Exploring Knowledge, Attitudes, and Practices on Seasonal Vaccination: Mediating 5C Antecedents and Moderating Vaccine Perception

Muhammad Awais Bhatti[1]*, Ahmad Zakariya[2]

[1]Department of Management, College of Business, King Faisal University, Al-Ahsa 31982, Saudi Arabia.
Email: mbhatti@kfu.edu.sa
[2]Department of Management Sciences, National University of Modern Languages, Lahore Campus, Pakistan.
Emails: azakariya@numl.edu.pk

Abstract

Purpose: This study investigates the relationships between knowledge, attitudes, and practices (KAP) toward seasonal vaccination, 5C psychological antecedents, and perceived vaccination benefits. It aims to explore the mediating role of the 5C psychological antecedents and the moderating role of vaccine perception in these relationships, providing a comprehensive framework to understand vaccination behavior. **Method:** A cross-sectional survey was conducted on a sample of 284 individuals who had received seasonal vaccinations in the past three months. Data were collected using structured scales adopted from prior research. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed for data analysis, assessing direct, indirect, and moderating effects among the constructs. **Findings:** The results demonstrate that KAP significantly influences perceived vaccination benefits both directly and indirectly through the 5C psychological antecedents. The study also confirms the moderating effect of vaccine perception on the relationship between KAP and perceived benefits. The findings highlight the critical roles of confidence, collective responsibility, and complacency in shaping individuals' perceptions of vaccination benefits. **Originality/Implications:** This research advances theoretical understanding by integrating the KAP model with the 5C framework and vaccine perception. Practically, it provides actionable insights for designing targeted interventions to enhance vaccination uptake and address hesitancy, particularly in seasonal vaccination contexts.

Keywords: Seasonal Vaccination, 5c Psychological Antecedents, Vaccine Perception, Vaccination Benefits, Vaccination Behavior.

Introduction

Seasonal vaccination is among the most vital interventions in public health, particularly when controlling the effect of infectious diseases such as influenza, which continues to be a recurrent threat to global health systems.[1] Vaccination has been touted as one of the most cost-effective interventions to reduce morbidity, mortality, and the economic burden associated with seasonal outbreaks.[2] Although it has been effective in many places, vaccination coverage remains poor in most parts of the world due to multiple inter-related knowledge deficits, attitudinal barriers, and inconsistencies in practice.[3] In recent years, scholars have drawn intense attention to exploring the determinants of vaccine uptake, which have laid emphasis on knowledge, attitudes, and practices in forming health-related behavior.[4,5] In addition, psychological models like the 5C framework have extended this definition to include confidence, complacency, constraints, calculation, and collective responsibility as some of the antecedents of vaccination behavior.[6]

The findings of researches on KAP and vaccination emphasize that high levels of awareness significantly relate to greater vaccine uptake and benefits.[7] For example, the literature shows that persons with greater knowledge of diseases caused by vaccines appreciate immunization as an essential preventive measure.[8] Attitudes, including trust in vaccine effectiveness and health care delivery, have been strong predictors of acceptance for vaccines.[9] Furthermore, habitual health practices, such as routine medical checkups, have been positively related to vaccination behaviors.[10] The 5C psychological antecedents have also been extensively

Access This Article Online

Quick Response Code:

Website: www.jnsbm.org

DOI: https://doi.org/10.4103/jnsbm.JNSBM_16_1_4

Address for Correspondence: Department of Management, College of Business, King Faisal University, Al-Ahsa 31982, Saudi Arabia
Email: mbhatti@kfu.edu.sa

Submitted: 19th August, 2024 **Received:** 21st September, 2024
Accepted: 02nd December, 2024 **Published:** 12th January, 2025

How to Cite This Article: Bhatti, M A Zakariya, A. Exploring Knowledge, Attitudes, and Practices on Seasonal Vaccination: Mediating 5C Antecedents and Moderating Vaccine Perception. J Nat Sc Biol Med 2025;16:30-42

studied in the literature.[11,12] Confidence, referring to the belief in vaccine safety and efficacy, appears to be a strong predictor of perceived benefits of vaccination.[13] According to complacency research, individuals who think that they are less likely to contract infectious diseases are said to overestimate their reliance on vaccine safety.[14] Obstacles include physical difficulties in terms of delivery as well as cost significantly limit the demand for vaccination; individuals who purposefully weigh vaccine benefit versus drawback tend to seek vaccination.[5,15] Herd immunity, which presupposes the role of immunization in obtaining positive effects for society, has been positively associated with collective responsibility.[16] There have also been studies on the moderating role of vaccine perception.[9,17] It is found that it enhances the association between KAP and perceived benefits through positive perceptions of vaccination, while negative perceptions lead to resistance to immunization even when the level of knowledge is enough.[15] Furthermore, the role of psychological precursors has emphasized the mediator status, explaining the gap between KAP and vaccine result.[17]

Despite the significant research conducted on vaccination behaviors, various gaps are left unaddressed. For one, the interaction between KAP and perceived benefits is mostly addressed in isolation from mediating and moderating variables.[17] This gap means that the comprehension of how psychological and contextual variables affect the conversion of knowledge and attitudes into perceived vaccination benefits cannot be fully ascertained.[1] Most studies target specific populations, such as healthcare workers or high-risk groups, without investigating generalizable findings across diverse demographic settings.[5] Another gap that is notable is the limited use of psychological frameworks like the 5C model in studies about vaccination behavior. Although the 5C model was confirmed to be a predictor, there is less knowledge of its mediating role in influencing the relationship between KAP and perceived benefits.[5,6] Another gap filled in this literature is that the research on the moderating effect of vaccine perception, especially concerning how positive or negative perceptions alter the impact of KAP on outcomes in vaccination, is scarce.[14,15] The main aim of this research is to explore the complex interlinkages between KAP, psychological precursors, perception of vaccine, and perceived benefits of vaccination. Specifically, the study aims to:

1. Investigate the direct influence of KAP on perceived vaccination benefits.
2. Assess the impact of the 5C psychological antecedents on perceived benefits.
3. Explore the mediating role of the 5C psychological antecedents in the relationship between KAP and perceived benefits.
4. Examine the moderating effect of vaccine perception on the KAP-perceived benefits relationship.

These objectives align with the gaps identified in previous research and seek to add to a more robust understanding of vaccination behaviors.

This study has significant theoretical as well as practical implications. Theoretically, this study contributes to the literature on vaccination behavior through the integration of psychological antecedents and perceptual factors within the KAP framework; hence, as explained by Venuto *et al*.[13] and Wu *et al*.[18]. Practically, findings can inform targeted interventions and public health strategies designed to improve vaccination uptake and optimize health outcomes, as suggested by Akmatova *et al*.[17].

The Health Belief Model and the 5C framework complement each other perfectly for this research study. The HBM considers that individual health behavior is conditioned by perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy.[12] Here, the KAP component directly relates with cues to action and self-efficacy influencing the perceived benefit. The 5C framework complements HBM by identifying other psychological antecedents, such as confidence and calculation, which mediate and amplify these relationships.[6] Intending to fill the gaps between theory and empirical studies of determinants of behavior for vaccination from prior works, this study combines the frameworks. It hypothesizes that the 5C antecedents mediate the KAP-perceived benefits relationship, while vaccine perception moderates this dynamic, offering a comprehensive model for future public health interventions.[19]

Literature Review

Theory to Explain Research Relationships and Model

The Health Belief Model (HBM) provides an excellent theoretical structure for understanding how KAP influences psychological antecedents, influences vaccine perception, and impacts the perceived benefits of vaccination. For instance, within HBM, factors that determine health behavior include susceptibility, severity, benefits, barriers, cues to action, and self-efficacy.[20] In the current study, knowledge is the analogue of cues to action, attitude is equivalent to perceived benefits and barriers, and practice translates to self-efficacy. The 5C model completes HBM by utilizing psychological antecedents that are comprehensive in providing insight into how confidence, complacency, constraints, calculation, and collective responsibility mediate and moderate health behaviors.[18] Vaccine perception serves as the contextual factor that impinges on the way individuals make sense of these constructs in reinforcing the dynamic interplay proposed by HBM. Together, these frameworks explain the mechanisms driving vaccination-related behaviors and outcomes, affording a more encompassing understanding of the proposed model.

Seasonal immunization is recognized as a very important public health intervention in terms of arresting the dissemination and impact of infectious diseases, especially those that have predictable seasonal outbreaks like influenza. Research conducted on this topic indicates complex interactions between knowledge, attitudes, and practices in the context of vaccination behavior,[21]

which reflects perceptions of awareness about the availability of vaccines, mechanisms in preventing disease, and self-perceived susceptibility and risk.[20] Studies repeatedly indicate that those better informed about the seasonal vaccines will be more receptive to them.[15,22] However, it is knowledge that is not sufficient, because attitudes—shaped by cultural beliefs, social influences, and perceived efficacy—really determine decision making. Positive attitudes towards vaccination are built on trust for healthcare providers and public health systems, as well as past successful experiences with immunization.[15] On the other hand, vaccine hesitancy, influenced by misinformation and misconceptions, is a big barrier to reaching ideal coverage.[2] For example, apprehension over adverse effects, questions about the efficacy of vaccines, and religious or philosophical objections create reluctance, even among those who recognize the value of vaccination. Practices related to seasonal vaccination are influenced by a combination of individual, structural, and systemic factors. Accessibility and affordability are critical determinants, with individuals in low-income settings or rural areas facing significant barriers to vaccine uptake.[5,23] Moreover, the availability of healthcare infrastructure and vaccination campaigns significantly influences practices, as robust systems ensure greater outreach and higher coverage rates.[19] Behavioral insights found that habitual practices of vaccination would be more frequent among individuals having a strong orientation toward preventive health and those regularly recommended by the healthcare providers.[13] Workplace and school-based vaccination programs, along with public awareness programs, have reduced logistical barriers, thus enhancing the convenience of obtaining vaccinations.[20] Social norms and peer behaviors also have a strong impact, as individuals are more likely to vaccinate if it is perceived as the norm and acceptable within their community.[7] These findings emphasize the need for integrated approaches that address the multifaceted dimensions of knowledge, attitudes, and practices to enhance seasonal vaccination rates and achieve broader public health objectives.

Hypotheses Development

Many studies have indicated that KAP is the significant factor in perception of the benefits of vaccination. Wu *et al.*[18] and El Bilbeisi *et al.*[24] further supported this perception. Knowledge is always associated with positive health behavior, including the uptake of vaccines.[8] For instance, research has indicated that the people who are aware of the fact that seasonal vaccines are accurate will be more aware of the fact that seasonal vaccines reduce the severity of diseases and prevent complications

The vast majority of the studies mentioned have identified KAP as the strong influencing factor regarding perception of vaccination benefits.[18,24] Indeed, further supports of this perception include the results presented by Robertson *et al.*[8], knowledge has been consistently correlated with positive health behaviors, and such includes getting vaccinated. For example, studies have shown that the population that is conscious of the fact that seasonal vaccines are accurate will be more conscious of the fact that seasonal vaccines reduce the severity of diseases and prevent complications.[3] In addition, this perception of benefit is further enhanced by positive attitudes toward vaccination, giving confidence to vaccination in terms of safety and efficacy.[25] People who view vaccination as a very essential health intervention highly perceived the advantage associated with vaccination, such as community immunity and low healthcare cost.[14] Practical practices involved frequent attendance at health services and engagement in vaccination programs.[19] Together, these factors comprise a model that describes how KAP could be associated with the benefits perceived with ample empirical support coming from a wide range of populations and settings.[23]

Building on previous studies, it is hypothesized that the interaction of knowledge, attitudes, and practices directly impacts the perceived benefits of seasonal vaccination.[17,26] The theoretical frameworks, such as the Health Belief Model (HBM), suggest that higher awareness among individuals will lead to a greater appreciation of the protective benefits of vaccination, thus promoting positive attitudes and preventive practices.[8] Empirical evidence seems to support that knowledge about vaccine impact in reduction of morbidity and mortality can be translated to stronger perceived benefits, which is especially realized in high-risk groups.[27] Again, attitudes stemming from cultural or social influences then determine whether this benefit is internalized.[28] Behavioral reinforcements such as vaccination uptake are in the form of consistent practices which strengthen the value of immunization.[10] As the theory builds its ground from KAP as such being a broad multidimensional concept having deep bearing for individual's conceptualization of perceived advantage in taking seasonal vaccinations.

H1: Knowledge attitude and practices toward seasonal vaccination significantly influences the vaccination perceived benefits.

These are the 5C psychological determinants of vaccines: confidence, complacency, constraints, calculation, and collective responsibility.[22] Among these, vaccines' safety and efficacy, that is, vaccination's health system, are extremely important in judging the perceived advantages. Higher a level of self-confidence will gain more recognition and understanding of this protective value vaccination provides.[24] The perception of the risk of disease and complacency determines whether the process of vaccination is viewed as a preventive measure.[1] Studies have shown that with lower complacency, the perceived benefits are therefore high as individuals realize their self-value and societal value associated with immunization.[8,9] Constraints refer to cost, availability, and time barriers defining a person's perception of convenience and value associated with immunization.[27] Calculation refers to the degree of deliberation and the amount of information required, and this characteristic has a positive impact on perceived benefits as educated individuals in society are likely to give

importance to the immunization benefit related to protection.[29] Finally, the feeling of community responsibility or a sense of obligation toward group immunity reinforces the perceived value because vaccination behavior gets transformed into socially desirable activity.[5]

The 5C model presents a comprehensive view of the manner in which psychological antecedents influence the perceived benefits of vaccination.[6] Confidence will increase the level of trustfulness in the efficiency of vaccines hence directly increasing their perceived benefits.[4] Complacency increases risk awareness, which translates to an increase in the need for immunization.[25] Under the scenario where advantages are given focus against constraints about vaccination, constraints are minimized.[16] Calculation also leads to effective decision. It finally increases the felt value of the vaccine in controlling the disease.[27] Group action makes the impression more secure in the minds of individuals by increasing the well-being of a population at its preventive level. It not only protects the weak members through herd immunity but also touches people at different capacities.[7,8] Empirical research exists to support that each of the dimensions of the 5C model synergistically interlinks and affects the quality of perceived benefits.[6,12] Therefore, for this hypothesis, it is indicated that psychological antecedents collectively and profoundly impact the perceived seasonal vaccination benefits

H2: 5c psychological antecedents of vaccination significantly influences the vaccination perceived benefits. Intermediate variables include psychological antecedents, which serve to mediate between broader constructs like KAP and vaccination outcomes. This type of mediation study is most common in the field.[18] The 5C model is one of the most important in this regard. Studies indicate that knowledge increases confidence, reduces complacency, and promotes an informed calculation that builds or strengthens intentions.[17,26] Positive attitudes tend to enhance trust and collective responsibility.[16] Routine health-seeking behaviors directly remove barriers and influence the 5C dimensions.[21] Evidence also shows that every aspect of the 5C dimension transforms KAP into tangible results, linking awareness, attitudes, and behavior with benefits perceived in vaccines.[11] For example, it is a case where strong knowledge and favorable attitudes are not enough but rather a situation where individuals will look for psychological drivers like self-confidence and collective obligation to gain more benefits from immunization.[13]

The mediation hypothesis, based on empirical evidence, claims that the 5C psychological antecedents acts as a vessel between KAP and perceived vaccination benefits.[2] Knowledge increases confidence and reduces complacency, thus building a cognitive pathway through which perceptions of greater advantages of vaccination arise.[10] Also driven by trust and cultural norms, attitudes build the calculus or group responsibility that then reinforces perceptions of social and individual advantages.[19] Behaviors, while alleviating inhibitions, create a behavioral bridge that supports the psychological precursors.[25] The mediation process makes clear that the 5C model is an integration of cognitive, emotional, and behavioral dimensions for converting KAP into a robust perception of vaccination benefits-theoretically relevant yet practically consequential.

H3: 5c psychological antecedents of vaccination significantly mediates the relationship of knowledge attitude and practices toward seasonal vaccination and the perceived benefits.

Vaccine perception is beliefs about the effectiveness, safety, and need for vaccines.[14] Vaccine perception is a moderating variable in health behavior models. Research has shown that individuals with positive perceptions of vaccines are more likely to translate their knowledge and attitudes into health behaviors, such as immunization.[12] For example, investigations have shown people with high vaccination efficacy tend to perceive even more benefits notwithstanding the fact their initial knowledge and attitudes are set at moderate scores.[3] On the other hand, the negative attitude may negate the effects of knowledge or attitude on positive perception of more benefits.[30] Perception's effect in moderation is high, especially for populations with a range of exposure to misinformation, because perception directly impacts how people view information and consequently take preventive measures.[23]

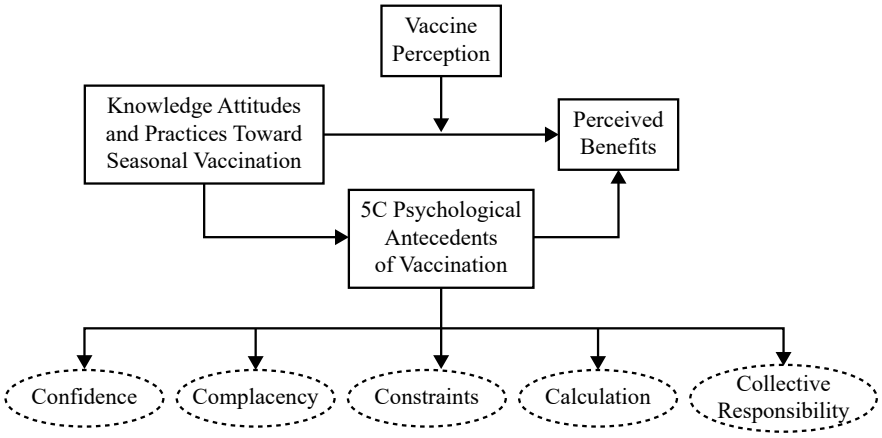

Figure 1: Research Model.

The moderating hypothesis is that vaccine perception enhances or reduces the effect of KAP on perceived benefits.[20] Favorable perceptions, characterized by trust in vaccine safety and efficacy, strengthen the relationship between knowledge and perceived benefits by framing information within a positive context.[28] Similarly, positive perceptions enhance the impact of attitudes by validating trust and reducing hesitancy.[7] When vaccine perceptions are positive, perceived benefits from vaccination are more likely to be supported by practices such as frequent vaccine uptake.[15] The hypothesis for this study is founded on the belief that perception is a lens by which KAP influences outcomes; thus, perception will modify the strength and direction of its relationship with vaccination benefits.

H4: Vaccine perception significantly moderates the relationship of knowledge attitude and practices toward seasonal vaccination and the perceived benefits.

Methodology

This study utilized a quantitative cross-sectional research design to explore the relationships among knowledge, attitudes, and practices (KAP) toward seasonal vaccination, 5C psychological antecedents, and perceived vaccination benefits (Figure 1). The cross-sectional design allowed for data collection at one point in time, thus allowing for an efficient analysis of the proposed relationships. The Partial Least Squares Structural Equation Modeling (PLS-SEM) method was applied in the analysis as it is perfectly suited for complex models testing and direct and indirect relationships examination. The target population included individuals who had recently come in contact with the health system to receive immunizations. A sample size of 284 was deemed necessary and representative. This study chose patients of the hospital seeking seasonal immunization shots during the last quarter. In fact, this process allowed for in-depth observation to derive the kind of information an individual may possess about his own knowledge, attitude, practice, and psychological conditions associated with an antecedent. A non-probability purposive sampling technique was used to recruit participants who met the specified criteria. This method ensured that data was collected from individuals actively engaged with vaccination processes, thereby enhancing the validity of the findings. The study applied structured, pre-validated scales adapted from earlier research to measure the constructs (Table 1).

Table 1: Questionnaire Profile.

Construct	No of Items	Source
Knowledge attitude and practices toward seasonal vaccination	8	Dhaouadi *et al.*[31]
5c psychological antecedents of vaccination	15	Koh *et al.*[32]
Vaccine perception	6	Van Nguyen and Nguyen[33]
Perceived benefits	9	Karlsson *et al.*[34]

Each item was measured on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), thereby enabling the measurement of the different levels of agreement with the statements.

Self-administered questionnaires were used to collect data. Questionnaires were provided to the respondents during their visit to the hospital. The main constructs under study and demographic information were sought on the questionnaire. To avoid confusion and ensure simplicity, the questionnaire was kept concise with easy instructions on what was to be done by the respondents. Research assistants guided the respondents on the data collection and clarified any issues arising from the questionnaire. A total of 320 questionnaires were distributed, and after eliminating incomplete or invalid responses, 284 valid responses remained for analysis, thus providing an effective response rate of 88.75%. The data collected were analyzed using the robust statistical technique of PLS-SEM widely applied for testing complex models with latent constructs. The procedure followed two-stage analysis: This included evaluating the reliability and validity of the constructs based on Cronbach's alpha, composite reliability, and average variance extracted. It was also analyzed using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The hypothesized relationships were checked using the path coefficients, t-statistics, and p-values. Bootstrapping procedures with 5,000 resamples were used to ensure robust mediation and moderation effects. The PLS-SEM enabled testing the direct, indirect, and moderating effects simultaneously, ensuring that all proposed theoretical frameworks are fully evaluated. The generation of descriptive statistics was also carried out to summarize the demographic characteristics of the sample, providing a background for the findings.

Results

Table 2 summarizes the reliability and validity measures of the constructs in the study, assessed using Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Cronbach's Alpha values for all constructs exceed the threshold of 0.70, indicating internal consistency. The 5C psychological antecedents of vaccination exhibit a Cronbach's Alpha of 0.880, demonstrating excellent reliability. Similarly, subconstructs such as Calculation (0.836), Collective Responsibility (0.766), and Complacency (0.732) also show strong reliability. Confidence (0.764) and Constraint (0.704) meet acceptable standards.

The CR values for all variables are above 0.80, further confirming construct reliability. AVE values, reflecting convergent validity, are above 0.50 for all constructs, with the highest AVE observed for Confidence (0.680) and Constraint (0.628). These results suggest that the constructs are reliable and valid for further analysis, demonstrating robust psychometric properties.

Table 2: Variables Reliability and Validity.

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
5c psychological antecedents of vaccination	0.880	0.899	0.537
Calculation	0.836	0.826	0.613
Collective responsibility	0.766	0.815	0.596
Complacency	0.732	0.848	0.651
Confidence	0.764	0.864	0.680
Constraint	0.704	0.835	0.628
Knowledge attitude and practices toward seasonal vaccination	0.791	0.842	0.574
Perceived benefits	0.865	0.893	0.548
Vaccine perception	0.890	0.916	0.645

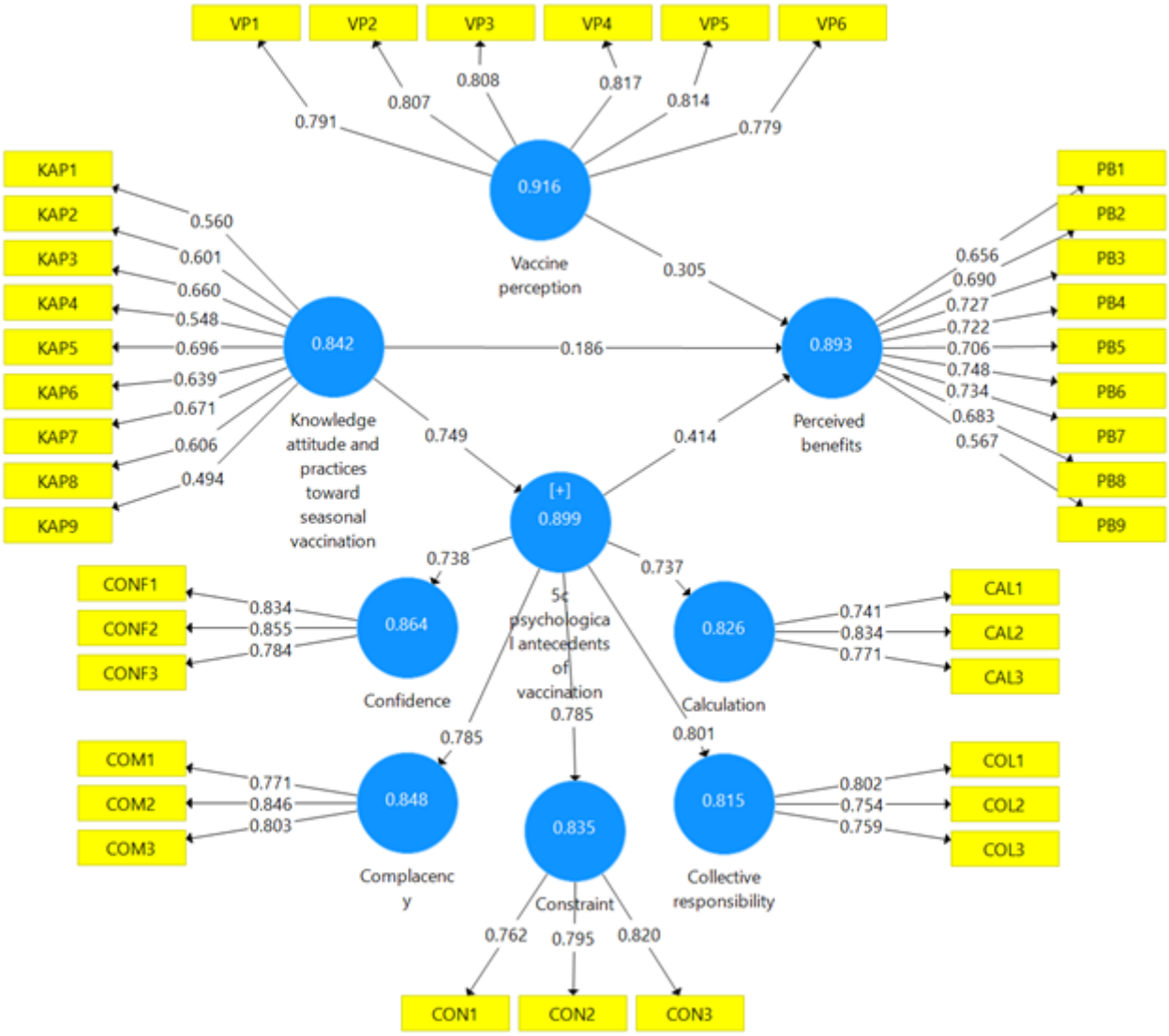

Figure 2: Estimated Model.

Table 3 evaluates the fitness of measurement items for each variable (Figure 2), focusing on factor loadings, standard deviations, T-statistics, and p-values. All indicators show strong factor loadings, with most above the 0.70 threshold, indicating sufficient individual item reliability. For example, Calculation indicators (CAL1, CAL2, CAL3) range from 0.741 to 0.834 with significant T-statistics exceeding 19.9 ($p < 0.001$). Collective Responsibility items also show high loadings between 0.754 and 0.802, with T-statistics over 15.6. Complacency and Constraint indicators similarly exhibit strong loadings, supporting their relevance to the constructs. Knowledge, Attitude, and Practices (KAP) items display slightly lower loadings for some items, such as KAP1 (0.560), but remain statistically significant with T-values above 8.3. These results confirm the appropriateness of the measurement model and the reliability of the observed indicators in capturing the latent constructs.

Table 3: Measurement Items Fitness Statistics

Variable		Indicator	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
5c psychological antecedents of vaccination	Calculation	CAL1	0.741	0.739	0.037	19.962	0.000
		CAL2	0.834	0.835	0.020	42.493	0.000
		CAL3	0.771	0.768	0.037	20.934	0.000
	Collective responsibility	COL1	0.802	0.801	0.031	25.734	0.000
		COL2	0.754	0.750	0.048	15.652	0.000
		COL3	0.759	0.756	0.036	21.055	0.000
	Complacency	COM1	0.771	0.768	0.034	22.955	0.000
		COM2	0.846	0.846	0.018	46.840	0.000
		COM3	0.803	0.803	0.027	29.925	0.000
	Constraint	CON1	0.762	0.760	0.040	18.984	0.000
		CON2	0.795	0.797	0.025	31.174	0.000
		CON3	0.820	0.820	0.021	38.334	0.000
	Confidence	CONF1	0.834	0.832	0.024	34.651	0.000
		CONF2	0.855	0.854	0.020	43.521	0.000
		CONF3	0.784	0.782	0.031	25.563	0.000
Knowledge attitude and practices toward seasonal vaccination		KAP1	0.560	0.554	0.049	11.422	0.000
		KAP2	0.601	0.600	0.052	11.554	0.000
		KAP3	0.660	0.658	0.039	16.927	0.000
		KAP4	0.548	0.546	0.064	8.508	0.000
		KAP5	0.696	0.697	0.034	20.749	0.000
		KAP6	0.639	0.641	0.050	12.902	0.000
		KAP7	0.671	0.671	0.039	17.247	0.000
		KAP8	0.606	0.605	0.050	12.167	0.000
		KAP9	0.494	0.492	0.060	8.300	0.000
		KAP10	1.955	1.961	0.120	16.295	0.000
Perceived benefits		PB1	0.656	0.657	0.043	15.439	0.000
		PB2	0.690	0.692	0.035	19.865	0.000
		PB3	0.727	0.726	0.031	23.596	0.000
		PB4	0.722	0.720	0.036	19.955	0.000
		PB5	0.706	0.707	0.029	24.430	0.000
		PB6	0.748	0.748	0.028	26.754	0.000
		PB7	0.734	0.734	0.033	22.321	0.000
		PB8	0.683	0.682	0.040	17.156	0.000
		PB9	0.567	0.568	0.052	10.858	0.000
Vaccine perception		VP1	0.791	0.791	0.026	30.996	0.000
		VP2	0.807	0.807	0.023	35.798	0.000
		VP3	0.808	0.808	0.023	34.647	0.000
		VP4	0.817	0.817	0.029	28.463	0.000
		VP5	0.814	0.815	0.020	41.034	0.000
		VP6	0.779	0.779	0.021	37.279	0.000

The Fornell-Larcker criterion (Table 4) tests discriminant validity by comparing the square root of AVE for each construct with its correlations with other constructs. Diagonal values, representing the square root of AVE, exceed the inter-construct correlations, confirming discriminant validity. For example, the square root of AVE for 5C psychological antecedents (0.612) is greater than its correlation with KAP (0.749) and perceived benefits (0.775). Similarly, Confidence (0.825) and Collective Responsibility (0.772) maintain discriminant validity across all comparisons. These results affirm that each construct is distinct and measures unique dimensions of the theoretical framework.

Table 4: Fornell-Larcker Criterion.

	1	2	3	4	5	6	7	8	9
5c psychological antecedents of vaccination	0.612								
Calculation	0.737	0.783							
Collective responsibility	0.801	0.662	0.772						
Complacency	0.785	0.381	0.458	0.807					
Confidence	0.738	0.416	0.519	0.476	0.825				
Constraint	0.785	0.436	0.479	0.653	0.422	0.793			
Knowledge attitude and practices toward seasonal vaccination	0.749	0.506	0.599	0.597	0.577	0.597	0.611		
Perceived benefits	0.775	0.534	0.518	0.733	0.502	0.674	0.703	0.695	
Vaccine perception	0.728	0.471	0.567	0.607	0.542	0.601	0.681	0.732	0.803

Table 5: Heterotrait-Monotrait Ratio (HTMT).

	1	2	3	4
5c psychological antecedents of vaccination				
Knowledge attitude and practices toward seasonal vaccination	0.875			
Perceived benefits	0.880	0.832		
Vaccine perception	0.816	0.789	0.821	

Table 5 evaluates discriminant validity using the HTMT ratio. All HTMT values are below the conservative threshold of 0.85, indicating strong discriminant validity. For instance, the HTMT value between 5C psychological antecedents and KAP is 0.875, and between perceived benefits and vaccine perception is 0.821. These findings reinforce the distinction between constructs, confirming that they are not redundant and measure separate theoretical domains.

Table 6 highlights the explanatory power of the model through R^2 values and model fit statistics. The R^2 value for perceived benefits is 0.674, indicating that 67.4% of the variance is explained by the predictor variables. The 5C psychological antecedents of vaccination also show a robust R^2 of 0.562, demonstrating that the model captures over half of its variance. The Standardized Root Mean Square Residual (SRMR) values for the saturated (0.041) and estimated (0.061) models fall below the recommended threshold of 0.08, confirming excellent model fit. These results indicate the model's effectiveness in explaining the relationships between variables.

Table 6: R-square statistics Model Goodness of Fit Statistics.

	R^2	R^2 Adjusted	5c Psychological Antecedents of Vaccination	Calculation	Collective Responsibility	Complacency	Confidence	Constraint	Perceived Benefits
5c psychological antecedents of vaccination	0.562	0.561		1.190	1.793	1.603	1.196	1.603	0.184
Calculation	0.543	0.542							
Collective responsibility	0.642	0.641							
Complacency	0.616	0.615							
Confidence	0.545	0.544							
Constraint	0.616	0.615							
Knowledge attitude and practices toward seasonal vaccination			1.281						0.042
Perceived benefits	0.674	0.672							
Vaccine perception									0.122
			Saturated Model			Estimated Model			
SRMR			0.041			0.061			

Table 7 presents the structural model (Figure 3) results, showcasing path coefficients, T-statistics, and significance levels. The hypothesis that KAP significantly influences perceived benefits is supported with a path coefficient of 0.159 (T = 2.825, p = 0.005). Similarly, the 5C psychological antecedents have a stronger influence on perceived benefits, with a path coefficient of 0.366 (T = 5.300, p < 0.001).

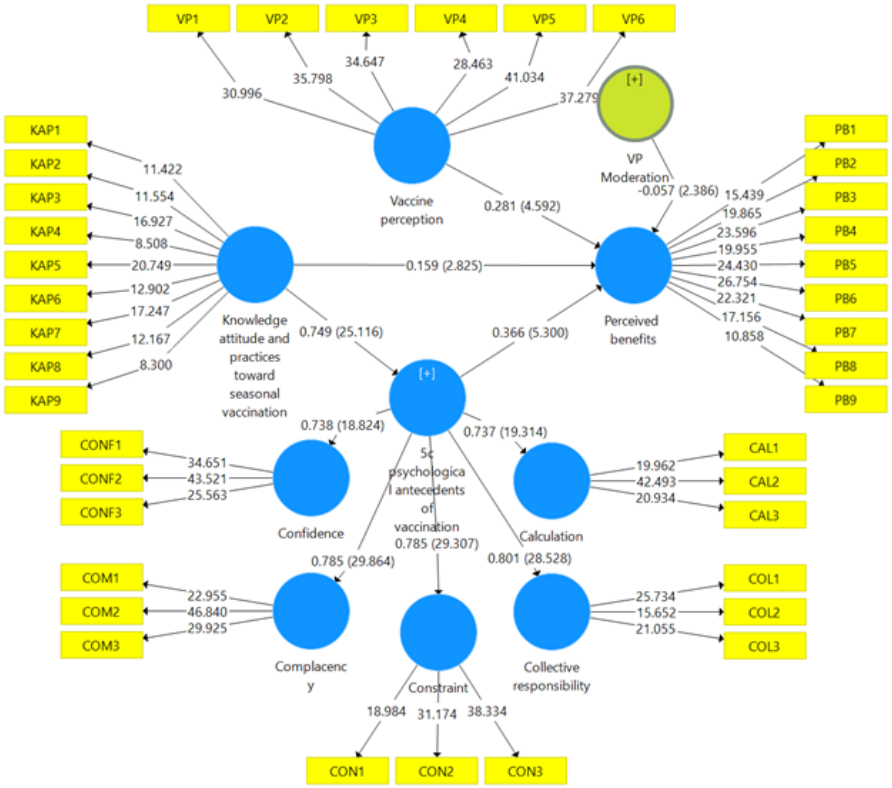

Figure 3: Structural Model for Path Analysis.

Mediation by the 5C psychological antecedents between KAP and perceived benefits is also significant, with a coefficient of 0.274 (T = 5.124, p < 0.001). The moderating role of vaccine perception in the relationship between KAP and perceived benefits is weaker but significant, with a negative coefficient of -0.057 (T = 2.386, p = 0.017). These results affirm the hypotheses and provide robust empirical evidence for the proposed relationships.

Table 7: Path Analysis.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Knowledge attitude and practices toward seasonal vaccination significantly influences the vaccination perceived benefits.	0.159	0.161	0.056	2.825	0.005
5c psychological antecedents of vaccination significantly influences the vaccination perceived benefits.	0.366	0.368	0.069	5.300	0.000
5c psychological antecedents of vaccination significantly mediates the relationship of knowledge attitude and practices toward seasonal vaccination and the perceived benefits.	0.274	0.277	0.054	5.124	0.000
Vaccine perception significantly moderates the relationship of knowledge attitude and practices toward seasonal vaccination and the perceived benefits.	-0.057	-0.058	0.024	2.386	0.017

Discussion

The discussion chapter fully explains the analysis of the results in relation to the objectives set by the research, past works, and underpinning theoretical frameworks. Such contextualization, in this instance, of results within the broad literature is where this section unfolds to highlight what the accepted hypotheses add to the established body of knowledge while addressing the areas of previous knowledge gaps identified. It discusses, too, implications of the results for theory, practice, and future research as it further reinforces the importance of understanding multifaceted dynamics involving knowledge, attitudes, and practices (KAP), psychological antecedents, vaccine perception, and perceived benefits of vaccination.

The result shows that KAPs significantly affect perceived benefits from vaccination, supporting H1. Previous studies have shown that with more vaccine knowledge and belief in vaccination effectiveness and regular health behavior, an individual will more likely realize immunization benefits in terms of protection. The observed relationship fits the Health Belief Model, which suggests that heightened awareness serves as a cue to action, increasing perceptions of the benefits of preventive measures such as vaccination.[14] For example, respondents with full knowledge about seasonal vaccines showed a greater appreciation for their role in reducing disease severity and preventing complications. Additionally, positive attitudes developed by cultural, social, and experiential factors make this relationship even stronger by strengthening confidence in the health care system. Actual practice in the form of regular campaigns of vaccinations or checkup reinforces the belief through evidence provided by practical implementation of vaccine benefit. The result vindicates theoretical prediction of KAP models, while underlining the need to have educational and behavioral interventions incorporated in public health measures to promote maximal vaccination.

The second hypothesis, H2-that the 5C psychological antecedents affect perceived benefits from vaccination- was also found. Confidence again surfaced as a strong determinant of which individuals holding strong beliefs that vaccines are safe and effective, feel more vaccination benefit. Less complacency-the appreciation of severity of disease and the susceptibility thereto-also amplified perceived value for preventing disease with vaccine. At the very least, constraints created this relationship since they eliminated all barriers that may blur the effects of immunization. Additionally, those who made decisions regarding their immunization (evaluating costs and benefits of the vaccination) could better see the protection benefits and community advantages.[13] Shared responsibility-the sense of responsibility to protect the health of others in the community also added to the perceived benefits of vaccination, particularly among individuals who put more emphasis on herd immunity. The results expand the literature by empirically testing the 5C framework within the seasonal context, and they provide an example of how useful the 5C framework can be for designing psychological and behavioral interventions for the betterment of public health outcome.

The results also test and validate the H3 regarding the fact that the 5C psychological antecedents significantly mediated the relationship of KAP against perceived vaccination benefits. The results suggest that in this case, the psychological facets of vaccination behavior act more like a facilitator, mediating knowledge and attitudes into tangibles of being perceived as benefits. For instance, those who possessed greater knowledge of vaccines were more confident about the efficacy of vaccines, which, in turn, improved their recognition of its protective value. Similar to this, positive attitudes increased the sense of collective responsibility, which points to the social benefits of immunization.[12] Health engagement practices such as routine healthcare utilization reduced constraints, enabling the respondent to focus on the benefit of vaccination without having logistics as a constraint. The theoretical linkage of HBM and the 5C framework is empirically supported because it indicates the multidimensional paths by which KAP influences perceived benefits. This mediated relationship underlines the importance of taking psychological antecedents into consideration in vaccination campaigns so that knowledge and attitudes do translate into actionable health outcomes.

The fourth hypothesis (H4) such that the perception for vaccine strongly moderated the relationship between KAP and perceived benefits was also supported. Findings suggest that an exaggeration effect occurs to the extent that positive perceptions for vaccine magnify the influence of KAP on perceived benefits, whereas an attenuating effect occurs in case of a negative perception. An example is that people who believe that vaccines are safe and effective are more likely to tap their knowledge and attitude to identify vaccination benefits.[6] The perception of the KAP variables showed weak associations for those with negative perceptions, who had adequate knowledge or better attitudes. This moderation effect shows that perception is an important contextual variable in how people interpret and act on their knowledge and attitudes. The findings emphasize the necessity to target vaccine perceptions through communication strategies in populations that are vulnerable to misinformation or vaccine hesitancy. Public health can make the KAP effect of perceived benefits greater through making the process of vaccination look safe, effective, and socially responsible. In conclusion, the results of this study have that KAP as well as psychological antecedents have complex and mediated interrelations with vaccine perception and perceived benefits of vaccination. All four hypotheses are confirmed, and the research contributes to an enhanced understanding of factors at cognitive levels, psychological lines, and contexts that are exerted in vaccination behavior. These insights not only fill gaps in much-needed literature but also have practical implications for the design of sustainable public health strategies. Educational programs, psychological intervention, and communication initiatives based on the perception approach enhance vaccination coverage in that they bring with them public health improvements. It is high time to follow this new research result forward to test other theoretical models.

Conclusion

This research brings out the complex dynamics of vaccination behavior by integrating the KAP model, the 5C psychological antecedents' framework, and vaccine perception. Findings reveal the critical roles of knowledge, attitudes, and practices, along with psychological antecedents, in shaping perceived vaccination benefits. This establishes the mediating influence of psychological antecedents and the moderating role of vaccine perception, giving the study a more nuanced understanding of the factors driving vaccination decisions. These insights validate the theoretical framework and fill important gaps in the literature to offer a holistic perspective on vaccination behavior. The study's theoretical and practical contributions are thus significant for advancing both academic research and public health practice. The study will, therefore, be of benefit in identifying actionable pathways for improving uptake through enhancement of psychological antecedents and adjustment of vaccine perception. It may open avenues for future exploration of socio-psychological and contextual factors influencing vaccine acceptance, thereby encouraging researchers to go deeper. Finally, this work will contribute to the global efforts aimed at tackling vaccine hesitancy, public health outcomes improvement, and the establishment of resilient healthcare systems that are better placed to address seasonal and emerging vaccination challenges.

Implications of the Study

This research adds significant meaning to the theoretical comprehension of vaccination behavior by proposing integration with the 5C psychological antecedents' framework to offer a multidimensional perspective on vaccination decision-making. The study empowers a strong foundation for extending the Health Belief Model by confirming the interplay of KAP and the 5C antecedents in shaping perceived vaccination benefits. Psychological factors, such as confidence and complacency, therefore, seem to mediate the translation of knowledge and attitudes into actionable perceptions of vaccination benefits. This kind of theoretical integration is an addition to the already rich understanding about how individual and psychological variables interact, forming a nuanced framework for studying vaccination behavior in various contexts. In addition, the study fills a gap in current theories by showing the moderating role of vaccine perception and focusing on the contextual factors that influence the strength and direction of these relationships. This study advances the application of behavioral theories in public health through the operationalization of the constructs of the 5C psychological antecedents in the seasonal vaccination context. The findings in this paper clearly show how such concepts as collective responsibility and calculation influence health outcomes, offering an applied lens to apply psychological theories in the real world. In addition, through the confirmation of the moderating role of vaccine perception, this study underlines the need for the integration of social and cultural dimensions into theoretical models. Such a contribution is not only able to expand the scope of the existing frameworks but also opens the way for future research to discover other mediators and moderators such as socio-demographic variables and policy interventions, thus further enhancing the explanatory power of vaccination behavior theories.

Findings from this study will be beneficial for designing practical vaccination campaigns and public health interventions. Public health professionals can exploit the influence of KAP on the perceived benefits of vaccination by making education-based interventions enhance knowledge and attitudes. Trust will improve if appropriate communication strategies focus on the protective value of vaccines. It will make the vaccination consistent. Furthermore, by talking to psychological factors like confidence and complacency, healthcare providers reduce vaccine hesitancy and invoke a sense of collective responsibility. For example, enhancing confidence concerning the safety and efficacy of a vaccine through accurate information and addressing the complacency side by highlighting what may happen as a result of not vaccinating can strengthen people's trust of the vaccine and increase intake.

This, in turn, highlights the requirement for interventions tailored to change perceptions favorably. Combat misinformation through fact-based campaigns that are

culturally appropriate for a region or a demographic likely to be vaccine skeptic. Pragmatic tools for overcoming barriers of constraints and complacency include community workshops, digital outreach, and personalized reminders. Psychological insights can therefore be integrated in public health programs to foster engagement and collective responsibility at the community level, with the ultimate potential for higher vaccination rates. These implications are crucial and will help with the global issue of seasonal vaccine uptake, especially where vaccine-hesitant parents and emerging diseases are concerned.

Limitations and Future Research Directions

While this study offers important insights, it has some limitations that need to be considered. First, the reliance of the study on self-reported data may introduce bias because respondents may overestimate or underestimate their knowledge, attitudes, and practices. Future research could incorporate objective measures, such as vaccination records or healthcare provider data, to validate self-reported behaviors. Second, the cross-sectional design limits the ability to infer causal relationships among variables. Longitudinal designs that track respondents over time will provide more definitive evidence of causality and better delineate the dynamic nature of the psychological antecedents and vaccine perceptions. The study mostly focuses on one cultural or regional setting, which restricts generalizability of results to other populations with different health care systems or cultural attitudes toward vaccinations. Future research should, therefore, further investigate other potential mediators and moderators such as socioeconomic status, access to health care, social media influence among others, in order to have a well-rounded understanding of vaccination behavior. Additionally, taking this framework forward into other kinds of vaccines for instance, for emerging infectious diseases would be important to generalize these findings and explore different contexts of vaccination. Researchers might also look into ascertaining if policy-level interventions, such as mandates or subsidies, play a role in the psychological and behavioral aspects of vaccination decision-making. If these limitations have been addressed and the scope expanded to broaden the research, then the idea of understanding factors that influence uptake of vaccination might be more effective.

Acknowledgment

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia [KFU 242897].

References

1. Al-Taani GM, Muflih S, Alsharedeh R, Altaany Z. Knowledge, Willingness to Pay and Beliefs for Seasonal Influenza Vaccination, A Cross-Sectional Study from Jordan. Jordan Journal of Pharmaceutical Sciences. 2023; 16(4): 842-56. doi: https://doi.org/10.35516/jjps.v16i4.607.
2. Atkinson M, Ntontis E, Neville F, Reicher S. "I'll wait for the English one": COVID-19 vaccine country of origin, national identity, and their effects on vaccine perceptions and uptake willingness. Soc Personal Psychol Compass. 2023; 17(10): e12837. doi: https://doi.org/10.1111/spc3.12837.
3. Boisson A, Morgan CE, Stover A, et al. Changes in hepatitis B vaccine perception in response to the COVID-19 pandemic: Development of the Shift in vaccine confidence (SVC) survey tool. Vaccine. 2023; 41(3): 623-29. doi: https://doi.org/10.1016/j.vaccine.2022.12.028.
4. Bui HN, Duong CD, Nguyen VQ, et al. Utilizing the theory of planned behavior to predict COVID-19 vaccination intention: A structural equational modeling approach. Heliyon. 2023; 9(6): e17418. doi: https://doi.org/10.1016/j.heliyon.2023.e17418.
5. Hussein MF, Ibrahim SA, Abdel-Rahman S, et al. Psychological antecedents of vaccine inequity: keys to improve the rates of vaccination. J Egypt Public Health Assoc. 2024; 99(1): 31. doi: https://doi.org/10.1186/s42506-024-00175-7.
6. Ivan D, Anton K, Karine M, Serhii L. Psychometric Properties of the Scale "5C Psychological Antecedents of Vaccination": Ukrainian Sample. Insight: The Psychological Dimensions of Society. 2023; (10): 13-39. doi: https://doi.org/10.32999/2663-970X/2023-10-2.
7. Degarege A, Watanabe-Galloway S, Mansilla K, Sileshi RM, Peters ES. Evaluation of Theoretical Frameworks to Detect Correlates of HPV Vaccination in the Midwest, US, Using Structural Equation Modeling. Vaccines (Basel). 2023; 11(12): 1856. doi: https://doi.org/10.3390/vaccines11121856.
8. Robertson DA, Mohr KS, Barjaková M, Lunn PD. A lack of perceived benefits and a gap in knowledge distinguish the vaccine hesitant from vaccine accepting during the COVID-19 pandemic. Psychol Med. 2023; 53(7): 3238-41. doi: https://doi.org/10.1017/s0033291721003743.
9. Aziz K, Ismail M, Ahmad R, AlNuaimi AS, Bibars M, AlSaadi MM. Motivators and barriers of seasonal influenza vaccination among primary health care physicians in Qatar. Prev Med Rep. 2024; 38: 102595. doi: https://doi.org/10.1016/j.pmedr.2024.102595.
10. Sawalmeh A, Johansson EW, Kostas D, Hjaijeh D. Hepatitis B Patients' Adherence to Treatment in Relation to Knowledge, Attitudes, and Practices (KAP) in the West Bank, Palestine, 2022-2023. J Viral Hepat. 2025; 32(1): e14055. doi: https://doi.org/10.1111/jvh.14055.
11. Zhang M, Chen Z, Liu X, Liu J. Influencing factors of Chinese male circumcision acceptance willingness: a health belief model approach. Curr Psychol. 2024; 43(20): 18474-86. doi: https://doi.org/10.1007/s12144-024-05647-9.
12. Lee M, Qin C, Lee Y, Deng J, You M, Liu J. COVID-19 vaccine acceptance and 5C psychological antecedents amid the omicron surge in South Korea and China. Vaccine. 2025; 43(Pt 2): 126515. doi: https://doi.org/10.1016/j.vaccine.2024.126515.

13. Venuto R, Pappalardo R, Genovese C, et al. Indoor air pollution: an Italian Knowledge, Attitude and Practice (KAP) study among the general population. Ann Ig. 2024; 36(6): 683-94. doi: https://doi.org/10.7416/ai.2024.2640.
14. Guillari A, Sansone V, Giordano V, Catone M, Rea T. Assessing digital health knowledge, attitudes and practices among nurses in Naples: a survey study protocol. BMJ Open. 2024; 14(6): e081721. doi: https://doi.org/10.1136/bmjopen-2023-081721.
15. Peng Y, Wang Y, Huang W, et al. Exploring Perceptions and Barriers: A Health Belief Model-Based Analysis of Seasonal Influenza Vaccination among High-Risk Healthcare Workers in China. Vaccines (Basel). 2024; 12(7): 796. doi: https://doi.org/10.3390/vaccines12070796.
16. Mamun TI, Mahmud MW, Dey SC, et al. Knowledge, attitudes and practices regarding zoonotic diseases among cat and dog owners in Bangladesh. Prev Vet Med. 2024; 226: 106166. doi: https://doi.org/10.1016/j.prevetmed.2024.106166.
17. Akmatova R, Dzhangaziev B, Ebama MS, Otorbaeva D. Knowledge, attitudes, and practices (KAP) towards seasonal influenza and influenza vaccine among pregnant women in Kyrgyzstan: A cross-sectional study. Vaccine. 2024; 42 Suppl 4: 125510. doi: https://doi.org/10.1016/j.vaccine.2023.12.020.
18. Wu D, Mai Y, Liu P, et al. Knowledge, attitudes, and practices (KAP) toward seasonal influenza vaccine among college students under the COVID-19 pandemic in South China. Immun Inflamm Dis. 2023; 11(12): e1110. doi: https://doi.org/10.1002/iid3.1110.
19. Wu J, Wei Z, Yang Y, et al. Gap between cognitions and behaviors among children's guardians of influenza vaccination: The role of social influence and vaccine-related knowledge. Hum Vaccin Immunother. 2023; 19(1): 2166285. doi: https://doi.org/10.1080/21645515.2023.2166285.
20. Hester KA, Sakas Z, Ogutu EA, et al. Critical interventions for demand generation in Zambia, Nepal, and Senegal with regards to the 5C psychological antecedents of vaccination. Vaccine X. 2023; 14: 100341. doi: https://doi.org/10.1016/j.jvacx.2023.100341.
21. Coco Chin KK, Mahanta J, Nath TK. Knowledge, Attitude, and Practices toward Plastic Pollution among Malaysians: Implications for Minimizing Plastic Use and Pollution. Sustainability. 2023; 15(2): 1164. doi: https://doi.org/10.3390/su15021164.
22. Shahid S, Kalhoro S, Khwaja H, et al. Knowledge, attitudes, and practices towards seasonal influenza vaccination among pregnant women and healthcare workers: A cross-sectional survey in Afghanistan. Influenza Other Respir Viruses. 2023; 17(3): e13101. doi: https://doi.org/10.1111/irv.13101.
23. Panahi S, Spearman B, Sundrud J, Lunceford M, Kamimura A. Covid-19 Vaccine Perception and Hesitancy Among Uninsured Free Clinic Patients. Patient Exp J. 2024; 11(1): 131-40. doi: https://doi.org/10.35680/2372-0247.1804.
24. El Bilbeisi AH, Abuzerr S, El Afifi A. Knowledge, attitudes, and practices toward blood donation in the Gaza Strip, Palestine. SAGE Open Med. 2023; 11: 20503121231207707. doi: https://doi.org/10.1177/20503121231207707.
25. Hita MLR, Grégoire Y, Lussier B, Boissonneault S, Vandenberghe C, Sénécal S. An extended health belief model for COVID-19: understanding the media-based processes leading to social distancing and panic buying. J Acad Mark Sci. 2023; 51(1): 132-52. doi: https://doi.org/10.1007/s11747-022-00865-8.
26. Sumner KM, Duca LM, Arriola CS, et al. Knowledge, attitudes, and practices associated with frequent influenza vaccination among healthcare personnel in Peru, 2016—2018. Vaccine X. 2023; 14: 100314. doi: https://doi.org/10.1016/j.jvacx.2023.100314.
27. Ibrahim FM, Fadila DE, Elmawla D. Older adults' acceptance of the COVID-19 vaccine: Application of the health belief model. Nurs Open. 2023; 10(10): 6989-7002. doi: https://doi.org/10.1002/nop2.1954.
28. Limbu YB, Gautam RK. The determinants of COVID-19 vaccination intention: a meta-review. Front Public Health. 2023; 11: 1162861. doi: https://doi.org/10.3389/fpubh.2023.1162861.
29. Ghosh S, Bhattacharya S, Mukherjee S, Chakravarty S. Promote to protect: data-driven computational model of peer influence for vaccine perception. Sci Rep. 2024; 14(1): 306. doi: https://doi.org/10.1038/s41598-023-50756-3.
30. Dhaouadi S, Kharroubi G, Cherif A, et al. Knowledge attitudes and practices toward seasonal influenza vaccine among pregnant women during the 2018/2019 influenza season in Tunisia. PLoS One. 2022; 17(3): e0265390. doi: https://doi.org/10.1371/journal.pone.0265390.
31. Koh SWC, Liow Y, Loh VWK, Liew SJ, Chan YH, Young D. COVID-19 vaccine acceptance and hesitancy among primary healthcare workers in Singapore. BMC Prim Care. 2022; 23(1): 81. doi: https://doi.org/10.1186/s12875-022-01693-z.
32. Van Nguyen D, Nguyen PH. Social media and COVID-19 vaccination hesitancy: mediating role of the COVID-19 vaccine perception. Heliyon. 2022; 8(9): e10575. doi: https://doi.org/10.1016/j.heliyon.2022.e10575.
33. Karlsson LC, Lewandowsky S, Antfolk J, et al. The association between vaccination confidence, vaccination behavior, and willingness to recommend vaccines among Finnish healthcare workers. PLoS One. 2019; 14(10): e0224330. doi: https://doi.org/10.1371/journal.pone.0224330.

Appendix 1

Knowledge Attitude and Practices Toward Seasonal Vaccination

1. Influenza is more dangerous for pregnant women than no pregnant women.
2. Influenza vaccine can be dangerous for pregnant women.
3. Influenza vaccine can be dangerous for the fetus.
4. Influenza vaccine can be dangerous for the newborn.
5. Influenza vaccine helps protect pregnant woman against influenza.
6. Vaccination of pregnant women against influenza helps protect the fetus.
7. Vaccination of pregnant women against influenza helps protect the newborn.
8. Women should receive the Influenza vaccine during each pregnancy.

5c Psychological Antecedents of Vaccination

Confidence

1. Completely confident that COVID-19 vaccines are safe
2. COVID-19 vaccines are effective
3. Confident that public authorities decide in the best coemmanity interests

Complacency

1. Vaccination is unnecessary because COVID 19 is not common anymore
2. My strong immune system can protect me against COVID-19
3. COVID-19 is not so severe that I should be vaccinated

Constraint

1. Everyday stress prevents me from being vaccinated
2. It is inconvenient against COVID-10
3. Healthcare facility visits makes me uncomfortable

Calculation

1. I weigh its benefits and risks to make the best vaccine decision possible
2. For each vaccination, I closely consider whether useful for me
3. Important for me to fully understand COVID-19 vaccine before vaccination

Collective Responsibility

1. When everyone is vaccinated, I don't have to be vaccinated
2. I get vaccinated because I can also protect people with weaker immune system
3. Vaccination is a collective action to prevent the spread of COVID-19

Vaccine Perception

1. Perceive that getting vaccinated against COVID-19 is safety related to side effects.
2. Perceive that getting vaccinated against COVID-19 reduces the risk of the disease.
3. Perceive that vaccination against COVID-19 is required to prevent disease outbreaks.
4. Perceive that vaccination against COVID-19 is good for the community.
5. Perceive that vaccination against COVID-19 helps economic and social activities return to normal soon.
6. Research on a COVID-19 vaccine is needed in the context of many new variants.

Perceived Benefits

1. Vaccinating healthy children helps to protect others by stopping the spread of disease.
2. It is better to be immunized trough the disease than through the vaccine.
3. Children need vaccines for diseases that are not common anymore.
4. Childhood vaccines are effective in protecting against disease.
5. Measles is a very serious disease.
6. A good hygiene will make measles disappear from society–the vaccine is not necessary.
7. The influenza vaccines are effective in preventing against the disease.
8. It is not worth getting the influenza vaccine, as the influenza symptoms are not serious.
9. Good hand hygiene and other preventive efforts are enough for avoiding the influenza even without vaccination.