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Structural Exposition of concern and belief of COVID-19 vaccination Knowledge in Ghana

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Abstract

This study aimed to investigate the structural concerns, knowledge, and beliefs about COVID-19 vaccination in the Ghanaian context. As a result, understanding the changing dynamics of knowledge, concerns, and beliefs about COVID-19 vaccination and health is critical for disease control and prevention. This study used a quantitative method with convenience sampling to ask respondents about COVID-19 vaccine acceptance through an online questionnaire shared with indigenous residents in and outside Ghana with 346 respondents. This study employed various data analysis techniques, including structural equation modelling, multi-group data analysis, and interaction effects. The degree of belief and concern regarding vaccination knowledge was statistically different. It is assumed that males tend to believe more about vaccination and have higher knowledge than females. The study adds an original view of differences in the perception of people in Ghana on how they perceived the belief and concern for vaccination knowledge based on demographic factors of gender, employment, and unemployment

Keywords: COVID-19, vaccination, SEM, belief, concerns, and knowledge

Introduction

Attributed to the present pandemic, the novel SARS-COV-2 infection (COVID-19) has caused significant adverse economic, social and health impacts. Food transport chains have been negatively impacted (Sauramäki et al., 2021), educational systems disrupted, and the attainment of Sustainable Development Goals strained due to the COVID-19 pandemic (Ferrerias-Listán et al., 2021). With the documented infection of over half a billion people globally and millions of deaths attributed to the COVID-19 disease (WHO, 2020), the COVID-19 pandemic is one of the worst pandemics in modern public health history despite technological and healthcare advancements (Adusei-Mensah et al., 2021). The novel, protein-enveloped, positive-sense, single-stranded RNA SARS-COV-2 Beta-coronavirus

has been linked to the current outbreak. Currently, there is no definitive cure for this disease, and prevention has been achieved through numerous global and country-specific public health measures. Numerous public health interventions, including gathering, mobility restrictions, lockdowns, mass mask-wearing, social distancing, and mass vaccination campaigns, have been widely explored. Although the public's experience with most of these interventions was new, vaccination has been one of the oldest and tested arsenals in vaccine-preventable disease eradication. Like drug design and development, the process of vaccine development is a lengthy and money-intensive adventure in which many vaccine candidates do not eventually enter the market.

Recent studies have revealed that, based on the first Wuhan-Hu-1 strain, which was at the frontline of vaccine investigations and research, nine (9) Covid-19 vaccine candidates are currently available. The first four (4), NVX-CoV2373, mRNA-1273, Sputnik V, and BNT162b2, had (~96%), (~94%), (~92%), (~95%) respective efficacy against symptomatic Covid-19 disease (Hadj, 2022). Followed by AZD1222 has (~81%) efficacy against symptomatic Covid-19 disease (Hadj, 2022). The following vaccines were used: Covaxin (~78%) and BBIBP-CorV (~79%), CoronaVac (~51%), and Ad26.CoV. S (~66%) efficacy against symptomatic Covid-19 disease (Hadj, 2022). In general, all nine (9) Covid-19 vaccine candidates have more than 50% efficacy against symptomatic Covid-19 disease (Hadj, 2022). Nevertheless, the efficacy of all the aforementioned vaccines can be endangered or rendered inefficient as a result of the emergence of the SARS-CoV-2 variant and the widespread spread of the virus. The SARS-CoV-2 variant can escape neutralizing antibodies and cell-mediated immunity. In the case of mRNA and viral vector vaccines, unfavorable adverse health events rarely occur soon after administration. Although many Covid-19 vaccines have been developed, more potent and effective vaccines that could help fight all SARS-CoV-2 variants are still required to meet the huge global demand. Some promising Covid-19 vaccines such as ZF2001, AD5-nCOV, EpiVacCorona,

WIBP-CorV, CVnCoV, and ZyCoV-D, are promising for clinical studies. COVID-19-approved vaccines and booster shots have been globally rolled out, and new booster shots for variants are continually being developed.

Despite being known, vaccinations have always been greeted for mixed reactions. Concerns about vaccination, vaccination knowledge, infection prevention, and healthcare are widespread, including general and contextual factors. Health knowledge has been linked equally to variations in concerns and beliefs about vaccinations and their contextual, cultural, geographic, and developmental age dimensions. Evidence-based knowledge improvement via structured community education could be anticipated to positively impact COVID-19 vaccination, change social and personal dynamics, and improve perceptions. As a result, understanding the changing dynamics of knowledge, concerns, and beliefs about COVID-19 vaccination and health is critical for disease control and prevention. Against this backdrop, exploring the contextual impact and relatedness of the knowledge, concerns, and beliefs about vaccination will be worth investigating. The current study is one of the first to explore the interaction of knowledge, concerns, and beliefs regarding vaccination in the Ghanaian context.

Currently, there are no treatments for COVID-19, and vaccination is a proven public health tool for disease eradication. The present study, therefore, aimed to investigate the structural concerns, knowledge, and beliefs about COVID-19 vaccination in the Ghanaian context. For effective vaccination, knowledge of infection control and previous outbreaks and experiences is key to success in the current COVID-19 outbreak. Improving knowledge regarding the COVID-19 vaccine and vaccination program by addressing the barriers to vaccination and promoting facilitator inoculation is believed to improve acceptance of vaccinations and boosters (Kumari et al., 2021). The success of vaccination campaigns generally depends on the knowledge of attitudes and perceptions regarding the vaccination program (KAP). Higher vaccine acceptance can be ensured by strengthening the facilitators and limiting barriers (Kumari et al., 2021).

The public's concerns and beliefs about vaccines and vaccinations vary and are culturally inclined. Many concerns and beliefs have been identified regarding COVID-19 vaccines. For instance, in cross-sectional studies, limited knowledge of COVID-19 vaccination was associated, especially among vulnerable population groups, including poor populations, immunocompromised patients, people with allergies, pregnant and lactating mothers, and patients with chronic illness (Kumari et al., 2021).

Beliefs about vaccination of the public, vaccine safety, seriousness of health issues and vulnerabilities, fear of side effects, lack of healthcare practitioners, and reliability and fairness in communication have been previously believed to impact COVID-19 vaccine inoculation acceptance and hesitancy (Ullah et al., 2021). Acceptance of the COVID-19 vaccine has also been shown to vary globally, with approximately 90% reported in China compared to ~55% in Russia. Regional differences in vaccination factors are also significant and worth considering. For instance, in Indonesia, 15% out of total respondents hesitant to COVID-19 vaccine uptake were concerned about the safety and efficacy of the vaccine (Ullah et al., 2021), compared to (73.8%) on side effects (63.9%) of vaccine safety, and (52.4%) on vaccine effectiveness in China (Wagner et al., 2021) and 31% of the vaccine hesitancy among Americans was based on efficacy issues (Trojen & Pirofski, 2022). The lack of knowledge about "who, where, and when" to be vaccinated also influences vaccine acceptance and hesitancy. This study reviewed relevant literature, indicated appropriate methodology, presented the results, discussion, theoretical and managerial implications, conclusion and channelled the road map for the future.

Contextual background

Ghana is a developing country in Western Africa with a population of approximately 30 million based on the recent 2020 national census (Ghana Statistical Service, 2022). Ghana is one of the most functional healthcare systems in the region. However, as in many developing countries, health

resources are limited compared to their developed counterparts. As a result, many health services and health campaigns are equally negatively affected; data repositories, health promotion campaigns, and doctor/patient or nurse/patient ratios are stretched. This further indicates that health promotion exercises on COVID-19 vaccination, its importance, and the severity of COVID-19 without vaccination, among others, also suffered. A strong association between health knowledge and health-seeking behaviors, including vaccination, has been proposed. According to Saah et al., (2021), the contextual factors in vaccination uptake of hesitancy are key and cannot be ruled out. The healthcare-seeking behavior (HSB) of a population is a major determinant of the health status of a country, which is influenced by its socioeconomic development. The health beliefs and knowledge about COVID-19 and the vaccines and their efficacy and safety will inform the population's inactions, procrastination, or action against being vaccinated or for vaccine hesitancy.

Review of Existing Literature and Hypothesis Development

To develop effective COVID-19 preventive and treatment measures, it is critical to understand how conspiracy theories affect COVID-19 immunization. The current study investigated descriptive statistics and examined the relationships between concern for COVID-19 vaccination, belief in COVID-19 vaccination, and knowledge of COVID-19 vaccination across gender and employment status.

Concern about COVID-19 Vaccination

COVID-19 immunization is extremely concerning for various reasons. Researchers such as de Figueiredo, Simas, Karafillakis, et al., (2020); Robertson, Reeve, & Niedzwiedz et al., (2021), and a poll conducted by the Office of National Statistics in the United Kingdom have provided explanations for the general public's low uptake of COVID-19 vaccinations. Concerns about potential side effects, future health consequences, and long-term consequences. Furthermore, prior adverse reactions to

common immunizations, such as influenza vaccines, have been reported. Low belief in the importance, safety, and efficacy of immunization. The rapid development of COVID-19 vaccines is also a cause for concern, and no vaccine has been given to patients who provide incorrect contact information. There are also concerns regarding breastfeeding, pregnancy, and fertility. Conspiracy theories, such as the notion that COVID-19 does not exist or that vaccines alter DNA. Concerns about the current vaccine's safety remain a significant predictor of vaccine uptake and acceptance among healthcare professionals' attitudes (Verger et al., 2021; Papagiannis et al., 2021). In these two separate studies, it was revealed that the issue or concerns about the safety of the current COVID-19 vaccines are not a matter of isolated cases but associated with other vaccines among the general population as well as healthcare professionals (Di Martino et al., 2020; Yaqub et al., 2014). Such evidence re-enforces the assumptions in concept of 'the more information is provided on the risk and safety of a vaccine, the less concerns are raised, the higher the acceptance and uptake', hence the risk benefit-ratio of COVID-19 vaccine and vaccination is highly significant (Chou et al., 2021). Concerns about covid-19 vaccines and vaccination require urgent attention by ensuring that adequate information is made available and in good time, since delay in information sharing gives room for more people to become more hesitant with time, which reduces the number of people who get vaccinated (Chou et al., 2021; Glanz et al., 2015). We hypothesized that there would be a positive relationship between concerns about COVID-19 vaccination and knowledge of COVID-19 vaccination (H1).

Belief about COVID-19 Vaccination

Health belief is undeniably one of an important underlining factor that informs attitude and vaccination practice. Belief in vaccine safety and efficacy has been well documented in the literature. In a developing country like Ghana, where knowledge about fake medicines and vaccines is always on the discussion table of many, commitment towards new interventions is usually hampered. In our previous

study, we observed that developing countries, mostly African countries, were the least to be vaccinated (Adusei-Mensah et al., 2022). Factors such as miscommunication, adverse effects, and political will were also identified. SARS-CoV-2 (COVID-19) vaccinations have been developed to combat the COVID-19 pandemic. People are less likely to adopt a vaccine when it is widely available if they believe in false information about the virus, particularly their beliefs about the origin of COVID-19 (i.e., that it was created) (Salali & Uysal, 2020; Earnshaw et al., 2020). Conspiracy theories have harmed vaccination campaigns to such an extent that they have been linked to the recent resurgence of polio and measles, even though these diseases have caused many deaths and morbidities in recent decades (Karafillakis & Larson, 2017; Jolley & Douglas, 2014). People's perceptions of the low quality and safety of the vaccines, as well as their belief that they have enough immunity to fend off COVID-19, were the main deterrents to receiving the vaccinations, according to Nemat, Bahez, Salih, Raufi, et al., (2021). Further research on vaccine resistance and COVID-19-related beliefs is needed to increase the uptake of the COVID-19 vaccine among various communities. We hypothesized that a positive relationship exists between beliefs in COVID-19 vaccination and knowledge of COVID-19 vaccination (H2).

Male and Female Belief through COVID-19 Vaccination Knowledge

Another global issue is vaccination hesitancy. According to a survey conducted by the Institute of Global Health Innovation in 2021 (Institute of Global Health Innovation, 2021), the COVID-19 vaccine would be accepted by between 50% and 60% of respondents worldwide, with significant regional variations. Furthermore, there is evidence of greater vaccine aversion among women (21% versus 15%), younger age groups (28% versus 14%, for age 55-64 years), and those with less education (24% versus 13% for those with a secondary school diploma) (Robertson et al., 2021).

In three trials, Soiza, Scicluma & Thomson (2021) investigated vaccine safety and effectiveness in older people. Overall, their Phase II studies with limited data show that older participants in good health have lower antibody responses and mild-to-moderate adverse events than younger participants. The interim evaluations of the Pfizer and Moderna vaccines resulted in press releases announcing high levels of success, and several Phase III trials specifically attempted to recruit older adults. There are no published data on the safety and efficacy of this treatment in this population, and older adults with comorbidities and fragility have largely been excluded. Although the pandemic's rapidity and impact on the elderly and frail justify prioritizing immunization, patients, caregivers, and supervisory medical professionals must all base their decision to receive vaccination on limited data. We hypothesized that male perception of belief in COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H3a) and that female perception of belief in COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H3b).

2.4 Employed and Unemployed Belief through COVID-19 Vaccination Knowledge

An individual's opinion of the COVID-19 vaccine's safety is a reliable indicator of their willingness to receive it (Karlsson et al., 2021). According to research by Crespo et al., (2021), the median share of respondents who said they were concerned about the vaccine's side effects remained above 50% among females (53.7%, range:31.8-70.4), those who were working (50.5%, range:26.7-65.0), those who were not working or unemployed (53.3, range:35.4-73.8), and those who had children at home (55.8%, range:36.5-64.7). Compared to employed participants, those without jobs were more likely to think that the cost of vaccinations and the recommendations of medical professionals were the main factors influencing people's decisions to receive the Covid19 vaccines. Additionally, unemployed individuals were less likely to doubt immunization (Marzo, Ahmad, Islam et al., 2022). Further research is needed to monitor the long-term changes in public working status on their perception of COVID-19 vaccines if the goal of herd immunity is to be achieved. If the objective of herd immunity is to be accomplished,

additional research is required to evaluate long-term changes in people's working status on their impression of COVID-19 vaccinations.

We developed the hypothesis that unemployed perception about belief in COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H4a) and employed perception about belief in COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H4b).

Male and Female Concern through COVID-19 Vaccination Knowledge

Several studies have been conducted on the gender perspective on COVID-19 vaccination knowledge. Marzo et al., (2022) discovered that male participants were significantly more likely than female participants to agree that vaccination would effectively prevent and control COVID-19, accept the vaccines, and express their hesitancy to receive COVID-19 vaccines. Men were more likely to believe that the COVID-19 vaccine was effective and popular than women. Men were also more likely to agree that ease of vaccination and medical guidance were essential factors in COVID-19 vaccine uptake. From the literature, we hypothesized that male perception of concern for COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H5a), and female perception of concern for COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H5b).

Employed and Unemployed Concerns through COVID-19 Vaccination Knowledge

According to Handwerker, Meyer & Piacentini (2010), there has never been a job loss of this magnitude since World War II. Early in the crisis, many people expressed hope that with government assistance, employers and employees could quickly resume their pre-pandemic employment arrangements. However, as the COVID-19 situation worsens, more employer-employee relationships deteriorate, compounding harm to society and the economy. With the availability of COVID-19 vaccines, employment has quickly recovered from the pandemic job losses. However, Hall and

Kudlyak's (2022) study showed that total employment recovery takes time. For example, the recovery from the Great Recession was gradual, linear, and sloping. As a result, it is critical to understand how much a person's employment situation influences their opinion on COVID-19 immunization. Based on the literature, we developed the hypothesis that unemployed perception about concerns for COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H6a) and employed perception about concerns for COVID-19 vaccination is positively related to knowledge of COVID-19 vaccination (H6a).

Knowledge about COVID-19 Vaccination

Acceptance of COVID-19 vaccination is critical for disease control. Understanding how information about vaccines influences vaccine acceptance is critical for establishing immunization efforts. Vaccination provides personal protection against COVID-19 and contributes to the development of herd immunity, which prevents disease spread and protects vulnerable populations who cannot receive the vaccine³³. According to Fontanet and Cauchemez (2020), herd immunity against COVID-19 requires vaccination in 65%-70% of the population. Age, income and education levels, medical careers, and COVID-19 immunization status are all related to COVID-19 vaccination knowledge, according to Abebe, Shitu, & Mose (2021). However, these relationships may vary depending on context.

According to the WHO Health Organization, getting people to take COVID-19 immunizations is difficult in many countries. Vietnam (98%), India (91%), China (91%), Denmark (87%), and South Korea (87%) had the highest rates of general population acceptance of COVID-19 vaccination. In comparison, Serbia (38%), Croatia (41%), France (44%), Lebanon (44%), and Paraguay (51%) had the lowest (Wouters et al., 2021). These disparities have not been fully explained, and more research is critical to motivate the general population and healthcare practitioners to accept the vaccines, provide more information on vaccine safety and efficacy, and demystify the wrong beliefs, knowledge, attitude, and perception associated with the current COVID-19 vaccines. The findings of our study may be used

by management to encourage and improve public attitudes, knowledge, and perceptions of COVID-19 immunization. Based on this, we hypothesized that people’s knowledge of COVID-19 Vaccination is significant (H7).

Recent literature on Vaccination

This table below shows the focus and finding of some studies carried on vaccination.

Table 1: literature on Vaccination

Authors	Focus	Results
Chalkias, S., Charles Harper et al. (2022)	Investigated the safety and immunogenicity of the bivalent omicron-containing mRNA-1273.214 booster vaccine.	Their research shows that the 50-g bivalent mRNA-1273.214 vaccine, when given as a booster dose, showed a safety and reactogenicity profile that was similar to that of the 50-g mRNA-1273 vaccine and evoked better neutralizing antibody responses against omicron at 28 days following immunization. Additionally, neutralizing antibody responses were greater against the ancestral SARS-CoV-2 and omicron subvariants BA.4/5 (D614G). Additionally, the spike-binding antibody responses against the omicron, alpha, beta, gamma, and delta variants were stronger in response to the mRNA-1273.214 booster than mRNA-1273.

<p>Sridhar, Chicz, Warren et al., (2022)</p>	<p>Studied the safety and immunogenicity of the bivalent omicron-containing mRNA-1273.214 booster.</p>	<p>According to their analyses of the clinical data, this sublineage has retreated, clinical data with BA.4/BA.5 -prototype vaccinations are being developed, and mRNA vaccines that include BA.1 show greater neutralizing responses to BA.1 compared to the comparable prototype vaccines. In addition to stating that the Beta VOC should be a competitor for the booster SARS-CoV-2 vaccine, they hypothesize that each vaccine candidate must explain their booster strain selection process with data-driven conclusions.</p>
<p>Andrews, Stowe, Kirsebom et al., (2022)</p>	<p>They examined the efficacy of the Covid19 vaccine against symptoms brought on by the delta and omicron variants after two doses (primary vaccination) of the BNT162b2, mRNA-1273, or ChAdOx1 nCoV-19 vaccine as well as after homologous</p>	<p>According to their research, BNT162b2 or ChAdOx1 nCoV-19 immunization in two doses is insufficient to provide significant levels of protection against omicron variant infection and moderate illness. Boosting with BNT162b2 or mRNA-1273 significantly increased protection against mild illness, albeit this protection gradually waned over time. Boosters will</p>

	<p>or heterologous booster doses of the same three vaccines.</p>	<p>likely provide much higher levels of defense against serious and deadly illness. Also, they suggested that third doses of the vaccine can increase coverage in heavily immunized groups like those in the United Kingdom and emphasized that more research will be required to evaluate protection against serious illnesses and the persistence of protection following booster immunization.</p>
<p>Magen, Waxman, Makov-Assif et al., (2022)</p>	<p>evaluated the relative efficacy of a fourth vaccination dose compared to a third dose administered at least four months prior in people 60 years of age or older.</p>	<p>According to their findings, a fourth dose of the BNT162b2 vaccine provides greater protection against PCR-confirmed SARS-CoV-2 infection, symptomatic Covid-19, Covid-19-related hospitalization, severe Covid-19, and Covid-19-related death among people 60 years of age and older than a third (booster) dose administered at least 4 months earlier.</p>
<p>Gardner & Kilpatrick (2021)</p>	<p>They used projected drops in neutralizing antibody titers among viral types to analyze the diversity in vaccination</p>	<p>According to their investigations, protection from infection, clinical illness, and transmission is all but nonexistent for people whose immunity to vaccines has</p>

	<p>efficacy (VE). Additionally, correlations between variant-specific decreases in neutralizing antibodies and defense against confirmed infection, clinical sickness, and hospitalizations were investigated across variants and vaccinations.</p>	<p>faded. Third doses greatly lessen these decreases, but they only increase protection to levels comparable to waning protection against the Delta variety.</p>
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Figure 1. Framework

Methodology

Study Sampling

This study used a quantitative method with convenience sampling to ask respondents about COVID-19 vaccine acceptance through an online questionnaire shared with indigenous residents in and outside Ghana. We received 346 responses from the respondents. This quantitative study employed various data analysis techniques, including structural equation modelling, multigroup data analysis, and interaction effects. This study focuses on indigene residents in and outside of their views on accepting the COVID-19 vaccine.

The demographic responses accounted for 61% of the respondents being male, while 39% were female. Many respondents (39.6%) were between 21-30 years, Christian (90.2%), and single (59.5%). The respondents' educational background showed that most had bachelor's degrees (44.8%). Most of the respondents answered "No" to the questions on religious reasons (72.8%), cultural reasons (76.0%),

beliefs in traditional remedies (54.9%), beliefs in conspiracy theories (66.2%), and beliefs in myths (78.3%).

Adapted Instrument

SmartPLS version 3.0, with partial least squares structural equation modelling, was used to analyze the collected data. The fundamental aim of employing SEM in SmartPLS in this study is its ability to study and better comprehend the complexity within the context of COVID-19 vaccine hesitancy and uptake, taking cognizance of a cause-effect network among latent variables. SEM in SmartPLS is a method that perfectly permits the estimation of complex cause-effect relationship models with latent variables, as described in this study.

Much could have been achieved with multiple regression analysis but owing to the complexities associated with the issues associated with vaccines and vaccination, the researchers opted for SEM in SmartPLS. Conceptually, SEM in SmartPLS is similar to the use of multiple regression analysis but also supports the use of reflective and formative measures for the variables. Structural equation modelling in smart partial least squares (PLS-SEM) was employed to analyze the data because it is fitting for validating predictive models, notably composite and complex models, and is also convenient for correctly specify model (Chin, 1998). Moreover, SEM in SmartPLS is essential for the assessment of the measurement and structural model (Hair et al., 2012). Another merit of using SEM-PLS is that the residual variance of the latent variables is best explained by estimations rather than confirmation.

Given these merits over multiple regression analysis, the researchers employed SEM in SmartPLS to analyze, explore, and test both the established conceptual model and the hypotheses for the study. The authors also used SmartPLS 3.0 to investigate the interaction effect of concerns about COVID-19 vaccination, belief in COVID-19 vaccination, and knowledge of COVID-19 vaccination. SmartPLS statistics software was chosen for this study because it is simple to use and potentially solves

complex problems statistically. Although it has limitations, existing research has recommended it as helpful software (Qureshi et al., 2009; Almahamid et al., 2016; Hair, Ringle & Sarstedt, 2011).

Figure 2. Hypotheses Result

Table 2. Quality Criterion

Variables and Items	Factor Loadings	Mean	SD	CA	rho_A	CR	AVE	VIF	f Square
Belief				0.849	0.850	0.930	0.869		0.097
Belief1	0.936	1.272	0.445					2.191	
Belief2	0.928	1.240	0.427					2.191	
Concern				0.818	0.819	0.917	0.846		0.665
Concern1	0.917	1.379	0.485					1.919	
Concern2	0.922	1.373	0.484					1.919	
Knowledge				0.923	0.928	0.951	0.866		
Knowledge1	0.915	1.751	0.432					3.135	
Knowledge2	0.936	1.757	0.429					3.603	
Knowledge3	0.941	1.723	0.448					3.786	

Note: SD - Standard Deviation; CA – Cronbach Alpha; CR – Composite Reliability; AVE – Average Variance Extracted

Table 3. Construct Correlation

Variable	Belief	Concern	Vaccination Knowledge
Belief	0.932		
Concern	0.036	0.920	
Vaccination Knowledge	0.214	-0.609	0.931

Note: * Computation of the square root of AVEs (shown in bold on the diagonal) and factor correlation coefficients.

Table 4. Hypotheses Test Results

Hypotheses	Path Coefficient	Beta	Standard Deviation	T Statistics	P Values	Hypotheses Results
H1	Belief -> Vaccination Knowledge	0.236	0.041	5.697	0.001	Confirmed
H2	Concern -> Vaccination Knowledge	-0.618	0.038	16.127	0.001	Confirmed

Note: Two-tailed hypothesis. *** indicates significance at the 0.1% level, and * indicates significance at the 5% level.

Table 5. Multigroup Analysis Results

Hypotheses	Path Coefficient	Male	Female	Hypotheses	Employed	Unemployed	Different	Remarks
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	t							
H3	Belief -> Vaccinati on Knowledg e	4.350** *	3.841***	H4	3.752***	4.331***	Yes	A
H5	Concern - > Vaccinati on Knowledg e	8.473** *	14.278** *	H6	12.807** *	9.530***	Yes	A

*Two-tailed hypothesis. *** indicates significance at the 0.1% level, ** indicates significance at the 1% level, and * indicates significance at the 5% level. A: Accepted; R: Rejected; NS: Not Significant.

Result

The degree of reliability of this study's assessment methodologies did not change during the study. The conclusions drawn from the reliability of this study were dependent. Cronbach's Alpha and Composite Reliability are two measures that illustrate item consistency. Composite reliability, which assumes varying indicator loadings within a population, is a data analysis technique used to evaluate reflective outer models for internal consistency. It is more reliable than Cronbach's alpha, as it takes into consideration the number of items in a scale, as stated by Hair Jr., Sarstedt, Hopkins, & Kuppelwieser

(2014). This difference occurs because composite reliability considers the number of items on a scale.

Witjaksono & Saputra (2019) concluded that having accurate and valid test items is vital.

The loading threshold for each item was determined to be 0.5. (See Table 2). Cronbach's alpha, a reliability test that describes the association between latent variables and manifest indicators, was consistent with the verdict of 0.7 (Hair et al., 2014; Witjaksono & Saputra, 2009). In addition, rho A demonstrates that the latent variables have a significance that is more than the cutoff of 0.7, and the Average Variance Extracted for Belief, Concern, and Knowledge all demonstrate this (see Table 2). The discriminant table revealed a positive association between the variables when determining the relationship between trustworthiness and belief, worry, and vaccine knowledge (see Table 3).

There was a positive relationship between Belief and Vaccination Knowledge, that is, Belief \rightarrow Vaccination Knowledge with $t = 5.697$. The result was significant ($p < 0.01$) (see Table 4). For “f,” a weak effect exists between belief and vaccination knowledge with the threshold (0.02 - 0.15). There is a positive relationship between Concerns and Vaccination Knowledge, that is, Concerns \rightarrow Vaccination Knowledge with $t = 16.127$; the result is significant at $p < 0.01$. For “f,” a strong effect exists between Concerns and Vaccination Knowledge with the threshold (>0.35).

Result of Hypotheses Testing

There was a positive relationship with the male perception of belief concerning Vaccination Knowledge, that is, Belief*Male \rightarrow Vaccination Knowledge, $t = 4.350$; the result was significant with $p < 0.01$. There was a positive relationship between the female perception of Belief to Vaccination Knowledge, that is, Privacy*female \rightarrow Security, $t = 3.841$. The result was considered significant at $p < 0.01$. There is a positive relationship between the male perception of Concerns with Vaccination

Knowledge, that is, Concerns*Male-> Vaccination Knowledge, $t = 8.473$; the result is significant at $p < 0.01$.

There is a positive relationship with the female perception of concern for vaccination knowledge, that is, Concerns*Female-> Vaccination Knowledge, $t = 14.278$; the result is significant with $p < 0.01$. There is a positive relationship with the Employed perception of Belief about Vaccination Knowledge, that is, Belief*Employed-> Vaccination Knowledge, $t = 3.752$, and the result is significant with $p < 0.01$. There is a positive relationship with the Unemployed perception of Belief concerning Vaccination Knowledge, that is, Belief*Unemployed-> Vaccination Knowledge, $t = 4.331$; the result is significant at $p < 0.01$. There is a positive relationship between the Employed perception of Concerns and Vaccination Knowledge: Concerns*Employed-> Vaccination Knowledge, $t = 12.807$; the result is significant at $p < 0.01$. There is a positive relationship between the Unemployed perception of Concerns and Vaccination Knowledge: Concerns*Unemployed -> Vaccination Knowledge, $t = 9.530$; the result is significant with $p < 0.01$, see Table 5 and Figures 1-2.

Discussion

Regarding the ravaging of COVID-19, Africa is supposed to be the most vulnerable continent due to a lack of infrastructure, stable medical facilities, insufficient medical practitioners, and good governance. However, some African countries have managed pandemic crises carefully. One of the panaceas for COVID-19 in Africa is vaccination, but it is not without the challenge of vaccine hesitancy. According to a recent study by Ackah et al., (2022), the vaccine acceptance rate swings between 6.9 to 97.9%. It is assumed that African vaccine acceptance accounts for 50% or less because of scarce medical resources and poor management. Ghana, the focus of this study, had eight academic publications with 11.3% on vaccination, followed by Nigeria with 13 publications and 18.3% with a focus on COVID-19 vaccine acceptance or hesitancy Ackah et al., (2022). African Union Policy Updates also rolled out five

economic impacts of the COVID-19 vaccine in Africa: cost-effectiveness of preventing crowded cases of hospitalizations and deaths, more significant health benefits, and prioritizing vulnerable populations (elderly, pregnant women, health workers, and others with risk-increasing co-morbidities). African countries must embark on meaningful negotiations, obtain vaccines at the lowest price, and adhere to the latest available evidence to adapt their strategies to the emergence of new variants and data (African Union, 2022).

This study draws from the theory of reasoned action (Fishbein, 1979; Sarver, 1983) as articulated in the study of Bang, Ellinger, Hadjimarcou & Traichal (2000). This study used two constructs: concern and belief in predicting COVID-19 vaccination knowledge. Existing studies have shown the relationship between knowledge, attitude, and behavior. Mailinda & Lestari (2019) confirmed in their study that students have good knowledge, negative attitudes, and good behavior in choosing healthy snacks. The authors clarified this contradictory result in that students gained internal and external knowledge from teachers, parents, and friends. At the same time, negative attitudes emanate from friends' social influence, which could be positive or negative. This trend indicates that attitudes affect knowledge. Good behavior is associated with a child's attitude and knowledge. A study by Mailinda & Lestari (2019) did not find any correlation between attitudes, healthy snacks, and snacking behavior.

On the other hand, Bang et al., (2000) examined concerns, beliefs, and knowledge about renewable energy. They found a high level of concern, insufficient knowledge, and a positive relationship between beliefs and attitudes toward paying more for renewable energy. This study's results differed from the existing studies of Bang et al., (2000) and Mailinda & Lestari (2019) as concern for COVID-19 vaccination and belief in COVID-19 vaccination relates to COVID-19 vaccination. This result shows that both beliefs and concerns regarding COVID-19 vaccination will

increase people's knowledge of vaccination. Based on this result, people tend to have more concerns about COVID-19 vaccination than their beliefs about vaccination.

Further, this study embarked on Multigroup Analysis (MGA) to test whether the pre-defined groups of demographics have significant differences. The significance level was based on a smaller p-value of 0.05, or a p-value more significant than 0.05. The results showed that the degree of belief and concern regarding vaccination knowledge was statistically different from one another. It is assumed that males tend to believe more about vaccination knowledge than females do. This gender difference can be seen as the daring nature of men. Thus, based on the theory of planned behaviour (Ajzen, 1985) and the theory of Reasoned Action (Fishbein & Ajzen, 1975) the probability of males valuing the information or advice of healthcare practitioners about the safety and efficacy of vaccines and the vaccination process is higher than that of females.

On the other hand, females are more concerned about vaccination knowledge than men. It is presumed that women seek safety and security more than men. The fear of the unknown may warrant the concern of females for vaccination knowledge more than that of males. Likewise, the perception of the employed regarding belief in vaccination and vaccination knowledge is more than that of unemployed people in Ghana. The unemployment rate in Ghana was approximately 4.70 in 2021 (ILOSTAT, 2022). The luxury of having a good job with a fat salary may raise concerns for COVID-19. At the same time, the frustration of unemployment may prevent the unemployed group from showing concern, such as the employed. The bottom line shows how beliefs and concerns affect vaccination knowledge in Ghana.

Theoretical Implication

This study builds on the reasoned action theory and a COVID-19 framework based on the construct of belief and concern as independent variables and vaccination knowledge as dependent variables. In common parlance, knowledge is power, and the depth of knowledge matters concerning COVID-19

vaccination and the application of vaccination knowledge counts. This study took the turn of a quantitative empirical study and focused on one of the African countries vulnerable to COVID-19. This study contributes to the literature on vaccination by clearly showing the impact of beliefs and concerns of people in Ghana regarding vaccination knowledge. To the best of our knowledge, this is one of the studies that examines the structural exposure of concern and belief in COVID-19 vaccination Knowledge in Sub-Saharan Africa. Our study provides an in-depth understanding of how concerns about vaccination knowledge surpass beliefs in vaccination knowledge. Further, this also provides insight into the differences in perception of people in Ghana on how they perceived the belief and concern for vaccination knowledge based on demographic factors of gender, employment, and unemployment.

Managerial Implication

Because of the insights gained from this study, it is pertinent that health managers, international organizations, and policymakers at different governmental levels pay attention to the beliefs and concerns of people when formulating a strategy for the further rollout of vaccines in African countries. Presently, there are a lot of myths, fear and fake news that restrain people from accepting vaccines. Since knowledge has the power to break the tenacity of ignorance, policymakers should carefully craft orientation and awareness campaigns along with beliefs and concerns to liberate people from the captivity of hesitancy. Additionally, policymakers should come up with an updated policy that will appeal to males, females, the employed, and the unemployed to update their knowledge regarding COVID-19 vaccination.

Conclusion

Historically, Africa has experienced the largest immunization drive. We upvote on this research because of the huge gap in vaccinations in Africa. Recently, the WHO Health Organization Africa (WHO Africa, 2022) has covered the progress of vaccination in Africa. Statistics indicate that only

15% of the adult population is currently vaccinated. In addition, only 435 million doses of the 714 have been administered. Vaccination across African nations is non-linear. For example, 15 countries have below 10% and 19% vaccinations, while only five countries have reached between 40% and 69%. On the African continent, only two countries (Mauritius and Seychelles) are above the verge of 70%. We examined the impact of beliefs and concerns regarding vaccination knowledge to challenge the problem of ignorance because ignorance is an indicator of a lack of knowledge or information.

Study Limitation

Although this study contributes to the body of knowledge, it has some limitations. This study focuses only on African fragments. In addition, the study used limited constructs to predict vaccination knowledge and did not test the actual attitudes of people regarding COVID-19 vaccination. The study used variance structural equation modelling and did not test the proposed model by testing moderation and mediation effects. All these limitations show an extended gap in the vaccination literature, which is a roadmap for future research.

Future Research

Based on the limitations identified in this study, future research should extend these results to other African countries, mainly through comparative analysis, as vaccination progress is not at the same level. Future studies should add more constructs to the proposed model of vaccination knowledge, such as attitude, behavior, and hedonic constructs. Future studies should add a moderator and mediator for the mediation and interaction effects. This is because moderators and mediators have the potential to mask other significant predictors responsible for vaccine uptake and hesitancy.

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