Developing a framework of food choice determinants among construction workers in South Africa

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Abstract - A plethora of factors are known to influence an individual's food choice and overall nutrition, which in turn, influences their health and safety performance. However, it appears that little research has been conducted in South Africa, on the factors which influence the food choices and intake of construction workers in particular. The paper develops a framework of food choice determinants from literature review and tests the framework using principal components analysis of empirical data from a field questionnaire survey. Results evinced that food choices among South African construction workers are determinable by seven factors as opposed to six theorized factors. The study provides evidence which defines the factors that influence construction workers' food choice. The study will be useful to construction managers and stakeholders in planning for nutrition improvement in the construction industry. Improving nutrition will contribute to improvement in health and safety performance on construction sites.

*Index Terms:--*Construction workers, food choice determinants, health and safety performance, South Africa.

I. INTRODUCTION

Due to its invaluable role in productivity and H&S performance improvements, the little attention given to nutrition has been a major concern for employers and organizations for decades. According to [17], the International Labour Organisation (ILO) has been concerned with adequate nourishment of workers, food safety and education for general health, safety and work productivity since its establishment. The benefits of healthy eating and overall workers' health and well-being, including inter alia, improved morale, sense of well-being, and productivity as well as reduced absenteeism, health care costs, stress, and staff turn-over, are greater for low-paid workers in high risk occupations and settings, such as the construction industry [18].

Improving nutrition is even more important in the construction industry given the physically demanding and dangerous nature of construction work and the ever-increasing demand to improve the execrable image of the construction industry with regard to its H&S performance. Improving nutrition of a particular group requires an understanding of the factors which determine their food choice decisions. Food choices, eating behaviours and resulting nutritional health are

influenced by a number of complex and inter-related individual, collective and policy-related determinants [4].

A multitude of studies have dwelt onfood choice determinants, for instance,[16], which had a broad scope and employed qualitative methods;[1], [5] and [15], which only reviewed existing literature. However, it appears that there is little empirical research investigating the structure and relativity of these determinants. In addition, there is no evidence of astudy conducted amongst construction workers in South Africa. The current study therefore investigates and models the determinants of food choices amongst site workers in the South African construction industry. The model will enable identification of related individual factors which determine construction workers' food choices and uptake. The study will inform effectual planning for nutrition improvement which will invariably contribute to improvements in health and safety performance on construction sites.

II. FOOD CHOICE DETERMINANTS

A. Review

[16] developed a model of food choice integrating social (including family and co-workers), cultural and economic, personal (including gender, genetic predispositions to diseases, taste, personality and preferences) determinants as well as equipment, skill, knowledge, relationships, values and traditions, mass media, climate and physical structures. [16]employed qualitative methods to explore the perceptions of the participants. The study had a very broad scope incorporating factors relating to life course events and experiences such as changes in family through marriage, changes in residence through migration, etc.

In a related study by [15], it was found that environmental influences (including location and accessibility to shops) determine food choice and consumption. Other factors were indicated to be social acceptability, promotional or advertising effects, cost and availability of foods. This study reviewed existing research conducted on food access, and developed a model which depicted relationship between food choice and neighbourhood food access.

In a review of previous studies, [1] indicated that the choices

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people make about food determine which nutrients enter their body and these choices are influenced by many interrelating factors including biological mechanisms, genetic profiles, knowledge, social and cultural factors. Other factors were indicated to be psychological, economic, religious and demographic factors. Gender was also noted to be a primary factor underlying many decisions made about food. Gender differences and stereotyping influence habits, health consciousness, weight control, degree of resistance to nutrition education, body self-perception and so on [1]. For instance, based on the degree of health consciousness or desire to lose or add weight, women consume more fruits, vegetables and dairy products, while men consume more meat (especially red meat), alcohol and hearty portion sizes. In the same study, context, in terms of time, place or location and company, was indicated to influence food decisions. This study was a review which dwelt on the influence of gender in determining food choices.

In another review, [8] indicated that food choice decisions are based on economic factors (including cost, income and availability), physical factors (such as access, skill (for cooking), education and time), biological determinants (including hunger, taste and appetite), social factors, including culture, family, peers and meal patterns), psychological factors (such as mood, stress and guilt) as well as attitudes, beliefs and knowledge about food. Cultural influences lead to the differences in the habitual consumption of certain foods and in traditions of preparation, and in certain cases can lead to restrictions such as exclusion of meat and milk from the diet but they are amenable to change.

A mixed methods research study by [3] revealed that knowledge of value to health influence what is eaten. The study also indicated that variations existed amongst generations since older people preferred traditional foods which were healthier than conventional foods. This seemed to indicate that some food choices depend on preference and health consciousness. Other factors were found to be taste, cost and availability of food. This study, which used 24-hour dietary recall, was conducted among women in a remote settlement in Canada.

According to [2], the physical environment determines the choices of food made at a workplace. These include facilities provided on-site for food storage and preparation, as well as eating locations.

A cross-sectional study using focus groups and clinical measures indicated that insufficient time to prepare healthier meals at home and seasonality influenced dietary behaviours amongst South African employees [10]. Participants in this study felt that they generally followed healthier diets during summer when their intake of salads was higher and there was a greater variety of fruits and vegetables. Availability of healthy foods, a determinant also noted by [6] and [17], on construction sites depends on the season. [10] evaluated the effectiveness of an on-going workplace wellness programme which was conducted on South African employees, but not specifically on construction workers.

Other studies conducted in the construction industry concur that the nutrition of construction workers is influenced by a host of factors including knowledge about food and nutrition, social factors, economic factors, etc. [17] noted that construction workers' nutrition is influenced by availability and cost of healthy food alternatives on site or nearby, wages, work schedules (including length of meal breaks, since people generally do not make healthy food choices when they are rushed), work-related and welfare facilities (such as provision of eating areas) and economic environment. In his opinion, construction workers sometimes have no place to eat or money to purchase food; local and nearby restaurants can be expensive or in short supply and street foods are bacteria laden. In addition, the lackadaisical attitude of employers and unions towards nutrition was indicated to exacerbate the situation. Workers' access to food at construction sites was not a top union concern. Main concerns included wages, distribution of working time and non-unionized migrant workers. Construction employers on their part are usually more interested in maximizing productivity and profits and meeting tight deadlines, with little regard to their workers' wellbeing and health pursuits [14]. [17] had a broad scope, including workers in general and focusing on food quality and quantity.

Work schedules, regular travel between worksites due to the transient nature of construction, and limited on-site catering facilities (e.g. a kitchen and/or healthy food) were also indicated to be environmental determinants on a typical construction worksite which can determine workers' eating lifestyle [13]. However, this study focused on the environmental factors and excludes personal factors which could influence nutritional intake on a construction site.

According to [5], construction apprentices' food choices are determined by nutritional knowledge and cooking skills, familial factors (socio-economic status of parents and parental influence), peer influence, food supply and acquisition (e.g., at home, work or through fast-food outlets) demographic factors (age and gender differences, income, ethnicity and cultural variables); dietary restraint (conscious choice to regulate body weight), work and financial responsibilities, unhealthy childhood and adolescent food practices which endure into adulthood. The other factors were found to be media and stereotypical views about nutrition (since men generally view nutrition and cooking as socially prescribed for women and are relatively unconcerned about health and diet). In a related study, which explored these factors using focus groups and thematic analysis, found that apprentices' dietary practices were moderated by convenience, availability and cost of foods, nutritional beliefs, significant others, colleagues in the workplace and body image[6]. However, [5] and [6] only focused on apprentices in the construction industry and therefore their results may not be generalized.

Literature reviewed in this section, seemed to suggest that there are a multitude of factors which determine food choices and uptake. The studies which dwelt on construction workers' nutrition also identified the factors which influence the nutrition of construction workers in particular. Some nutrition factors were indicated to be economic, social and environmental elements. Other factors were indicated to be physiological, cultural, and religious in nature. Summarizing the classifications and views expressed in the above-discussed studies, the food choice determinants are theorized to be nutritional knowledge, economic factors, environmental factors, social factors, psychological factors and physiological factors. These are presented in Table I.

B. Theoretical framework

Taking into consideration the views expressed in the review section above, a theoretical framework (Figure I) was developed. It was thought that:

- some of the studies had a broader focus (for instance, [17], which incorporated workers in general; and [16], which incorporatedlife course events and experiences.
- some focused on young construction workers only
 [5] and [6] and therefore cannot really be generalized.
- the methods used in some of the studies were different. For instance, [3] studied the influences on diet intake, but employed a mixed methods design and used 24 hour dietary recall to obtain information on intake among women only. The results of the study by [3] cannot really be generalized since the construction industry is male-dominated and the nutrition-influencers might differ when males are studied. [1] and [5] reviewed previous literature, while [6] used focus groups and questionnaires.
- there was little evidence of research conducted in South Africa, amongst construction workers.

The theoretical framework therefore incorporates factors which were thought to determine food choices and uptake amongst construction workers in South Africa. The rectangles represent the measurable variables, whereas the ovals represent the observed variables. The identified determinants are defined and summarized in Table I.

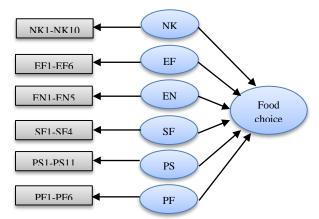


FIGURE I: THEORETICAL FRAMEWORK

TABLE I THEORETICAL FRAMEWORK MEASURES FOR NUTRITION DETERMINANTS

	ΓΙΟΝ DETERMINANTS					
Factor	Measures	Label				
	knowledge of what an adult should eat	NK1				
	n a day					
	knowledge of the sources of nutrients	NK2 NK3				
	knowledge of the sources of energy knowledge of health benefits					
	knowledge of health benefits (consequences of eating or not eating					
	particular foods)					
	knowledge of nutritional requirements	NK5				
	for body size	11110				
	knowledge of nutritional requirements	NK6				
f	or age					
	knowledge of nutritional requirements	NK7				
	or existing health status					
	knowledge of nutritional requirements	NK8				
	for the type of work engaged in mowledge about nutritional	NK9				
	requirements for gender	INKS				
	cooking skills	NK10				
	vages/income	EF1				
	vailability of food	EF2				
	cost/price of food	EF3				
n	narketing strategies/advertisements	EF4				
	orand name	EF5				
d	liscounts and subsidies	EF6				
Environmental le	ocation	EN1				
Factors (EN)						
S	easonality	EN2				
4	ime constraints	EN3				
L.	ime constraints	ENS				
O	on-site eating facilities	EN4				
	acilities for food preservation on site	EN5				
	riends/colleagues' influence	SF1				
(SF)	amilial influence (family norms and	SF2				
	raditions)	512				
S	ocial media and networking	SF3				
ç	ocial class	SF4				
	culture	PS1				
Factors (PS)	pelief that killing animals for food is not	PS2				
	good	152				
	pelief that avoiding meat keeps one	PS3				
	nealthier					
b	pelief that avoiding meat save money	PS4				
b	pelief about adequacy of diet	PS5				
	act that healthy eating increases	PS6				
1	productivity fact that healthy eating prevents	DC7				
	act that healthy eating prevents accidents and injuries	PS7				
	oody image	PS8				
	cynical attitude towards nutrition	PS9				
	promotions					
	nood	PS10				
e	eating habits	PS11				
• 0	nunger	PF1				
Factors (PF)	aste	PF2				
S	atiety	PF3				
q	quality	PF4				
	appetite quality of food	PF5				
p	palatability/appearance	PF6				

III. METHODS

Extant literature regarding factors which determine food choice and uptake were reviewed and synthesized. The theoretical framework and a likert-scale questionnaire were outputs from the literature review. The questionnaire consisted of 42 questions inquiring about factors which determine food choice. The questionnaire was pilot-tested, reviewed and revised by expertsbefore being self-administered construction workers on construction sites. The participants, which included construction site workers comprising electricians, brick-layers, tilers, painters, carpenters, steelfixers, plumbers, pavers and unskilled workers, were selected through heterogeneityand convenience sampling. Effort was made include workers from different constructionestablishments involved in building, civil engineering and general construction projects. This was done in order to enhance generalizability of the results. Out of a total of 220 questionnaires distributed, 183 were returned. Raw data were then subjected to Principal Components Analysis (PCA) using Statistical Package for Social Sciences (SPSS) version 22 software. PCA was done in order to test the structures and composition of the theorized determinants. Principal axis factoring and direct oblimin rotation were used. Two frameworks emerged from the PCA. One was adopted as the final framework. The results are presented in the next section. Missing data were excluded using listwise deletion. Preliminary descriptive analysis of data revealed that data were normally distributed. Outliers were identified and removed before analysis. The forty-two items were then subjected to PCA. Outputs from the PCA (principal components) were thought to contribute to the variance in the data set. They were obtained using the Kaiser's criterion (retaining eigenvalues above 1), scree test (retaining factors above "breaking point") and Monte Carlo parallel analysis (retaining factors whose initial eigenvalues were larger than the criterion values from parallel analysis). Cronbach's alpha a test was used to assess internal consistency reliability before and after PCA. The theoretical framework variables had alpha values ranging from "0.71 to 0.84", indicating good internal consistency [12]. The final framework (after PCA) ranged from "0.62 to 0.85", also indicating good internal consistency.

IV. FINDINGS AND DISCUSSION

Prior to performing the PCA for the factors influencing nutrition, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients with 0.3 and above. The Kaiser-Meyer-Olkin value was 0.743, exceeding the recommended value of 0.6 and the Bartlett's Test of Sphericity reached statistical significance (p = .000), supporting the factorability of the correlation matrix [12].

All the forty-two items theorized to be nutrition determinants were then subjected to PCA. Results from repeated PCA revealed that food choices could be determined by eleven or seven components. In the first analysis, eleven components exceeded eigenvalues above 1(10.679, 4.145,

2.879, 2.241, 1.883, 1.818, 1.592, 1.432, 1.377, 1.300 and 1.117), explaining 25.43%, 9.87%, 6.85%, 5.34%, 4.48%, 4.33%, 3.79%, 3.41%, 3.28%, 3.10% and 2.66%, respectively of the variance, and accounting for a total variance of 72.53%. The results of the scree test also revealed a break after the eleventh component. This was further supported by the results of the pattern matrix, which also shows the labeling of the components extracted and the items loading evenly on all the components extracted.

However, due to the large number of the components extracted, the difficulty in naming them and the low internal consistency reliability of some of the components, a decision was made to re-run the rotation with a number closer to the expected number or to the originally theorized framework to increase internal consistency reliability of the components. Cronbach's alpha values for the eleven-item structure ranged from "0.54 to 0.84".

The second rotation was done with the first seven components, which accounted for 60.09% of the total variance. Interpretation of these seven revealed that items loaded more on each component and the structure was similar to the theoretical framework(Appendix). In addition, the internal consistency reliability of the components improved, ranging from 0.62 to 0.85. The seven components were then adopted. In other words, the seven-factor modelwas preferred because of its closeness to the theoretical framework, sufficient number of primary loadings, ease of interpretation and increased reliability of components. The components were named food context, biological factors, knowledge, personal ideas and systems, economic factors, resources and cultural distinctions.

Food context was used to definebrand name, seasonality, time constraints, location, cooking skills and advertisements/marketing strategies. This is in line with findings from studies by [1] and [16], which indicated that food context is determined by time, place or location and company. The authors contended that food context defines the environment and specific setting in which food choices occur, encompassing the physical surroundings, social climate of the choice setting, specific food supply factors in the environment such as types of food, food sources and availability of foods in the food system, including seasonal and market factors.

Biological factors were found to include physiological needs and sensory aspects of the body such as hunger, satiety, palatability, taste and quality and appearance of food, as was viewed by [1] and [8].

Nutritional knowledge consisted of four basic aspects of knowledge which influence food decisions. These included knowledge about food sources of energy, knowledge about sources of different food nutrients, knowledge about the health implications or consequences of consuming or not consuming particular foods, and knowledge about the recommended daily dietary requirements. This is consistentwith what [9] indicated as being the essentials of nutritional knowledge.

The term *personal ideas and systems* was used to denote nutrition determinants comprising eating habits, attitude

toward advertisements and advertisers, mood, the fact that healthy food help to enhance concentration, peers/colleagues' influence, the need to belong to a social group, social media and networking, and belief that avoiding meat will keep one healthier, belief that killing animals for food is not good, and belief about adequacy of current diet. This was consistent with findings from [7] who contended that decisions on food choices were based on previously resolved deliberations and values which may stem from consideration of health status, managing relationships, society's food ideology, family environments, media and personal experiences, and which become habitual over time.

Economic factors comprised cost/price of food, availability of food, wages/income and foods on special offers and discounts, as viewed by [8].

Resourcescomprised on-site facilities for food storage and preservation, and heating up food, eating facilities such as benches, washing bowls, etc., knowledge of nutritional requirements for existing health conditions, for age and body size, the fact that healthy food will help to increase productivity and the fact that one will lose or add weight through consumption of certain foods. This aligns with findings from [16] which indicated thatindividuals consider assets which could be tangible or intangible, such asequipment (freezer, pantry space), space, knowledge, values, relationships, etc., in making food decisions.

Cultural distinctions comprised knowledge of what to eat as a man or woman; knowledge of what to eat for the type of work; belief that I should only eat food from my culture; and belief that avoiding meat will save money. This is consistent with findings from[11]which contended that culture encompasses knowledge, beliefs, customs and habits which a group of people share.

V. CONCLUSION

The study set out to establish a model of food choice determinants among construction workers. A framework was developed from literature and tested using PCA. The resulting framework had seven factors as opposed to the six factors theorized from literature.

The findings have practical implications for construction managers, employers and stakeholders who want to improve nutritional uptake of their workers. Awareness of the factors which influence their site workers' nutrition is valuable in planning for nutrition improvement. In addition, knowledge of the structure of these determinants will be helpful in collectively designing for the related individual factors. Improving nutrition, by targeting the identified nutrition determinants, will invariably result in improvement in health and safety performance on construction sites.

Although the study was conducted among construction workers, the model could be applicable to workers in general, especially low-income workers since working conditions and circumstances are similar. Future research could attempt to validate the model using more sophisticated analytical technique such as the structural equation modeling.

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LOADING MATRIX OF THE SEVEN COMPONENTS OF NUTRITION DETERMINANTS AFTER ROTATION

Measures	Service of the servic	F NUTRITION DETERMINANTS AFTER ROTATION Component						
		1	2	3	4	5	6	7
Food context	brand name	.726	.180	.065	.074	013	153	147
T ood context	food in season	.694	027	024	.084	.056	.024	.123
	time I have before work and during breaks	.551	.051	.017	067	.027	134	.373
	location of where the food is sold	.540	.046	065	.118	073	123	.064
	cooking skills	.482	029	.038	061	.078	.013	.369
	the way the food is advertised or marketed	.469	.178	.020	.133	010	158	.121
	what I am used to from home and family traditions	.279	.113	016	.129	.201	137	.106
Biological factors	the taste of the food	.156	.765	.283	093	030	.139	.110
	my appetite for particular foods	.186	.623	007	.020	081	086	.054
	how presentable the food is	002	.612	323	.067	043	243	.122
	the feeling of fullness I get from the food	.015	.576	046	.005	.346	.060	.012
	the quality of the food	096	.564	.009	.115	.031	142	061
	how hungry I am	016	.507	.108	.149	.307	.158	.057
Nutritional knowledge	what I know will give me energy	177	.046	.786	.085	.172	.149	.074
	what I know would give me different nutrients, eg., proteins, carbohydrates, vitamins and minerals	123	.105	.721	.069	094	163	091
	what I know can happen to my health if I eat or don't eat particular foods	.228	.206	.427	128	.178	270	099
	what I know an adult should eat in a day	.180	138	.404	043	030	086	.122
Personal ideas and systems	my eating habits, eg. adding salt no matter what, having my food with beer or juice instead of water, eating something sweet after a meal, eating the same cereal everyday	058	.256	124	.610	.023	010	.038
	my idea that particular foods are advertised for the benefit of the sellers or advertisers	.142	206	.084	.574	.165	021	088
	my mood, eg. happy, sad, stressed, etc.	.196	.226	.018	.538	.110	.027	075
	the fact that healthy food will help me concentrate on my work and avoid accidents and injuries	331	.020	.064	.521	.104	182	092
	what my friends choose for us to eat	.104	.276	.011	.483	036	.075	.213
	the need to belong to a particular social group	.002	.114	068	.471	.013	112	.248
	social media and networking	.315	.277	.032	.471	102	034	.005
	my belief that avoiding meat will keep me healthier	.204	163	.080	.448	278	188	.313
	my belief that killing animals for food is not good	.328	047	.159	.429	106	.043	.268
	my belief that my current diet is adequate	.072	066	.258	.358	114	081	.093
Economic factors	the cost/price of the food	.049	168	.074	.118	.845	.051	127
	the foods available	.062	.074	014	249	.729	198	.100
	the wages I am paid/income I make	254	.069	.005	.079	.636	154	.233
	the foods on special offers or discounts	.333	.122	.006	.204	.464	.190	.011
Resources	the facilities on site for storing and heating up my food	.466	.034	100	.106	.041	633	065
	the eating facilities provided on site, eg. benches, tables, washing bowls/sinks, etc.	.355	.033	.074	.120	.042	616	026
	what I know my body needs for my current health status	.174	.036	.237	080	071	564	.138
	what I know my body needs at my age	114	048	.151	.100	062	558	.300
	the fact that healthy food will help increase my productivity at work	188	.131	.055	.073	.232	525	112
	what I know my body size needs	.144	175	.212	059	.074	413	.263
	my idea that I will add or lose weight with particular foods	.047	.173	131	.298	.110	318	.020
Cultural distinctions	what I know I should eat as a man or woman	.202	.035	002	011	.014	.003	.652
	what I know my body needs for the type of work I do	222	.232	.109	059	.091	062	.560
	my belief that I should only eat food from my culture	.109	.027	.049	.396	.015	.022	.515
	my belief that avoiding meat will save money	.251	206	252	.367	097	138	.427