact (Nwaogu and Chan, 2021). If two or more variables have the same mean, the variable with the lowest standard deviation is ranked highest. In this study, the mean score ranges between 1 and 4; the higher the mean, the more the item's perceived intensity to create stress or mitigate the occurrence of stress. Following the relative importance index limits shown in Aghili et al. (2019), three levels of importance of the strategies were transformed from the mean: high importance $3.2 < \text{MS} \leq 4.0$, medium importance $2.0 < \text{MS} \leq 3.2$, and low importance $0 < \text{MS} \leq 2.0$.

3.4.2. Logistic regression

In order to determine the stressors, which are apparent risk factors for mental ill-health, and to highlight where to direct preventive intervention, univariate logistic regression was applied. This type of regression is mostly employed in medicine, epidemiology, or allied professions because researchers are concerned about whether or not a person has an illness or not (Offord and Kraemer, 2000). If the OR is less than one, the odds associated with the stressor causing the mental ill-health symptom are lower. On the contrary, if the OR is greater than one, the odds of causing the mental ill-health symptom are higher; thus, it is a risk factor. For the univariate analysis, the respondents were classified into two groups each- *with depression versus no depression*, *with anxiety versus no anxiety*, as shown in Nwaogu et al. (2021), Li et al. (2017), and Choi et al. (2020). For dichotomous coding, the stressors and mental ill-health symptoms were coded as follows:

- With depression versus no depression- participants were categorized as “depression” if they had PHQ-9 scores ≥ 5. With anxiety versus no anxiety- participants were categorized as “anxiety” if they had GAD-2 scores ≥3. For depression or anxiety symptoms; 1 = "several days", 2 = "more than half the days", and 3 = "nearly every day" were combined and coded as 1, while 0 = "not at all" was coded as 0.
- For stressors, 1 = “never” was coded as 0 (i.e., No), while 2 = “very little”, 3 = “moderately”, and 4 = “very great” were combined and coded as 1 (i.e., Yes).

3.4.3 Test for Independence

Chi-square test (χ^2) or Fisher’s exact test was used to explore whether there exists a relationship between the demographic characteristics (i.e., gender, years of experience) and each mental ill-health condition as well as the risk factors. Chi-square test is used to determine if a relationship exists between two categorical variables (Kim, 2017). Suppose the distribution of the categorical variable is highly different over the different groups. In that case, it is concluded that the categorical variable’s distribution is associated with the variable of groups. If otherwise, then it is independent or not associated. When the expected number of frequencies in more than 20% of the cells is fewer than five, the Fisher exact test is employed in place of the Chi-square test (Kim, 2017;Kroonenberg and Verbeek, 2018).

Bonferroni correction was used to carry out a posthoc test to determine whether there is a significant difference between the years of experience groups. Bonferroni correction is used to control or avoid the familywise error rate, also known as Type 1 error. Suppose the Chi-square or Fisher’s test indicates that there is a significant association, and one or more of the groups has more than two categories (e.g., in this study, years of experience has six groups), it is vital to

determine if there is any significant difference in the group (i.e., between 1-5, 6-10, 11-15, 16-20, 20-15 and over 25 years) (Kim, 2017).

3.4.4. Model construction for System Dynamic Modeling

The model construction involved an expert discussion session with six project managers. Following the descriptive statistics and logistic regression analysis, a causal loop diagram indicating the risk factors for mental ill-health and the interventions to mitigate risk factors and ameliorate mental health over time was developed. Further refinement of the loop diagram was conducted with the project managers to analyze the feedback loop critically. After several iterations between the panelists on the accuracy of the feedback loops, a final causal loop diagram that conceptualizes the system was agreed upon (see Fig. 1) and developed into stock and flow diagram using the Vensim software (Fig. 2).

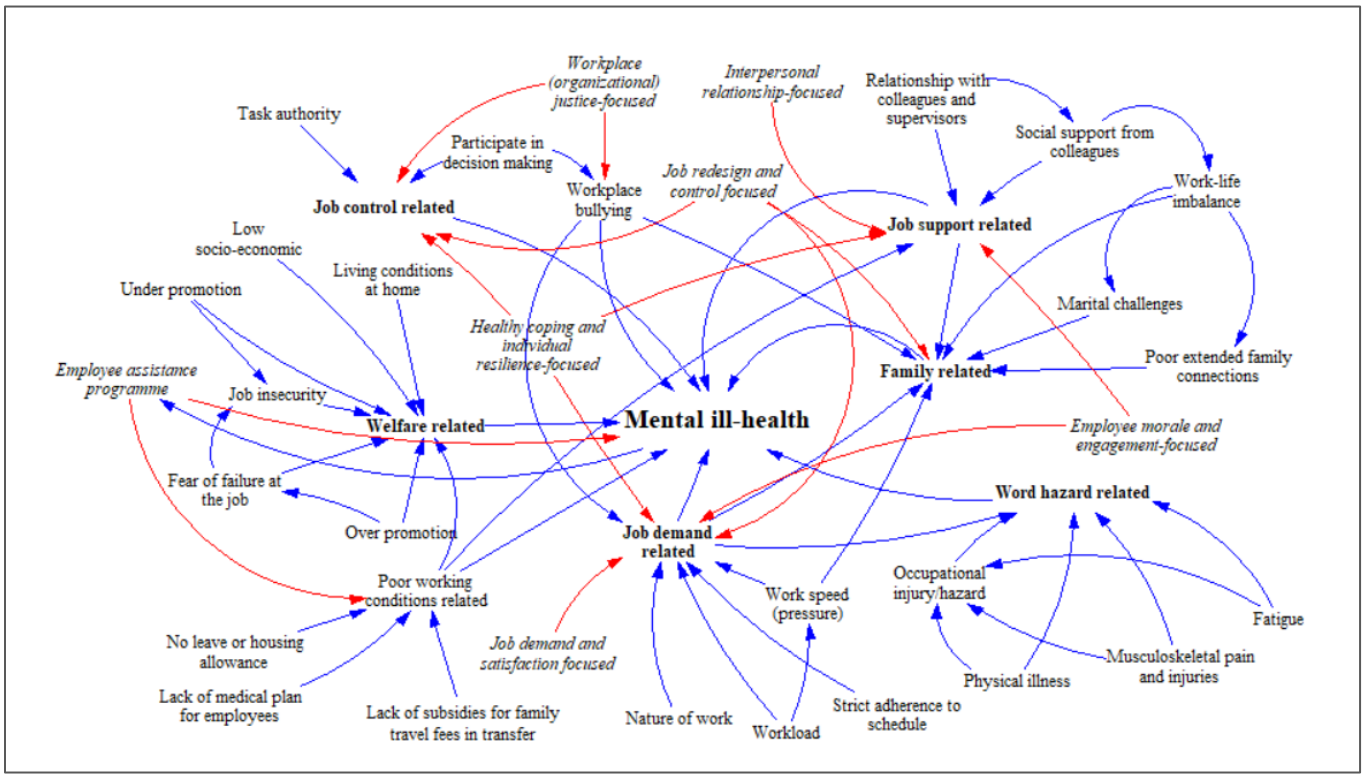


Fig. 1. Causal loop diagram for mental ill-health and intervention strategies.

3.4.4.1 Parameters and simulation

The entire model includes 17 auxiliary variables, seven levels, two lookups, 64 symbols, and 32 constants. The auxiliary variables represent the strength of the impact of the risk factors. The model has to be parametrized before the simulation can be carried out. Winzer et al. (2018) opine that allowing adequate post-intervention follow-up periods are essential as intervention benefit may change direction and strength over time. Thus, the time horizon for observing the system's behavior was set to 36 weeks to allow an adequate period to assess the intervention effect. The odd ratio deduced from the logistic regression was entered as values for the risk factors. For the interventions, the baseline value was 1 representing the intervention's intensity. The panelists agreed upon the values during the expert discussion session. The model parameters and equations are shown in Appendix III. The simulation began by running a baseline simulation to test the effects of the risk factors. Thereafter simulation was run to test the effects of the intervention strategies and changes required to reduce the likelihood of developing mental ill-health symptoms.

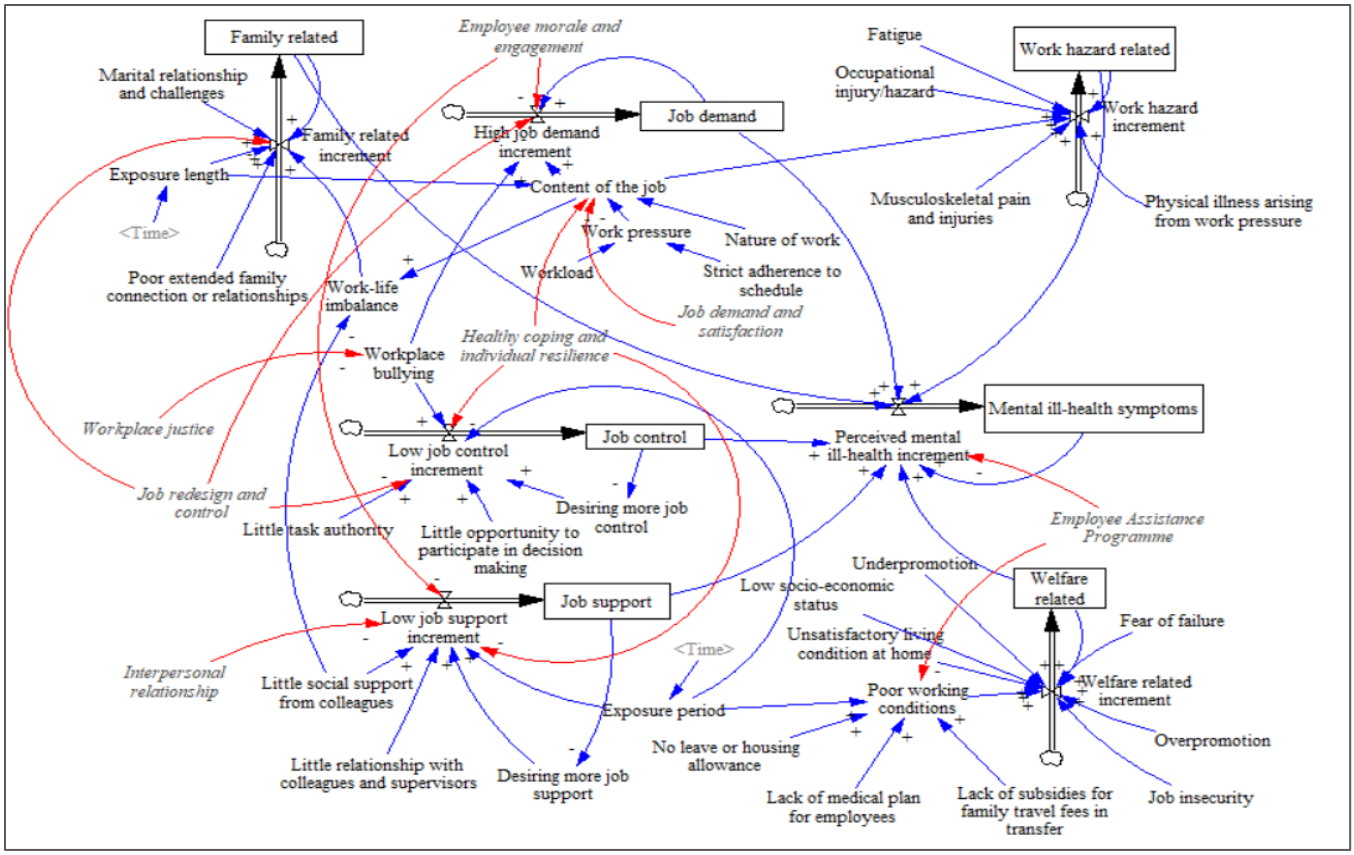


Fig. 2. Stock and flow diagram showing interventions interacting with risk factors of mental ill-health.

4.0. Results

4.1. Profile of the respondents

At the end of the data collection period, out of 550 questionnaires administered, a total of 174 filled questionnaires were retrieved, representing a 34.8% response rate. Aligning with the nature of the construction industry, the respondents were predominantly male (90.8%), while only 9.2% were females (see Table 1). The supervisors' nomenclature included site engineer/supervisors, project manager and their assistants, 73.6% of the respondents had over six years of work experience. Given the respondents' demographic characteristics, all the supervisors are fit to provide credible information.

Table 1: Demographic and mental ill-health characteristics of the construction supervisors

Variable	Categories	Frequency (%)
Demographics characteristics		
Sex	Male	158 (90.8)
	Female	16 (9.2)
Years of Experience	1-5 years	46 (26.4)
	6-10 years	66 (37.9)
	11-15 years	41 (23.6)
	16-20 years	10 (5.7)
	21-25 years	4 (2.3)
	over 25 years	7 (4.0)
Position	Project Manager	62 (35.6)
	Site Engineer / Supervisor	73 (41.9)
	Asst. Site Engineer / Supervisor	39 (22.4)
Education	HND	43 (24.7)
	PGD	19 (10.9)
	BSc. / B.Tech.	67 (38.5)
	MSc. / M. Tech.	45 (25.9)
Professional Affiliation	NIOB	93 (53.4)
	NICE	74 (42.5)
	NIQS	5 (2.9)
	NIA	2 (1.1)
Mental ill-health symptoms		
Depression (0, 27)	None-Minimal (0-4)	79 (45.4)
	Mild (5-9)	65 (37.4)
	Moderate (10-14)	27 (15.5)
	Moderately severe (15-19)	3 (1.7)
Anxiety (0, 6)	None-minimal (0-2)	149 (85.6)
	Mild-moderate (≥ 3)	25 (14.4)

4.2.1 Test of Independence between mental ill-health conditions and demographic variables

As shown in Table 2, Chi-square test and Fisher test revealed no statistically significant relationship between the years of experience, gender, and any mental ill-health condition. However, as indicated in Table 3, the Chi-square test revealed a statistically significant association between gender and three stressors (i.e., CS14, CS27, CS24). Similarly, Fisher's exact test revealed a significant association between years of experience and four risk factors of depression and anxiety (CS04, CS07, CS18, CS17) as well as three stressors (CS15, CS28, CS23). With Boneforri correction ($p = 0.00417$), there was a significant difference between the years of experience group for two risk factors: CS17 (21-25years, $p = 0.00223$; over 25years, $p = 0.00318$) and CS18 (6-10 years, $p = 0.00367$).

Table 2: Test of Independence between mental ill-health conditions and demographic variables

Demographic characteristics	**Mental ill-health condition**

	Depression		Suicidal ideation		Anxiety	
	χ^2 / Fisher	p-value	χ^2 / Fisher	p-value	χ^2 / Fisher	p-value
Gender	2.078*	0.190	0.230*	0.645	1.619*	0.253
Years of experience	2.541f	0.791	7.027f	0.158	7.025f	0.164

Note: * or χ^2 = Chi-square Test; f = Fisher's exact test

4.2 Risk factors of mental ill-health symptoms in the study population

The PHQ score revealed that 55% (95) of the respondents had depressive symptoms while 14.4% (25) had anxiety symptoms (see Table 1). Logistic regression revealed that only 25 out of 37 stressors were risk factors of mental ill-health among the respondents (see Table 3). Specifically, the 25 stressors were associated with the likelihood of developing depression. In contrast, only two stressors (i.e., occupational injury and poor family relationship) were related to anxiety symptoms. The odds of developing depression or anxiety ranged from 1.03 to 4.96, respectively, among those exposed to the stressors.

405 **Table 3.** Mental ill-health risk factors and their constructs

Code	Variables	Test for Independence				Univariate Logistic Regression			
		Years of experience		Gender		Depression		Anxiety	
		F	p-value	χ^2	p-value	p-value	OR	OR	p-value
Job demand related									
CS04	Work overload	**13.882**	**0.009**	0.140	0.718	**0.002**	**4.26**	0.998	33.00
CS05	Increased work speed	0.721	0.996	0.652	0.419	**0.009**	**3.77**	0.191	3.94
CS12	Strict adherence to time or schedule	5.067	0.383	1.303	0.363	**0.002**	**3.18**	0.986	1.01
CS02	Nature of work causing increased mental demand	7.122	0.183	1.760	0.243	**0.000**	**3.94**	0.089	2.98
Job support related									
CS07	Little social support from colleagues and supervisors	**11.027**	**0.005**	0.040	0.841	**0.000**	**4.96**	0.255	2.09
CS08	Little relationship with colleagues and supervisors	2.662	0.769	2.136	0.162	**0.000**	**4.03**	0.064	3.28
CS14	Criticisms from superiors	4.724	0.442	**6.172**	**0.020**	0.052	1.93	0.053	1.37
CS15	Lack of feedback mechanism in place	***14.722***	***0.007***	0.983	0.377	0.569	1.22	0.904	0.94
Job control related									
CS06	Little opportunity to participate in decision making	8.914	0.085	0.136	0.770	**0.000**	**4.93**	0.080	3.80
CS18	Little task authority	**14.626**	**0.008**	0.286	0.397	**0.009**	**2.40**	0.099	2.57
Welfare related									
CS11	Job insecurity	8.838	0.088	0.914	0.347	**0.002**	**3.39**	0.088	3.66
CS10	Lack of leave or housing allowance	6.501	0.223	2.532	0.121	**0.015**	**2.53**	0.423	0.68
CS34	Lack of subsidies for family travel fees in the case of a transfer	2.818	0.748	1.331	0.265	**0.002**	**2.83**	0.910	0.95
CS33	Lack of a medical plan for employees	2.258	0.837	2.961	0.096	**0.000**	**4.04**	0.204	1.96
CS16	Low socio-economic status	5.774	0.312	0.158	0.782	**0.001**	**3.07**	0.274	1.79
CS32	Under promotion	7.151	0.194	0.585	0.444	**0.000**	**3.61**	0.216	1.85
CS29	Unsatisfactory living condition at home	3.242	0.674	0.005	0.943	**0.000**	**3.84**	0.450	1.46
CS19	Fear of failure at the job	7.598	0.169	0.000	0.995	**0.004**	**2.48**	0.183	0.56
CS17	Over promotion	**17.516**	**0.000**	1.658	0.293	**0.039**	**1.89**	0.256	0.60
CS27	Low income causing financial insecurity	5.985	0.239	**18.021**	**0.001**	0.068	2.48	0.557	1.58
CS28	Salaries not paid on time	***17.223***	***0.002***	1.606	0.287	0.924	1.03	0.774	0.88
CS35	Lack of opportunity for career development	3.660	0.602	0.083	0.773	0.053	1.94	0.349	0.65
CS36	Lack of opportunity for promotion	3.893	0.556	0.001	0.978	0.116	1.75	0.281	1.86
CS37	Lack of team or departmental or company social get-togethers	1.249	0.962	0.283	0.779	0.101	1.72	0.379	1.55
Work hazard-related									
CS13	Fatigue resulting from work causing poor sleep and recovery	2.559	0.774	0.001	0.982	**0.003**	**3.49**	0.070	6.56
CS01	Physical illness arising from work pressure	10.161	0.053	3.535	0.074	**0.001**	**3.27**	0.231	1.99
CS21	Musculoskeletal pain and injuries	4.437	0.491	1.357	0.293	**0.004**	**2.47**	0.477	1.38
CS09	Occupational injury/hazard	4.888	0.435	0.383	0.606	**0.000**	**3.36**	**0.029**	**2.96**
CS22	Poor physical working condition	5.824	0.315	2.512	0.174	0.523	1.22	0.510	1.35
Family-related									
CS26	Work-home/life imbalance	7.661	0.154	3.176	0.090	**0.000**	**3.40**	0.773	1.15
CS31	Poor family connection or relationships	5.077	0.414	1.912	0.197	**0.012**	**2.19**	**0.014**	**3.35**
CS30	Marital relationship and challenges	0.441	0.533	2.703	0.117	**0.006**	**2.40**	0.163	1.84
Workplace injustice related									
CS25	Workplace bullying	7.231	0.195	0.226	0.793	**0.048**	**1.03**	0.334	1.52
CS24	Workplace harassment	7.340	0.188	**5.264**	**0.033**	0.608	0.86	0.406	1.44
CS23	Lack of respect from subordinates	***19.613***	***0.001***	2.958	0.115	0.240	1.43	0.084	2.21

406 **Note**: Figures in bold are significant; OR – Odds Ratio; F = Fisher's exact test; χ^2 = Chi-square Test

4.3. Intervention strategies to improve mental health

The mean score of the intervention strategies showed that the majority (27/28) of the strategies ranked within the high importance range (see Table 4). Notably, "*ensuring a sustainable retirement plan for employees,*" "*celebrate employee's success*" and "*reduce the threatening of staff with disengagement"* ranked as the top three strategies necessary to promote a Nigerian construction workplace that is psychologically healthy. Overall, the *interpersonal relationship construct* ranked the highest (mean = 3.48), followed by *employee morale and engagement-focused construct* (mean = 3.43).

Table 4. Intervention strategies to implement for mental health promotion.

Code	Strategies	Descriptive statistics			TOI
		Mean	**SD**	**R**	
Interpersonal relationship-related (SC1))		**3.48**			P, S
ST1	Ensure swift conflict resolution	3.53	0.61	5	
ST2	Supporting improved relationships at work	3.45	0.59	8	
ST3	Put in place measures that increase cooperation between supervisors and subordinates	3.45	0.67	9	
Employee morale and engagement-focused (SC2)		**3.43**			P, S
ST4	Celebrate employee's success	3.57	0.67	2	
ST5	Give constructive feedback instead of reprimanding	3.44	0.62	10	
ST6	Promote employees' deeply embedded life interest by designing job roles in-line with embedded interest	3.29	0.77	23	
Healthy coping and individual resilience-focused (SC3)		**3.42**			S
ST7	Provide employees with competence training	3.54	0.59	4	
ST8	Put better education policies in place (e.g., providing subsidies for / encouraging employee career development	3.49	0.63	6	
ST9	Promote mental health awareness through literacy programs	3.41	0.76	11	
ST10	Introduce wellness programs to workplaces/site offices, including measures in place for exercises such as exercise weekends or challenges or going for walks	3.39	0.66	13	
ST11	Empower staff to be individually more resilient through resilience training programs	3.35	0.75	17	
ST12	Provide practical stress management training	3.31	0.78	21	
Workplace (organizational) justice-focused (SC4)		**3.40**			P
ST13	Reduce threatening of staff with disengagement when they make mistakes	3.55	0.64	3	
ST14	Create policies to eliminate harassment	3.39	0.80	15	
ST15	Create policies to eliminate bullying	3.34	0.74	19	
ST16	Promote equality policies irrespective of gender, and age	3.32	0.80	20	
Job demand and satisfaction focused (SC5)		**3.35**			P
ST17	Better planning of work tasks and shifts	3.41	0.81	12	
ST18	Conduct employee satisfaction surveys	3.38	0.73	16	
ST19	Allow the taking of regular breaks to enable rest	3.34	0.69	18	
ST20	Hire more personnel to reduce the workload	3.25	0.78	26	
Employee Assistance Programme (SC6)		**3.34**			S, T
ST21	Offer a sustainable retirement plan for employees	3.63	0.62	1	

ST22	Conduct regular team meetings with supervisors and tradesmen focused on addressing work stress	3.39	0.69	14	
ST23	Promote communication about work stress from supervisors or tradesmen without penalty	3.29	0.67	22	
ST24	Provide aid for stressors such as financial challenges	3.25	0.66	25	
ST25	Offer assistance to nonwork stressors such as marital, family, or relationship challenges or lifestyle challenges	3.14	0.67	28	
Job redesign and control focused (SC7)		**3.33**			P
ST26	Offer employee's opportunities to balance work and life using a compressed workweek	3.48	0.70	7	
ST27	The workplace should allow site employees' a flexible work schedule with regards to work time and duration with no intention to reduce productivity or performance	3.29	0.83	26	
ST28	Employees should be allowed some flexibility to design their job roles and tasks while human resources approve it in-line with the job position and goals of the organization	3.22	0.79	27	

Note: The strategies are adapted from Nwaogu and Chan (2021); Figures in bold are the mean score for the construct; SD - Standard Deviation; TOI – Type of intervention; R – Rank; P – Primary; S – Secondary; T – Tertiary intervention

4.4. Simulation experiment and analysis

4.4.1. The impact of changing model components on mental health

Simulation was used to assess the impact of single and multiple risk factors on baseline mental ill-health. Overall, it was deduced that an intervention variable value of 1 has little effect on long-term stress and mental ill-health symptoms, while a variable value of 3 has three times effect.

4.4.1.1 Single-factor effects on mental health

Simulation was conducted to assess how changes to job control, job support, and job demand-related risk factors could impact baseline mental ill-health. As shown in Fig 3, reduced high job demand was associated with an exponential decrease in mental ill-health. It was observed that when job demand reduced by 25%, baseline mental ill-health decreased from 122.65 to 97.16 at week 6 and from 143.65 to 116.16 at week 36. Thus, amounting to a 20.78% and 17.74% reduction effect at week 6 and 36, respectively (see Appendix IV). On the contrary, increasing job control or job support by 25% (i.e., reducing low job control or low job support by 25%) was associated with a slight decrease in mental ill-health (see Fig. 4 and 5).

Specifically, on improving job control by 25%, baseline mental ill-health decreased slightly from 122.65 to 118.99 at week 6 and from 143.65 to 139.99 at week 36 (see Appendix V).

Similarly, by improving job support by 25%, baseline mental ill-health slightly decreased from 122.65 to 119.16 at week 6 and from 143.65 to 140.16 at week 36 (see Appendix VI). The job control had a 1.49% (week 6) and 1.27% (week 36) reduction effect, while job support had a reduction effect of 2.85% and 4.85% at week 6 and 36, respectively.

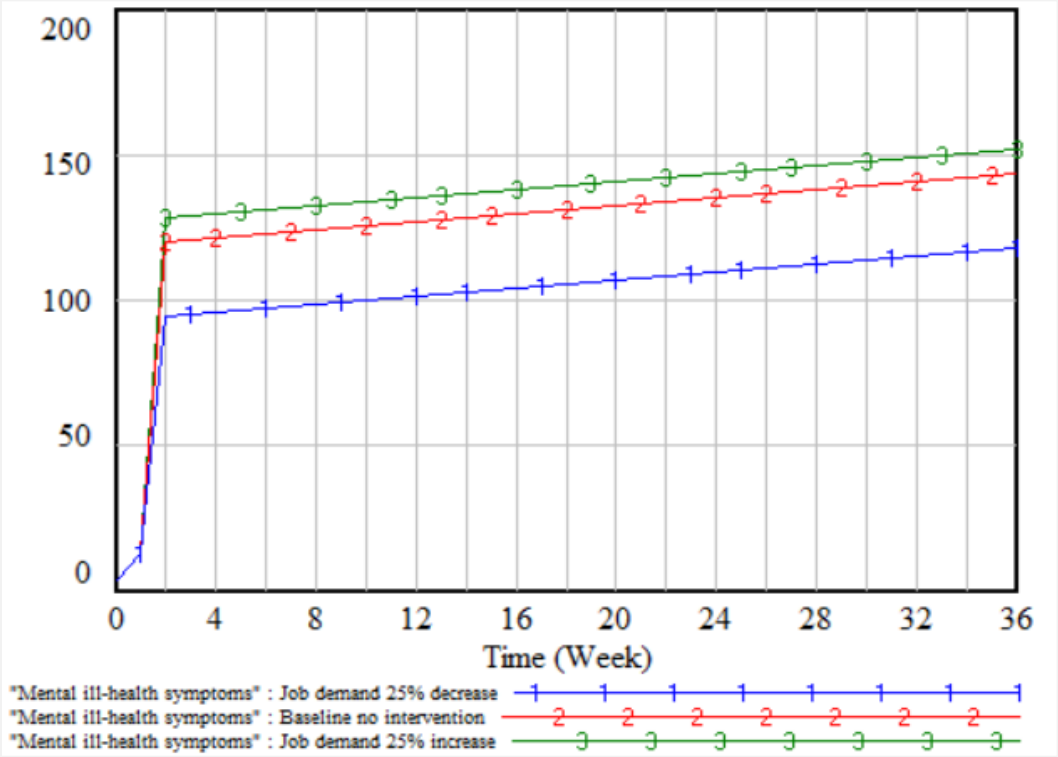


Fig. 3. Changes in mental ill-health based on changes in job demand.

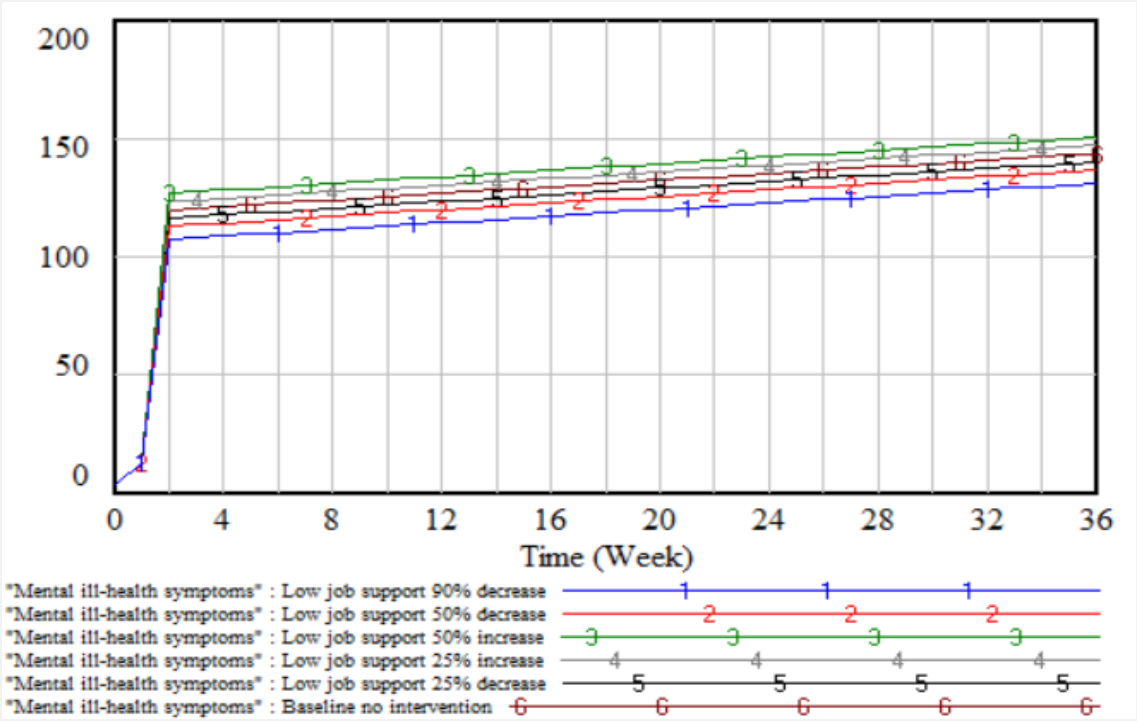


Fig. 4. Changes in mental ill-health based on changes in job support.

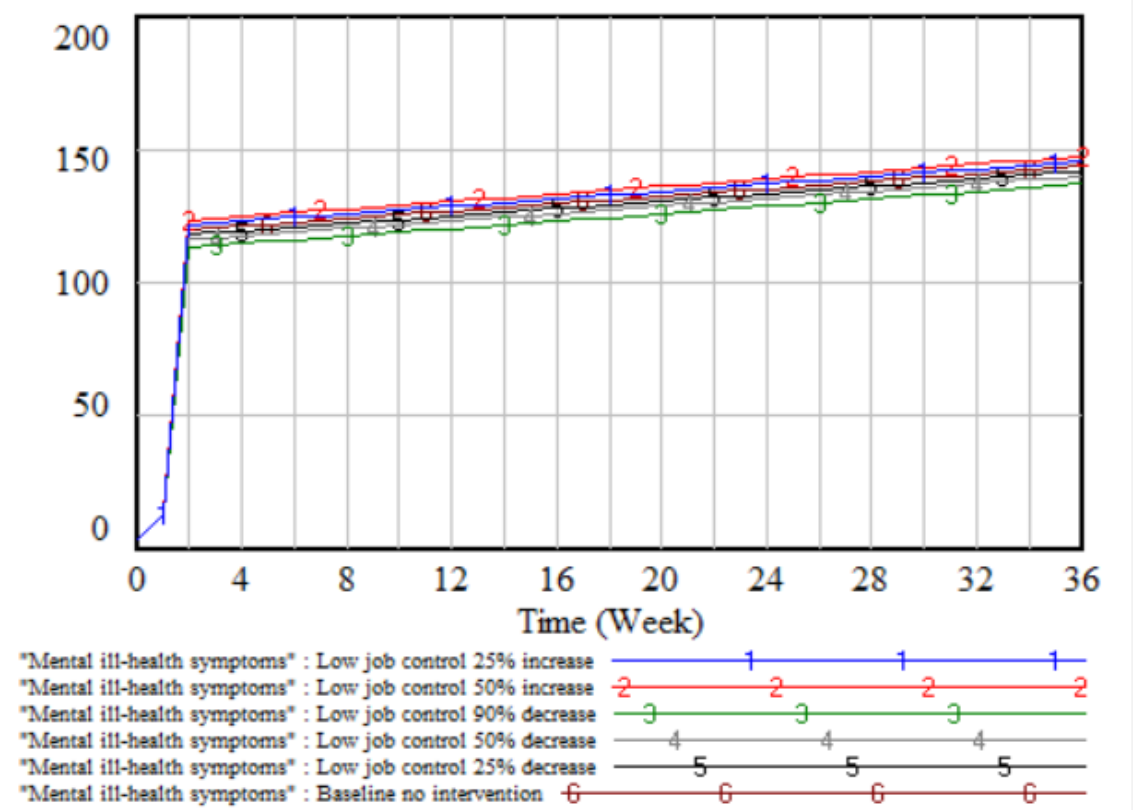
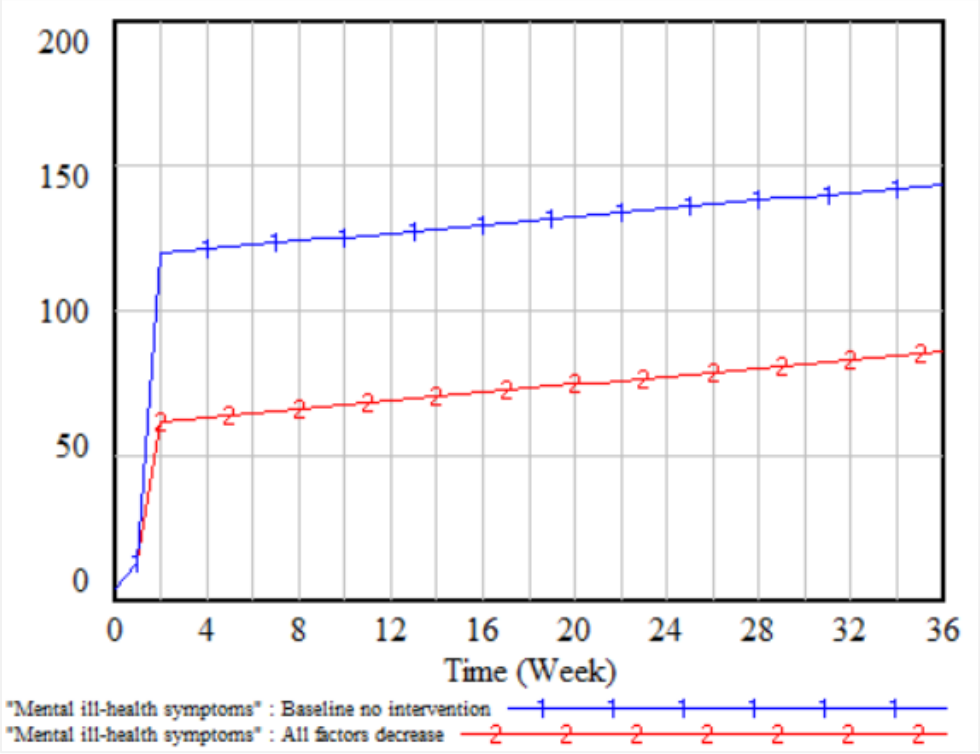


Fig. 5. Changes in mental ill-health based on changes in job control.

448 *4.4.1.2 Multiple factors effects on mental health*

449 After evaluating the single-component effect, all the seven factors were simulated using a 50%
450 reduction in job demand, family, workplace injustice, welfare, work hazard-related risk factors,
451 and 90% reduction in low job control and support. In this study, decreasing job demand by 25%
452 greatly improved mental ill-health conditions, while a 25% increase in job control or job support
453 slightly improved the condition. However, considering the nature of the construction industry, it
454 may not be feasible to reduce job demand and related constructs by 90%. Therefore, it was
455 hypothesized that, to increase the impact of job control and support on stress, low job control and
456 low job support should be decreased by at least 90%, while other risk factors reduced by 50%. The
457 simulation output indicated by Line 2 on Fig. 6 showed that by decreasing all the risk factors,
458 mental ill-health reduced from 122.65 to 64.73 at week 6 and from 143.65 to 85.73 at week 36,
459 implying a 47.23% and 40.32% improvement in mental health.



460
461 **Fig. 6.** Changes in mental ill-health based on changes in all risk factors.

462 *4.4.2. Single and multimodal interventions effects on mental health symptoms*

463 The baseline simulation revealed that mental ill-health increased over a period of 36 weeks; 4 (0
464 weeks) to 122.65 (6 weeks) to 131.05 (18 weeks) to 143.65 at week 36, as indicated by Line 1 in
465 Fig. 7. The simulation also revealed that at an intensity value of 1, the combined intervention
466 reduced mental ill-health slowly over a period of 36 weeks; from 122.65 (baseline 6 weeks) to
467 105.65 (6 weeks), 131.05 (baseline 18 weeks) to 114.05 (18 weeks), and 143.65 (baseline 36
468 weeks) to 126.65 (36 weeks). Specifically, at an intensity value of 1, the combined interventions
469 indicated by Line 2 had a 14.02%, 12.97%, and 11.83% reduction effect at weeks 6, 18, and 36,
470 respectively (see Appendix VII). On increasing the combined interventions by 200% (i.e., the
471 intensity value of 2) indicated by Line 3, the reduction effect per week increased two times.

472 The effect of single interventions on mental ill-health varied from one intervention to
473 another (see Fig. 7 and Appendix VIII). It was observed that at an intensity value of 1, secondary
474 intervention (SC3) indicated by Line 5 had a 4.08%, 3,81%, and 3.48% reduction effect in baseline
475 mental ill-health at weeks 6, 18, and 36, respectively. At value 2, secondary intervention (SC3)
476 had an 8.15% (week 6), 7.63% (week 18), and 6.96% (week 36) reduction effect on baseline mental
477 ill-health (see Appendix V). At an intensity value of 1, primary interventions (SC4, SC5, SC7)
478 indicated by Line 6, reduced the baseline mental ill-health from 122.65 (6 weeks) to 114.65 (6
479 weeks), 131.05 (18 weeks) to 123.05 (18 weeks), 143.65 (36 weeks) to 136.65 (36 weeks),
480 amounting to a 6.52%, 6.10%, and 5.57% reduction effect at 6, 18 and 36 weeks respectively on
481 baseline simulation. Likewise, increasing the primary intervention value to 2 resulted in a 13.05%,
482 12.21%, and 11.14% reduction effect at 6, 18, and 36 weeks, respectively, from the baseline
483 simulation.

At intensity value 1, combined primary and secondary interventions (SC1, SC2, SC3, SC4, SC5, SC7) indicated by Line 0 resulted in 13.05%, 12.21%, and 11.14% reduction effect on baseline mental ill-health at weeks 6, 18, and 36, respectively (Fig. 3). It was observed that the effect was the same as implementing a primary intervention (SC4, SC5, SC7) at an intensity value of 2 (Line 7). With multimodal interventions, increasing mental ill-health prevalence can be greatly mitigated. Therefore, to determine a stronger intervention effect necessary to reduce mental ill-health at week 36 by at least 40.32%, as shown by Line 2 in Fig. 6, the formula below was adopted:

$$\text{Intervention effect, } y = \frac{\text{percentage change when all factors were decreased without intervention}}{\text{lowest percentage change at baseline with intervention at value 1}} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

Following eqn. (3), the intervention value was determined to be 4. As indicated by Line 4 in Fig. 8, with a stronger multimodal intervention effect (e.g., increasing each intervention value to 4), at week 36, mental ill-health prevalence reduced by 47.2% to 75.65 from a baseline value of 143.65. Line 5 in Figure 8 shows that at an intervention value of 3.4, the effect of the combined intervention on alleviating long-term stress and mental ill-health is the same as reducing low job control and support by 90 percent, and other risk factors were reduced by 50 percent (Line 3).

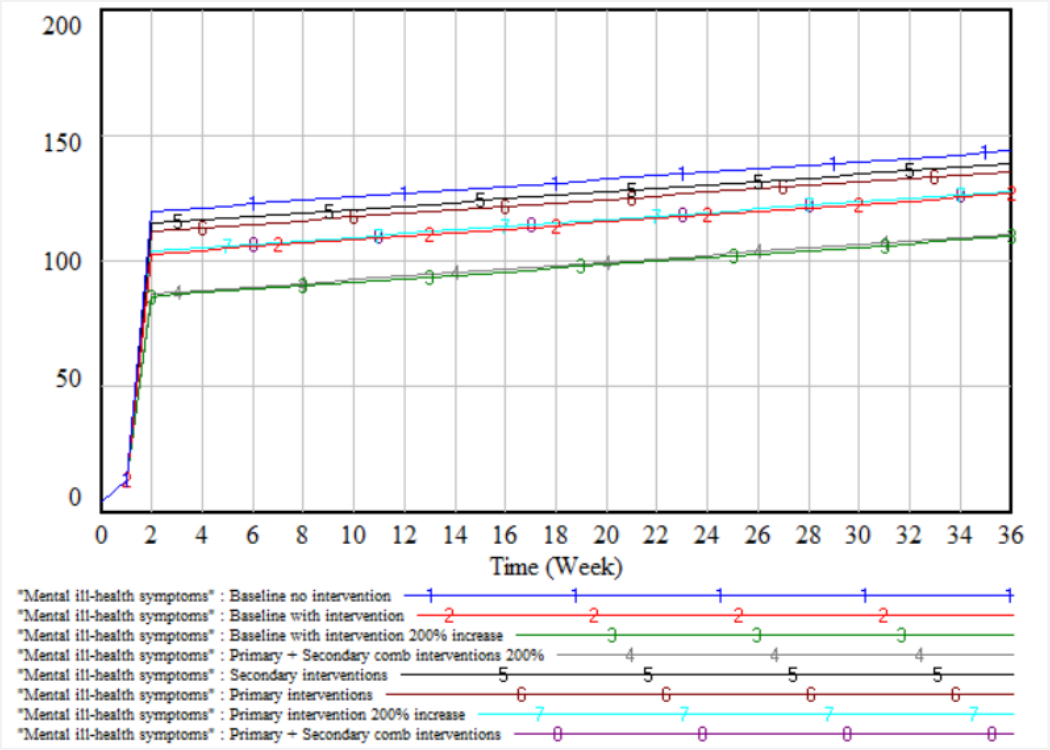


Fig. 7. Mental ill-health prevalence trend with intervention.

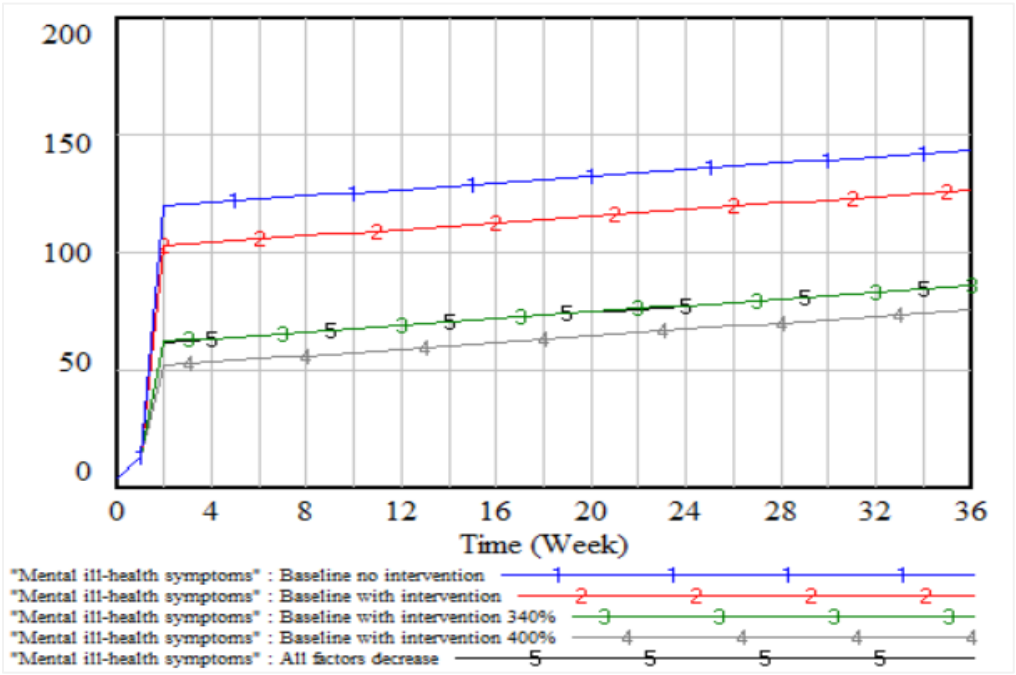


Fig. 8. The potential impact of mitigating risk factors over time.

5.0 Discussion

5.1 Mental ill-health prevalence and their risk factors

This study suggests a higher prevalence of depression than anxiety among construction supervisors in Nigeria. This negates Sunindijo and Kamardeen (2017) and Rees-Evans (2020) that reported a high prevalence of anxiety than depression among construction professionals in Australia and the UK. Although this finding negates evidence from developed economies, it is consistent with those that have reported a prevalence of depression than anxiety in the Nigerian population (Adewuya et al., 2018). This study extends Oladinrin et al. (2014) on stress management, where depression was ranked higher than anxiety as perceived stress outcomes among construction professionals in Nigeria.

The survey result indicates that “work overload” and “increased work speed” were perceived as the most critical stressors. This is consistent with previous studies, e.g., Sunindijo and Kamardeen (2017), who found that time pressure and excessive workload were leading causes of stress. Stressors related to high job demand (e.g., excessive workload), low job support, low job control, and poor working conditions (e.g., lack of a medical plan for employees) were risk factors for mental ill-health. Thus, agreeing with previous studies (e.g., Battams et al., 2014;Roche et al., 2016). This signals the need to enhance high job control and job support among construction supervisors. High job control and job support have protective abilities against mental ill-health symptoms and mediate job demand (Love and Edwards, 2005;Love et al., 2010;Battams et al., 2014). Thus, construction firms should expedite efforts to combine multimodal intervention measures that alleviate or eliminate the risk factors.

This study further revealed that although “criticisms from superiors”, "low income causing financial insecurity", and "workplace harassment" were significant to constitute risk factors for

depression or anxiety, they were more likely to affect male construction supervisors than females. The construction industry is male-dominated, and males are more likely to be assigned to team lead roles, subjecting them to increased criticism from their supervisors (Nwaogu, 2021). In addition to studies (Sunindijo and Kamardeen, 2017;Bowen et al., 2013) that have shown that females in the construction industry are more subjected to sexual harassment, this study indicates that males are victims of some workplace harassment. Although this study did not specify the category of harassment, it provides evidence that males in the construction industry experience more workplace harassment than females within the Nigerian context. In a highly patriarchal society with high dependence on the males like Nigeria (Akanle et al., 2018), men in the construction industry than their female colleagues are more likely to bear the pressure of low income as they are expected to cater to nuclear and extended families.

It appeared that construction supervisors with 6 to 10 years of experience than others were more likely to be affected by low task authority. This could arise from the feeling that after acquiring over five years of experience in the industry, their superiors should give them more opportunities to oversee construction projects independently. Additionally, construction supervisors with over 20 years of experience than others were more likely to be subjected to over promotion. In addition to Sutherland and Davidson (1993), who noted that stress arising from over-promotion is independent of grade level, this study shows that years of experience might affect over-promotion. This may point to the need for competence training among construction professionals with over 20 years of experience to help them cope with changes in technological applications relevant to their jobs (Ganah and John, 2015;Nwaogu and Chan, 2021).

5.2. Mental health promotion strategies

There are various strategies required to reduce mental ill-health and its likelihood of occurrence, out of which the most important strategies were explored in this study. As a strategy needed to mitigate stress and related mental ill-health outcomes in the Nigerian construction workplace, "offer a sustainable plan," "celebrate employees' success," and "ensure swift conflict resolution" occupied the first, second, and fifth position, respectively. This finding aligns with Nwaogu and Chan (2020), who deduced that experts in the Nigerian construction industry agree that the measures are among the five most essential strategies necessary in the construction workplace to ensure good mental health. The strategies are related to EAPs, boosting employees' morale and interpersonal relationships. Hence, there is a need to pay attention to these measures to advance mental health among construction supervisors. Additionally, it was observed that at least one strategy among the seven strategy constructs ranked in the top seven positions. This further highlights the need for multimodal intervention strategies for mental health promotion among construction supervisors.

5.3. Potential approaches and interventions for improving mental health

The model consists of feedback loops, which illustrate the cyclical nature of stressors. The simulation reflects the persistence in the trend of mental ill-health over time. In this study, decreased job demand greatly improved mental health, while increased job control slightly improved mental health. This finding is consistent with Jetha et al. (2017), who found that a 25 percent decrease in job demand and 25 percent increase in job control, respectively, greatly and slightly decreased the prevalence of stress among nursing staff. Hence, this study suggests that changes to organizational culture in construction firms using the outlined measures can generate conditions that weaken risk factors and mental ill-health symptoms. The study indicates that to

effectively reduce and prevent mental ill-health, the risk factors related to high job demand should be reduced by at least half. Simultaneously, strategies should be implemented to ensure that the supervisor's perception of job control and job support is continuously satisfactory. Therefore, measures to boost job control and support should be doubled to maintain the factors' protective ability.

A noteworthy finding was observed among single-component interventions. Primary interventions had the most significant mitigating impact on mental ill-health prevalence over the simulation period. Thus, affirming the importance of primary intervention as they are directed to the source of the stressor to eliminate or reduce it. Aligning with Brittin et al. (2015), the effect of single or multimodal interventions increased as the intervention's value increased. However, this study also affirmed that single component interventions do not significantly impact mental ill-health prevalence. Thereby, it highlights the need to adopt a holistic approach to reduce job demands, workplace injustice, work hazards, increase job resources (e.g., job support, control, and welfare) so as to improve experiences of stress and mental ill-health among construction supervisors.

This study shows that work-related stress and some nonwork stress, which may impact health and productivity, may be mitigated by designing primary, secondary, and tertiary interventions that address multiple risk factors. Furthermore, the study provides evidence that a stronger improvement in multimodal interventions would effectively ameliorate mental ill-health symptoms. Based on the SD model, findings point towards improving working conditions, job demand, job support, job control, work-life balance to change the perception of work and nonwork stress and their effects. Additionally, proper allocation of work duties and competence training can help eliminate concerns of under promotion, over-promotion, and job insecurity.

6.0. Limitation

This study is not without some limitations. The study relied on the survey respondents' perception and the expert panel for SD model development, subjecting it to some individual bias. The consistency of the findings with existing studies shows that the psychometric instruments and expert discussion may have reduced the bias. With regards to the scope of the study, only construction supervisors working in two major cities in Nigeria were surveyed; thus, the findings may not be geographically representative of the entire construction industry. However, it provides evidence on the mental ill-health impact of stress among supervisors and provides information for decision-making in the industry.

This study employed logistic regression and system dynamics; further studies may consider using structural equation modeling to determine the cause and effect relationship between the stressors, intervention strategies, and mental health. Additionally, further studies using the same parameters may be conducted in other developing countries. The result of such studies may aid comparability and conclusive result. This finding may be used to design a protocol for randomized control trials (RCT) for mental health intervention in the construction industry. The RCT will collect mental health information at baseline, short term, and long term after implementing the intervention strategies.

7.0. Conclusion

The workplace is an appropriate avenue for mental health promotion as the working population spends about two-thirds of their time at work (Joyce et al., 2016). An effective promotion would begin by understanding what elements of the work pose stress to employees and nonwork stressors that may affect the workplace's motivation, followed by intervention strategies that can prevent or

ease mental health problems. The study highlights the need for construction firms to holistically engage intervention strategies that target the organization and individual levels for a conclusive mental health and wellbeing outcome. The study suggests that to effectively mitigate and prevent mental ill-health prevalence, the risk factors related to job demand may need to be reduced by 50%. In contrast, job control and support factors need to be improved by almost two times in order to maintain their mental health protective ability.

By putting measures in place to address concerns relating to working conditions, job demand, job control, job support, work hazards, and family, organizations can have a primary, secondary preventive, and tertiary influence on construction supervisors' mental health and wellbeing. Therefore, this study recommends that the outlined intervention strategies form the basis for policy/decision-making regarding appropriate measures to implement in the Nigerian construction industry. Additionally, given that the nature of the construction industry is largely the same irrespective of location, these findings provide some applicability to other climes.

The system dynamics modeling reiterated the importance of reducing job demands and increasing job resources to improve mental health within the construction industry. By allowing the assessment of the impact of an intervention strategy through multiple feedback relationships, system dynamics modeling offers human resource or labor managers within the construction industry an avenue for system-based decision-making. This study indicates that the perception of job control, job support, and working conditions play an essential role in mental health promotion within the construction workplace. Therefore, significant policy improvements in these areas are required, as minor changes will not be appropriate.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgment

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Appendix I. Causes of Stress in the Construction Industry

Code	Sources of stress	References
CS01	Physical illness arising from work pressure	Chan et al. (2020)
CS02	Nature of work causing increased mental demand	Chan et al. (2020)
CS03	Hours worked per day	Chan et al. (2020)
CS04	Work overload	Chan et al. (2020)
CS05	Increased work speed	Chan et al. (2020)
CS06	Little opportunity to participate in decision making	Chan et al. (2020)
CS07	Little social support from colleagues and supervisors	Chan et al. (2020)
CS08	Little relationship with colleagues and supervisors	Chan et al. (2020)
CS09	Occupational injury/hazard	Chan et al. (2020)
CS10	Lack of leave or housing allowance	Chan et al. (2020)
CS11	Job insecurity	Chan et al. (2020)
CS12	Strict adherence to time or schedule	Chan et al. (2020)
CS13	Fatigue resulting from work causing poor sleep and recovery	Chan et al. (2020)
CS14	Criticisms from superiors	Chan et al. (2020)
CS15	Lack of feedback mechanism in place	Chan et al. (2020)
CS16	Low socio-economic status	Chan et al. (2020)
CS17	Over promotion	Chan et al. (2020)
CS18	Little task authority	Chan et al. (2020)
CS19	Fear of failure at the job	Chan et al. (2020)
CS21	Musculoskeletal pain and injuries	Chan et al. (2020)
CS22	Poor physical working condition	Chan et al. (2020)
CS23	Lack of respect from subordinates	Chan et al. (2020)
CS24	Workplace harassment	Chan et al. (2020)
CS25	Workplace bullying	Chan et al. (2020)
CS26	Work-home/life imbalance	Chan et al. (2020)
CS27	Low income causing financial insecurity	Chan et al. (2020)
CS28	Salaries not paid on time	Sunindijo and Kamardeen (2017)
CS29	Unsatisfactory living condition at home	Sunindijo and Kamardeen (2017)
CS30	Marital relationship and challenges	Sunindijo and Kamardeen (2017)
CS31	Poor family connection or relationships	Sunindijo and Kamardeen (2017)
CS32	Under promotion	Sunindijo and Kamardeen (2017)
CS33	Lack of a medical plan for employees	Chan et al. (2012)
CS34	Lack of subsidies for family travel fees in the case of a transfer	Chan et al. (2012)
CS35	Lack of opportunity for career development	Sunindijo and Kamardeen (2017)
CS36	Lack of opportunity for promotion	Sunindijo and Kamardeen (2017), Chan et al. (2020)
CS37	Lack of team or departmental or company social get-togethers	Campbell and Gunning (2020)

Appendix II. The strategies to improve mental health in the construction industry adapted from Nwaogu and Chan (2021)

Code	Strategies to improve mental health	References
Interpersonal relationship-related (SC1))		
ST1	Ensure swift conflict resolution	Havermans et al. (2018)
ST2	Supporting improved relationships at work	Enns et al. (2016); Ahola et al. (2012)
ST3	Put in place measures that increase cooperation between supervisors and subordinates	Pignata et al. (2018); Havermans et al. (2018)
Employee morale and engagement-focused (SC2)		
ST4	Celebrate employee's success	Havermans et al. (2018)
ST5	Give constructive feedback instead of reprimanding	Havermans et al. (2018)
ST6	Promote employees' deeply embedded life interest by designing job roles in-line with embedded interest	Hlanganipai and Mazanai (2014); Aguinis et al. (2012)
Healthy coping and individual resilience-focused (SC3)		
ST7	Provide employees with competence training	Pignata et al. (2018); Enns et al. (2016)
ST8	Put better education policies in place (e.g., providing subsidies for / encouraging employee career development)	Pignata et al. (2018); Enns et al. (2016)
ST9	Promote mental health awareness through literacy programs	LaMontagne et al. (2018), Gullestrup et al. (2011)
ST10	Introduce wellness programs to workplaces/site offices, including measures in place for exercises such as exercise weekends or challenges or going for walks	Burke (2019); Enns et al. (2016)
ST11	Empower staff to be individually more resilient through resilience training programs	Enns et al. (2016); Tan et al. (2014)
ST12	Provide practical stress management training	
Workplace (organizational) justice-focused (SC4)		
ST13	Reduce threatening of staff with disengagement when they make mistakes	Havermans et al. (2018)
ST14	Create policies to eliminate harassment	Pignata et al. (2018)
ST15	Create policies to eliminate bullying	Pignata et al. (2018); Sinclair et al. (2017)
ST16	Promote equality policies irrespective of gender, and age	Pignata et al. (2018); Enns et al. (2016)
Job demand and satisfaction focused (SC5)		
ST17	Better planning of work tasks and shifts	Havermans et al. (2018)
ST18	Conduct employee satisfaction surveys	Havermans et al. (2018)
ST19	Allow the taking of regular breaks to enable rest	Havermans et al. (2018)
ST20	Hire more personnel to reduce the workload	Havermans et al. (2018)
Employee Assistance Programme (SC6)		
ST21	Offer a sustainable retirement plan for employees	Pignata et al. (2018); LaMontagne et al. (2014)
ST22	Conduct regular team meetings with supervisors and tradesmen focused on addressing work stress	Havermans et al. (2018)
ST23	Promote communication about work stress from supervisors or tradesmen without penalty	Pignata et al. (2018); Havermans et al. (2018)
ST24	Provide aid for stressors such as financial challenges	Pignata et al. (2018); LaMontagne et al. (2014)
ST25	Offer assistance to nonwork stressors such as marital, family, or relationship challenges or lifestyle challenges	Pignata et al. (2018); LaMontagne et al. (2014)
Job redesign and control focused (SC7)		
ST26	Offer employee's opportunities to balance work and life using a compressed workweek	Pignata et al. (2018), Lingard et al. (2007)
ST27	The workplace should allow site employees' a flexible work schedule with regards to work time and duration with no intention to reduce productivity or performance	Pignata et al. (2018); Joyce et al. (2010)
ST28	Employees should be allowed some flexibility to design their job roles and tasks while human resources approve it in-line with the job position and goals of the organization	Pignata et al. (2018); Joyce et al. (2010)

Appendix III. Parameters for System Dynamics Modelling

(01) Content of the job= (Nature of work+Work pressure+Exposure length)-Job demand and satisfaction-Healthy coping and individual resilience

(02) Desiring more job control= -Job control

(03) Desiring more job support= -Job support

(04) Employee Assistance Programme= 1

(05) Employee morale and engagement= 1

(06) Exposure length = WITH LOOKUP (Time,
([(0,0)-(36,20)],(0,0.4),(4,0.8),(8,1.2),(12,1.6),(16,2),(20,2.4),(24,2.8),(28,3.2),(32,3.6),(36,4)))

(07) Exposure period = WITH LOOKUP (Time,
([(0,0)-(36,20)],(0,0.4),(4,0.8),(8,1.2),(12,1.6),(16,2),(20,2.4),(24,2.8),(28,3.2),(32,3.6),(36,4)))

(08) Family related= INTEG (Family related increment, 1.92)

(09) Family related increment= (Marital relationship and challenges+Poor extended family connection or relationships + "Work-life imbalance "+Exposure length-Family related)-Job redesign and control

(10) FINAL TIME = 36
The final time for the simulation.

(11) Healthy coping and individual resilience= 1

(12) High job demand increment= (Content of the job+Workplace bullying-Job demand)-Employee morale and engagement-Job redesign and control

(13) INITIAL TIME = 0
Units: Week
The initial time for the simulation.

(14) Job control= INTEG (Low job control increment, 2.21)

(15) Job demand= INTEG (High job demand increment, 2.44)

(16) Job demand and satisfaction= 1

(17) Job redesign and control= 1

(18) Job support= INTEG (Low job support increment, 2.22)

(19) Low job control increment= ((Little opportunity to participate in decision making+Little task authority+Workplace bullying+Exposure period)+Desiring more job control)-Job redesign and control-Healthy coping and individual resilience

(20) Low job support increment= (Little relationship with colleagues and supervisors+Little social support from colleagues+Exposure period+Desiring more job support)-(Interpersonal relationship)-(Healthy coping and individual resilience) - (Employee morale and engagement)

(21) "Mental ill-health symptoms"= INTEG ("Perceived mental ill-health increment", 4)
Units: Mental Ill-Health

(22) "Perceived mental ill-health increment" = (Family related+Job control+Job demand+Job support+Welfare related+Work hazard related) - Employee Assistance Programme -"Mental ill-health symptoms".

(23) Poor working conditions= (Lack of medical plan for employees+Lack of subsidies for family travel fees in transfer+No leave or housing allowance+Exposure period)-Employee Assistance Programme

(24) SAVEPER = TIME STEP
The frequency with which output is stored.

(25) TIME STEP = 1
The time step for the simulation.

(26) Welfare related= INTEG (Welfare related increment, 2.14)

(27) Welfare related increment= (Fear of failure+Overpromotion+Poor working conditions+Underpromotion+Unsatisfactory living condition at home+Job insecurity)-Welfare related

(28) Work hazard increment= (Content of the job+Fatigue+Musculoskeletal pain and injuries+ "Occupational injury/hazard")-Work hazard related

(29) Work hazard related= INTEG (Work hazard increment, 1.99)

(30) Work pressure= Strict adherence to schedule+Workload

(31) "Work-life imbalance" = Content of the job+Little social support from colleagues

(32) Workplace bullying= 1.59-Workplace justice

(33) Workplace justice= 1

Appendix IV. Effect of changes in job demand on mental ill-health symptoms

Time	Simulation output for high job demand			Percentage Change	
	Baseline (no intervention)	25% decrease	25% increase	25% decrease	25% increase
0	4	4	4	0.00	0.00
1	12.92	12.92	12.92	0.00	0.00
2	119.85	94.36	128.43	21.27	7.16
3	120.55	95.06	129.13	21.14	7.12
4	121.25	95.76	129.83	21.02	7.08
5	121.95	96.46	130.53	20.90	7.04
6	122.65	97.16	131.23	20.78	7.00
7	123.35	97.86	131.93	20.66	6.96
8	124.05	98.56	132.63	20.55	6.92
9	124.75	99.26	133.33	20.43	6.88
10	125.45	99.96	134.03	20.32	6.84
11	126.15	100.66	134.73	20.21	6.80
12	126.85	101.36	135.43	20.09	6.76
13	127.55	102.06	136.13	19.98	6.73
14	128.25	102.76	136.83	19.88	6.69
15	128.95	103.46	137.53	19.77	6.65
16	129.65	104.16	138.23	19.66	6.62
17	130.35	104.86	138.93	19.56	6.58
18	131.05	105.56	139.63	19.45	6.55
19	131.75	106.26	140.33	19.35	6.51
20	132.45	106.96	141.03	19.24	6.48
21	133.15	107.66	141.73	19.14	6.44
22	133.85	108.36	142.43	19.04	6.41
23	134.55	109.06	143.13	18.94	6.38
24	135.25	109.76	143.83	18.85	6.34
25	135.95	110.46	144.53	18.75	6.31
26	136.65	111.16	145.23	18.65	6.28
27	137.35	111.86	145.93	18.56	6.25
28	138.05	112.56	146.63	18.46	6.22
29	138.75	113.26	147.33	18.37	6.18
30	139.45	113.96	148.03	18.28	6.15
31	140.15	114.66	148.73	18.19	6.12
32	140.85	115.36	149.43	18.10	6.09
33	141.55	116.06	150.13	18.01	6.06
34	142.25	116.76	150.83	17.92	6.03
35	142.95	117.46	151.53	17.83	6.00
36	143.65	118.16	152.23	17.74	5.97

Appendix V. Effect of changes in low job control on mental ill-health symptoms

Time	Simulation output for low job control						Percentage Change		
	Baseline (no intervention)	25% decrease	25% increase	50% decrease	50% increase	90% decrease	25% decrease	50% decrease	90% decrease
0	4.00	4.00	4.00	4.00	4.00	4.00	0.00	0.00	0.00
1	12.92	12.92	12.92	12.92	12.92	12.92	0.00	0.00	0.00
2	119.85	118.02	121.68	116.19	123.52	113.25	1.53	3.05	5.50
3	120.55	118.72	122.38	116.89	124.22	113.95	1.52	3.04	5.47
4	121.25	119.42	123.08	117.59	124.92	114.65	1.51	3.02	5.44
5	121.95	120.12	123.78	118.29	125.62	115.35	1.50	3.00	5.41
6	122.65	120.82	124.48	118.99	126.32	116.05	1.49	2.98	5.38
7	123.35	121.52	125.18	119.69	127.02	116.75	1.48	2.97	5.35
8	124.05	122.22	125.88	120.39	127.72	117.45	1.48	2.95	5.32
9	124.75	122.92	126.58	121.09	128.42	118.15	1.47	2.93	5.29
10	125.45	123.62	127.28	121.79	129.12	118.85	1.46	2.92	5.26
11	126.15	124.32	127.98	122.49	129.82	119.55	1.45	2.90	5.23
12	126.85	125.02	128.68	123.19	130.52	120.25	1.44	2.89	5.20
13	127.55	125.72	129.38	123.89	131.22	120.95	1.43	2.87	5.17
14	128.25	126.42	130.08	124.59	131.92	121.65	1.43	2.85	5.14
15	128.95	127.12	130.78	125.29	132.62	122.35	1.42	2.84	5.12
16	129.65	127.82	131.48	125.99	133.32	123.05	1.41	2.82	5.09
17	130.35	128.52	132.18	126.69	134.02	123.75	1.40	2.81	5.06
18	131.05	129.22	132.88	127.39	134.72	124.45	1.40	2.79	5.03
19	131.75	129.92	133.58	128.09	135.42	125.15	1.39	2.78	5.01
20	132.45	130.62	134.28	128.79	136.12	125.85	1.38	2.76	4.98
21	133.15	131.32	134.98	129.49	136.82	126.55	1.37	2.75	4.95
22	133.85	132.02	135.68	130.19	137.52	127.25	1.37	2.73	4.93
23	134.55	132.72	136.38	130.89	138.22	127.95	1.36	2.72	4.90
24	135.25	133.42	137.08	131.59	138.92	128.65	1.35	2.71	4.88
25	135.95	134.12	137.78	132.29	139.62	129.35	1.35	2.69	4.85
26	136.65	134.82	138.48	132.99	140.32	130.05	1.34	2.68	4.83
27	137.35	135.52	139.18	133.69	141.02	130.75	1.33	2.66	4.80
28	138.05	136.22	139.88	134.39	141.72	131.45	1.33	2.65	4.78
29	138.75	136.92	140.58	135.09	142.42	132.15	1.32	2.64	4.75
30	139.45	137.62	141.28	135.79	143.12	132.85	1.31	2.62	4.73
31	140.15	138.32	141.98	136.49	143.82	133.55	1.31	2.61	4.71
32	140.85	139.02	142.68	137.19	144.52	134.25	1.30	2.60	4.68
33	141.55	139.72	143.38	137.89	145.22	134.95	1.29	2.59	4.66
34	142.25	140.42	144.08	138.59	145.92	135.65	1.29	2.57	4.64
35	142.95	141.12	144.78	139.29	146.62	136.35	1.28	2.56	4.61
36	143.65	141.82	145.48	139.99	147.32	137.05	1.27	2.55	4.59

Appendix VI. Effect of changes in low job support on mental ill-health symptoms

	Simulation output for low job support						Percentage Change		
Time	Baseline (no intervention)	25% decrease	25% increase	50% decrease	50% increase	90% decrease	25% decrease	50% decrease	90% decrease
0	4	4	4	4	4	4.00	0.00	0.00	0.00
1	12.92	12.92	12.92	12.92	12.92	12.92	0.00	0.00	0.00
2	119.85	116.36	123.34	112.88	126.83	107.30	2.91	5.82	10.48
3	120.55	117.06	124.04	113.58	127.53	108.00	2.90	5.78	10.41
4	121.25	117.76	124.74	114.28	128.23	108.70	2.88	5.75	10.35
5	121.95	118.46	125.44	114.98	128.93	109.40	2.86	5.72	10.30
6	122.65	119.16	126.14	115.68	129.63	110.10	2.85	5.68	10.24
7	123.35	119.86	126.84	116.38	130.33	110.80	2.83	5.65	10.18
8	124.05	120.56	127.54	117.08	131.03	111.50	2.81	5.62	10.12
9	124.75	121.26	128.24	117.78	131.73	112.20	2.80	5.59	10.06
10	125.45	121.96	128.94	118.48	132.43	112.90	2.78	5.56	10.01
11	126.15	122.66	129.64	119.18	133.13	113.60	2.77	5.53	9.95
12	126.85	123.36	130.34	119.88	133.83	114.30	2.75	5.49	9.90
13	127.55	124.06	131.04	120.58	134.53	115.00	2.74	5.46	9.84
14	128.25	124.76	131.74	121.28	135.23	115.70	2.72	5.43	9.79
15	128.95	125.46	132.44	121.98	135.93	116.40	2.71	5.41	9.74
16	129.65	126.16	133.14	122.68	136.63	117.10	2.69	5.38	9.68
17	130.35	126.86	133.84	123.38	137.33	117.80	2.68	5.35	9.63
18	131.05	127.56	134.54	124.08	138.03	118.50	2.66	5.32	9.58
19	131.75	128.26	135.24	124.78	138.73	119.20	2.65	5.29	9.53
20	132.45	128.96	135.94	125.48	139.43	119.90	2.63	5.26	9.48
21	133.15	129.66	136.64	126.18	140.13	120.60	2.62	5.23	9.43
22	133.85	130.36	137.34	126.88	140.83	121.30	2.61	5.21	9.38
23	134.55	131.06	138.04	127.58	141.53	122.00	2.59	5.18	9.33
24	135.25	131.76	138.74	128.28	142.23	122.70	2.58	5.15	9.28
25	135.95	132.46	139.44	128.98	142.93	123.40	2.57	5.13	9.24
26	136.65	133.16	140.14	129.68	143.63	124.10	2.55	5.10	9.19
27	137.35	133.86	140.84	130.38	144.33	124.80	2.54	5.07	9.14
28	138.05	134.56	141.54	131.08	145.03	125.50	2.53	5.05	9.09
29	138.75	135.26	142.24	131.78	145.73	126.20	2.52	5.02	9.05
30	139.45	135.96	142.94	132.48	146.43	126.90	2.50	5.00	9.00
31	140.15	136.66	143.64	133.18	147.13	127.60	2.49	4.97	8.96
32	140.85	137.36	144.34	133.88	147.83	128.30	2.48	4.95	8.91
33	141.55	138.06	145.04	134.58	148.53	129.00	2.47	4.92	8.87
34	142.25	138.76	145.74	135.28	149.23	129.70	2.45	4.90	8.83
35	142.95	139.46	146.44	135.98	149.93	130.40	2.44	4.88	8.78
36	143.65	140.16	147.14	136.68	150.63	131.10	2.43	4.85	8.74

Appendix VII. Effect of changes in combined interventions on mental ill-health symptoms

	Simulation output					Percentage Change			
Time	Baseline (no intervention)	Baseline with intervention	All interventions 200%	Primary + Secondary intervention	Primary + Secondary (200% increase)	With intervention	Primary + secondary	Primary + Secondary (200% increase)	All intervention 200%
0	4	4	4	4	4	0.00	0.00	0.00	0.00
1	12.92	12.92	12.92	12.92	12.92	0.00	0.00	0.00	0.00
2	119.85	102.85	85.85	103.85	86.85	14.18	13.35	27.53	28.37
3	120.55	103.55	86.55	104.55	87.55	14.10	13.27	27.37	28.20
4	121.25	104.25	87.25	105.25	88.25	14.02	13.20	27.22	28.04
5	121.95	104.95	87.95	105.95	88.95	13.94	13.12	27.06	27.88
6	122.65	105.65	88.65	106.65	89.65	13.86	13.05	26.91	27.72
7	123.35	106.35	89.35	107.35	90.35	13.78	12.97	26.75	27.56
8	124.05	107.05	90.05	108.05	91.05	13.70	12.90	26.60	27.41
9	124.75	107.75	90.75	108.75	91.75	13.63	12.83	26.45	27.25
10	125.45	108.45	91.45	109.45	92.45	13.55	12.75	26.31	27.10
11	126.15	109.15	92.15	110.15	93.15	13.48	12.68	26.16	26.95
12	126.85	109.85	92.85	110.85	93.85	13.40	12.61	26.01	26.80
13	127.55	110.55	93.55	111.55	94.55	13.33	12.54	25.87	26.66
14	128.25	111.25	94.25	112.25	95.25	13.26	12.48	25.73	26.51
15	128.95	111.95	94.95	112.95	95.95	13.18	12.41	25.59	26.37
16	129.65	112.65	95.65	113.65	96.65	13.11	12.34	25.45	26.22
17	130.35	113.35	96.35	114.35	97.35	13.04	12.27	25.32	26.08
18	131.05	114.05	97.05	115.05	98.05	12.97	12.21	25.18	25.94
19	131.75	114.75	97.75	115.75	98.75	12.90	12.14	25.05	25.81
20	132.45	115.45	98.45	116.45	99.45	12.84	12.08	24.92	25.67
21	133.15	116.15	99.15	117.15	100.15	12.77	12.02	24.78	25.54
22	133.85	116.85	99.85	117.85	100.85	12.70	11.95	24.65	25.40
23	134.55	117.55	100.55	118.55	101.55	12.63	11.89	24.53	25.27
24	135.25	118.25	101.25	119.25	102.25	12.57	11.83	24.40	25.14
25	135.95	118.95	101.95	119.95	102.95	12.50	11.77	24.27	25.01
26	136.65	119.65	102.65	120.65	103.65	12.44	11.71	24.15	24.88
27	137.35	120.35	103.35	121.35	104.35	12.38	11.65	24.03	24.75
28	138.05	121.05	104.05	122.05	105.05	12.31	11.59	23.90	24.63
29	138.75	121.75	104.75	122.75	105.75	12.25	11.53	23.78	24.50
30	139.45	122.45	105.45	123.45	106.45	12.19	11.47	23.66	24.38
31	140.15	123.15	106.15	124.15	107.15	12.13	11.42	23.55	24.26
32	140.85	123.85	106.85	124.85	107.85	12.07	11.36	23.43	24.14
33	141.55	124.55	107.55	125.55	108.55	12.01	11.30	23.31	24.02
34	142.25	125.25	108.25	126.25	109.25	11.95	11.25	23.20	23.90
35	142.95	125.95	108.95	126.95	109.95	11.89	11.19	23.08	23.78
36	143.65	126.65	109.65	127.65	110.65	11.83	11.14	22.97	23.67

Appendix VIII. Effect of changes in single interventions on mental ill-health symptoms

	Simulation output							Percentage Change				
Time	Baseline (no intervention)	Baseline with intervention	All interventions 200%	Primary intervention	Primary interventions 200%	Secondary interventions	Secondary 200%	With intervention	Primary	Primary interventions 200%	Secondary interventions	Secondary 200%
0	4	4	4	4	4	4	4	0.00	0.00	0.00	0.00	0
1	12.92	12.92	12.92	12.92	12.92	12.92	12.92	0.00	0.00	0.00	0.00	0.00
2	119.85	102.85	85.85	111.85	103.85	114.85	109.85	14.18	6.68	13.35	4.17	8.34
3	120.55	103.55	86.55	112.55	104.55	115.55	110.55	14.10	6.64	13.27	4.15	8.30
4	121.25	104.25	87.25	113.25	105.25	116.25	111.25	14.02	6.60	13.20	4.12	8.25
5	121.95	104.95	87.95	113.95	105.95	116.95	111.95	13.94	6.56	13.12	4.10	8.20
6	122.65	105.65	88.65	114.65	106.65	117.65	112.65	13.86	6.52	13.05	4.08	8.15
7	123.35	106.35	89.35	115.35	107.35	118.35	113.35	13.78	6.49	12.97	4.05	8.11
8	124.05	107.05	90.05	116.05	108.05	119.05	114.05	13.70	6.45	12.90	4.03	8.06
9	124.75	107.75	90.75	116.75	108.75	119.75	114.75	13.63	6.41	12.83	4.01	8.02
10	125.45	108.45	91.45	117.45	109.45	120.45	115.45	13.55	6.38	12.75	3.99	7.97
11	126.15	109.15	92.15	118.15	110.15	121.15	116.15	13.48	6.34	12.68	3.96	7.93
12	126.85	109.85	92.85	118.85	110.85	121.85	116.85	13.40	6.31	12.61	3.94	7.88
13	127.55	110.55	93.55	119.55	111.55	122.55	117.55	13.33	6.27	12.54	3.92	7.84
14	128.25	111.25	94.25	120.25	112.25	123.25	118.25	13.26	6.24	12.48	3.90	7.80
15	128.95	111.95	94.95	120.95	112.95	123.95	118.95	13.18	6.20	12.41	3.88	7.75
16	129.65	112.65	95.65	121.65	113.65	124.65	119.65	13.11	6.17	12.34	3.86	7.71
17	130.35	113.35	96.35	122.35	114.35	125.35	120.35	13.04	6.14	12.27	3.84	7.67
18	131.05	114.05	97.05	123.05	115.05	126.05	121.05	12.97	6.10	12.21	3.82	7.63
19	131.75	114.75	97.75	123.75	115.75	126.75	121.75	12.90	6.07	12.14	3.80	7.59
20	132.45	115.45	98.45	124.45	116.45	127.45	122.45	12.84	6.04	12.08	3.78	7.55
21	133.15	116.15	99.15	125.15	117.15	128.15	123.15	12.77	6.01	12.02	3.76	7.51
22	133.85	116.85	99.85	125.85	117.85	128.85	123.85	12.70	5.98	11.95	3.74	7.47
23	134.55	117.55	100.55	126.55	118.55	129.55	124.55	12.63	5.95	11.89	3.72	7.43
24	135.25	118.25	101.25	127.25	119.25	130.25	125.25	12.57	5.91	11.83	3.70	7.39
25	135.95	118.95	101.95	127.95	119.95	130.95	125.95	12.50	5.88	11.77	3.68	7.36
26	136.65	119.65	102.65	128.65	120.65	131.65	126.65	12.44	5.85	11.71	3.66	7.32
27	137.35	120.35	103.35	129.35	121.35	132.35	127.35	12.38	5.82	11.65	3.64	7.28
28	138.05	121.05	104.05	130.05	122.05	133.05	128.05	12.31	5.80	11.59	3.62	7.24
29	138.75	121.75	104.75	130.75	122.75	133.75	128.75	12.25	5.77	11.53	3.60	7.21
30	139.45	122.45	105.45	131.45	123.45	134.45	129.45	12.19	5.74	11.47	3.59	7.17
31	140.15	123.15	106.15	132.15	124.15	135.15	130.15	12.13	5.71	11.42	3.57	7.14
32	140.85	123.85	106.85	132.85	124.85	135.85	130.85	12.07	5.68	11.36	3.55	7.10
33	141.55	124.55	107.55	133.55	125.55	136.55	131.55	12.01	5.65	11.30	3.53	7.06
34	142.25	125.25	108.25	134.25	126.25	137.25	132.25	11.95	5.62	11.25	3.51	7.03
35	142.95	125.95	108.95	134.95	126.95	137.95	132.95	11.89	5.60	11.19	3.50	7.00
36	143.65	126.65	109.65	135.65	127.65	138.65	133.65	11.83	5.57	11.14	3.48	6.96

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