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Article

Hesitant Minds in Vulnerable Times: COVID-19 Vaccine Hesitancy Among University Students in Ukraine

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Abstract

COVID-19 vaccine hesitancy (VH), like attitudes towards other vaccines, is a critical global public health concern. Despite numerous studies covering psychological, sociodemographic, and other determinants of vaccine acceptance, resistance, and hesitance, few studies have reported these factors among students, particularly in politically unstable settings like Ukraine. This cross-sectional, descriptive, and quantitative study assesses hesitancy towards COVID-19 vaccines, utilizing the 5Cs Model. Among 936 respondents surveyed in 2023, 64% received at least one shot of the COVID-19 vaccine (acceptant), 11% were still considering getting vaccinated (hesitant), and 25% refused vaccination (resistant). Vaccination behavior is significantly associated with the 5Cs. Higher collective responsibility significantly increased acceptance and reduced resistance, while higher constraints lowered the chances of being either acceptant or resistant. Confidence protected against resistance. Complacency, counterintuitively, reduced odds of resistance, pointing to differences between passive hesitancy and active refusal. Male gender and sources of information and misinformation influenced confidence. Collective responsibility was positively associated with official sources and negatively with conspiracy beliefs. Complacency increased with official sources, while constraints and calculation were least explained by predictors. Practical barriers should be tackled through improved accessibility and fostering collective responsibility via targeted communication strategies. These findings provide actionable insights for policymakers, healthcare providers, and academic institutions to enhance vaccine uptake among university students, particularly in crisis settings.

Keywords: conspiracy theories; COVID-19 vaccines; health communication; health knowledge; attitudes; practice; information sources; misinformation; psychological antecedents; students; vaccine hesitancy

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1. Introduction

Vaccine hesitancy continues to be a critical public health concern globally and in Ukraine, where the current sociopolitical instability, the circulation of misinformation, and conspiracy theories about vaccines have undermined vaccination campaigns [1–3]. Despite the availability of effective vaccines, COVID-19 vaccination uptake in Ukraine has lagged [4,5]. Prior to the pandemic, Ukraine had some of the lowest full vaccination rates in Europe (about 14–16%), up to the WHO declaring an end to the COVID-19 pandemic as a public health emergency in May 2023 [1,5,6], partly attributable to widespread misinformation and historical public distrust in healthcare institutions [5,7,8]. In addition, vaccine hesitancy has intertwined with political and social dynamics, contributing to rising vaccine refusal rates both in the United States and Europe [9]. Hesitancy, orchestrated and promoted by political unrest and political leaders, could cause many people to develop negative opinions, not only toward COVID-19 vaccines but also other vaccines [10,11]. This is as a result of eroded trust in public health institutions for promoting vaccinations globally [12–14].

Recent studies indicate a growing trend of vaccine hesitancy across diverse populations, including healthcare professionals. For instance, 12–66% booster hesitancy has been reported among healthcare workers across continents [15,16]. Studies on medical professionals and students revealed varied levels of vaccine acceptance due to access to scientific information, field of study, or perceived personal risk. Published studies from Poland, Italy, and Greece, for instance, show that even among medical students and professionals, VH can be high due to exposure to misinformation or sociocultural dynamics [17–19]. In a politically unstable and conflict-affected state like Ukraine, the phenomenon of COVID-19 VH, with its intricate determinants, may present different dynamics in terms of strategies to address it. The ongoing war against Ukraine, along with displacement of people, including students, has also disrupted COVID-19 vaccination efforts, breaking down routine immunization infrastructure and stopping rollout campaigns [20,21]. These war-induced interruptions of public health services and routine surveillance have further culminated in a stifled vaccine delivery and uptake, especially among the young, higher-educated population [21,22].

These vaccination impediments, compounded by the war, translated into the COVID-19 era, as demonstrated in literature. For example, studies showed that only about 35% of the Ukrainian population had completed a full COVID-19 vaccination course as of late 2022, compared to 42% by December 2023 [5,23–25]. Surveys during the pandemic found that over half of Ukrainian adults were reluctant to get vaccinated, and about 43% were strongly opposed to COVID-19 shots [5,26]. The reasons outlined for the observed hesitancy were multifaceted; a lack of confidence in vaccine safety and efficacy, low trust in government and the medical system, and gaps in health literacy have all been highlighted as key factors in Eastern Europe. In Ukraine specifically, public fears have been fueled by historical distrust, pervasive misinformation, and concerns about side effects of vaccines. Indeed, conspiracy theories and myths ranging from absurd claims about vaccines "blocking the soul's sensor" to fears of DNA alteration circulated widely on social media, reflecting an atmosphere of confusion and fear surrounding vaccination. While direct research on Ukrainian university students is limited, evidence from Eastern Europe suggests that mistrust in media significantly contributes to vaccine hesitancy in this group. Specifically, students who distrust media sources are up to twice as likely to exhibit COVID-19 vaccine hesitancy [27,28]. A UNICEF report showed that about 40% of Ukrainian healthcare workers were vaccine hesitant during the COVID-19 pandemic [29].

The present study applies the 5Cs model of the psychological antecedents of vaccination as a guiding framework. The 5Cs model describes five key determinants of

vaccine hesitancy and acceptance: Confidence: trust in the vaccine's safety and effectiveness and in the health system; Complacency: perceiving the disease as low risk, hence vaccination is seen as unnecessary; Constraints: structural or psychological barriers to vaccination; Calculation: engagement in extensive information gathering and deliberation about the vaccines; and Collective responsibility willingness to vaccinate for the benefit of others [30–32]. Each of these factors has been shown to play a role in explaining vaccination behavior. The 5Cs scale, a validated questionnaire measure of these antecedents, has demonstrated good psychometric properties and ability to predict vaccination uptake in various populations [32,33].

Against the afore-stated backdrop, this study seeks to address a critical research gap in applying the 5Cs model to grasp vaccine hesitancy in post-Soviet, politically distressed, and war contexts like Ukraine, especially among university students. University students, though instinctively assumed to be health savvy and socially active, remain vulnerable to conspiracy theories and are an essential target group for promoting vaccination coverage. The research was set to achieve two primary objectives: (1) to identify predictors of COVID-19 vaccination behavior (categorized as vaccine-acceptant, vaccine-hesitant, or vaccine-resistant) and (2) to explore how sociodemographic and informational factors relate to the 5Cs psychological antecedents of hesitancy. By integrating descriptive analysis with inferential modeling, we aim to shed light on the drivers of vaccine acceptance or hesitancy among young Ukrainians and to inform tailored strategies to improve vaccine uptake, particularly in crisis settings. Grounded in these aims, this study tests three key hypotheses: (1) each of the 5Cs is significantly associated with vaccination behavior; (2) higher confidence and collective responsibility predict vaccine acceptance, while higher constraints are associated with hesitancy or resistance; and (3) exposure to misinformation and low trust in official sources significantly shape confidence and complacency.

2. Materials and Methods

2.1. Questionnaire

The 48-item questionnaire consisted of four main parts. The first part documented the sociodemographics of participants, including age, gender, marital status, level of education, faculty (medical/non-medical), and study site (university). The second part probed basic information about participants and vaccines, that is, their medical history (suffering from chronic diseases and previous infection of COVID-19) and their COVID-19 vaccination status, that is, whether they received two doses and at least one booster shot, one or two doses only, and were still considering getting vaccinated or were not willing to get vaccinated. Additionally, this part also recorded their vaccine experience based on whether participants previously received nine specific vaccines, such as those against MMR, flu, and tetanus. The third part of the questionnaire was dedicated to evaluating the psychological antecedents regarding the COVID-19 vaccine. Here, the participants' responses to the 5Cs (Confidence, Complacency, Constraints, Calculation, and Collective responsibility), adopted from Betsch et al. (2018) as a guide, were assessed [32]. Each antecedent of the 5Cs was measured via three items. It should be noted that one extra item was added, "If it is 2023, please choose answer number «2»", to enhance the quality of data during collection and credibility of responses. The fourth part covered sources of information respondents rely on when deciding to get vaccinated against COVID-19, which included governmental agencies, social influencers, and/or scientific literature, as well as items measuring their level of misinformation (conspiracy mentality regarding the COVID-19 vaccine, which was common around the time of the pandemic in Ukraine, such as the vaccine leading to sterility, affecting spirituality and relationship with God, or being produced as a harmful weapon). Here, once again, one item exploring misinformation about vaccines was true, "vaccines

sensitize the body and offer protection against diseases", and was included to improve data quality. The questionnaire, together with the collected data, is openly available on OSF (https://doi.org/10.17605/osf.io/y8nha, accessed on 20 May 2025).

The questionnaire included categorical and ordinal variables. Gender, marital status, educational level, faculty (health or non-health related), university name, presence of chronic diseases, previous COVID-19 infection, COVID-19 vaccination status, and vaccine experience were recorded as categorical variables. For vaccine experience, participants initially indicated their familiarity with nine specific vaccines by responding "Yes", "No", or "I do not know". By adding up the number of "I do not know" answers for all vaccines asked, these categorical variables were transformed into the ordinal variable "vaccine experience" using the 33rd and 66th percentiles, thus resulting in three equally sized groups: nearly "uninformed" (participants above the 66th percentile, showing predominantly uncertainty or lack of knowledge), "moderately informed" (participants between the 33rd and 66th percentiles), and nearly "fully informed" (participants below the 33rd percentile, demonstrating clear and comprehensive awareness of their vaccination status). As for the ordinal variables, the 5Cs antecedents of vaccine hesitancy, influence of sources of information, and level of misinformation (conspiracy mentality) were measured on a seven-point Likert-type scale from 1 (strongly disagree) to 7 (strongly agree).

2.2. Study Design and Data Collection

This cross-sectional study employed a questionnaire, which was distributed digitally via a link or a QR code from February to March 2023 by researchers and trained volunteers using emails and posts on student-group platforms, such as WhatsApp and Facebook, aiming to reach as many university students as possible. The prepared scale (the 5Cs), which was piloted, pretested, and validated as a measurement applied in our previous study in Ghana, was utilized in this cohort. Initially, this study targeted specific institutions, including Bukovinian State Medical University (BSMU), Danylo Halytsky Lviv National Medical University (LNMU), Ivano Frankivsk National Medical University (IFNMU), Karazin Kharkiv National University (KKNU), Lesya Ukrainka Volyn National University (LUVNU), Lutsk National Technical University (LNTU), Lviv Medical Institute (LMI), and Ternopil Volodymyr Hnatiuk National Pedagogical University (TVHNPU). Study locations are represented in Figure 1.

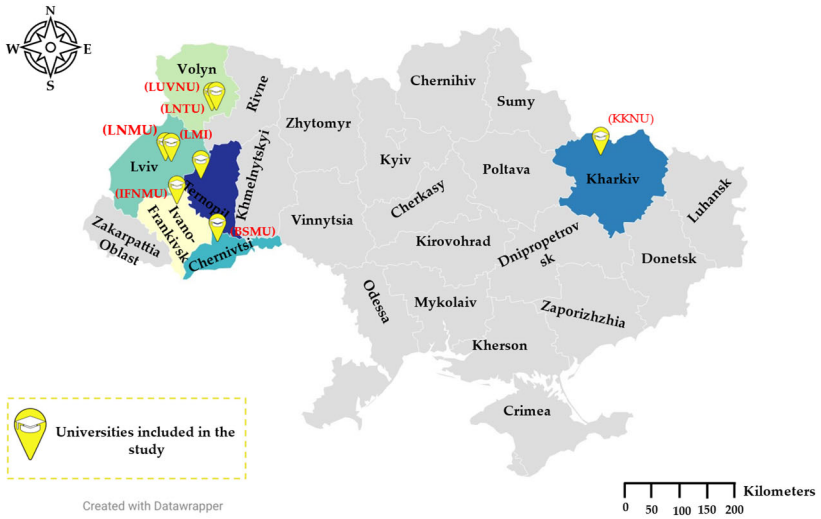

Figure 1. A map of Ukraine showing the different locations of data collection.

Due to logistical challenges associated with the ongoing conflict, however, the inclusion criteria were adjusted to encompass (1) students from any Ukrainian university

(Ukrainian territory not under Russian occupation), broadening the scope to ensure adequate participant recruitment; (2) Ukrainian university students outside Russian-occupied territories due to the war; and (3) all levels of university studies. The following were excluded: (1) acutely ill persons and (2) all non-university individuals. After acquiring consent, the questionnaire was self-administered by participants. This study did not assume the sample to be representative of the university student population due to the study site being a war-torn country with blockages and no internet. We, however, tried to reach as many people as possible given the circumstances. The data were collected through Google Forms and stored in a password-protected electronic format.

2.3. Statistical Analysis

The raw data were transferred to Microsoft Excel version 16.78.3 (2019), where they were validated qualitatively, checked, and cleaned. All subsequent analyses were conducted using R (R core team, 2021), including the packages boot [34], car [35], and nnet [36], at the Department for Economics and Sociology of Sports, Faculty of Economics and Empirical Human Sciences, Saarland University, Germany. A total of 1197 participants responded to the questionnaire. After excluding one participant who stopped answering in the first part, eight participants who chose a "Gender" other than male or female, eight participants with age > 47, two who chose a "Prefer not to say" when asked about previous infection with COVID-19, 114 participants who chose Ph.D. or professor as the highest level of education attained, 61 participants who chose "Prefer not to say" when asked about their COVID-19 vaccination status, and 67 participants who answered the quality control item in the 5Cs wrong, the total number for the statistical analysis was $n = 936$.

As for the inferential statistics, two models were employed. The first model utilized multinomial logistic regression to predict COVID-19 vaccination behavior (VB), based on the participants' vaccination status against COVID-19 as a dependent variable categorized into three groups: "Acceptant" (participants who received at least one dose of the vaccine), "Hesitant" (participants still considering vaccination), and "Resistant" (participants who decided not to get vaccinated). The "Hesitant" category was selected as the baseline group for comparison. Independent variables included gender (binary: male/female), study program (binary: health/non-health), and the 5Cs psychological antecedents, namely, Confidence, Complacency, Constraints, Calculation, and Collective responsibility, as continuous predictors. This was carried out to quantify how participants from the "Hesitant" category differ from either the "Acceptant" or "Resistant" participants based on changes in these predictors. Odds ratios greater than 1 (OR > 1) suggest factors that are associated with a higher probability of being acceptant (or resistant) compared to hesitant, while OR less than 1 (OR < 1) suggest factors that are negatively associated with differences between the groups. Meaning, they could be interpreted as either reducing the chances of firm resistance or as insufficient to encourage acceptance.

The second model aimed to explain vaccine hesitancy (VH) by deploying a multivariate regression method having the 5Cs as multivariate dependent variables, which were scrutinized using five different univariate sub-models. This multivariate multiple regression model included the following independent variables: gender (male or female), study program (health or non-health), marital status, vaccination experience (informed, moderately informed, or uninformed), sources of information (official or unofficial), and vaccine misinformation (conspiracy mentality). The analysis provides the following statistical information about factors influencing hesitancy: For the multinomial logistic regression ORs with non-parametric bootstrapping confidence intervals (CI), as well as the Nagelkerke pseudo R^2, are reported. When the CI did not include 1, the influence of the variable was considered significant. For the multivariate regression model, adjusted R^2 values for

each sub-model, regression/beta coefficients indicative of the strength and direction of the association between the predictors and the outcome when holding other variables constant, and *p*-values are reported. The level of significance was set to $\alpha = 0.05$. Additional information, including *t*-values showing if the regression/beta coefficients significantly differ from zero, is also reported; see OSF (https://doi.org/10.17605/osf.io/y8nha, accessed on 20 May 2025).

3. Results

3.1. Descriptive Statistics

3.1.1. Sociodemographic Indicators

A total of 936 university students were included in the analysis. The participants are mostly young (94% within the [18–27] age group), female (85%), single (49%), and studying a medical-related program (58%), which represent common features in health-related survey responses. Around 64% of the participants report receiving at least one dose of the vaccine against COVID-19, while only 11% were hesitant (still considering) and 25% were resistant (no intention). The overall sociodemographic characteristics of participants, along with basic medical information, are summarized in Figure 2.

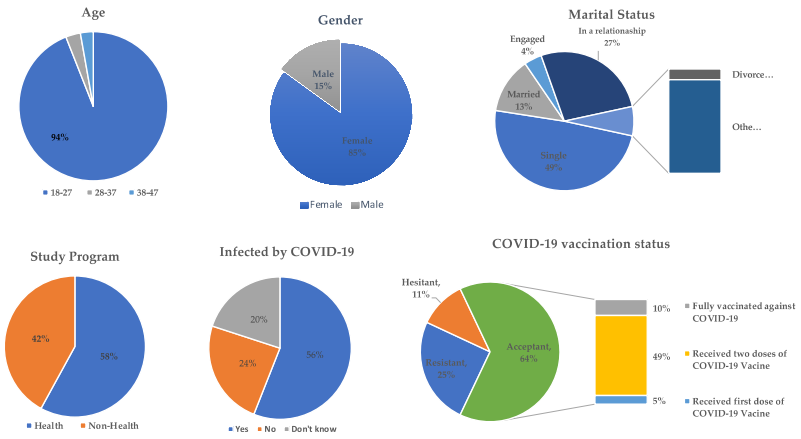

Figure 2. Sociodemographic and basic information about the COVID-19 vaccine of respondents.

3.1.2. The 5Cs Antecedents, Sources of Information, and Conspiracy Mentality

The mean values of the 5Cs scores of participants are presented in Table 1 together with the mean values for the influence of sources of information and misinformation/conspiracy mentality. The results are to be interpreted on a seven-point Likert-type scale from 1 (strongly disagree) to 7 (strongly agree) and presented as mean and standard deviations in Table 1.

Table 1. Mean scores and standard deviations for the 5Cs and factors influencing vaccination. Results were measured on a seven-point Likert-type scale from 1 (strongly disagree) to 7 (strongly agree).

Characteristic	Overall N = 936	COVID-19 Status		
		Acceptant *n* = 600	Hesitant *n* = 101	Resistant *n* = 235
Confidence	4.37 (1.59)	4.81 (1.40)	4.79 (1.21)	3.05 (1.43)
Complacency	4.67 (1.49)	5.05 (1.37)	4.89 (1.20)	3.58 (1.36)
Constraints	2.25 (1.24)	2.12 (1.16)	2.80 (1.35)	2.35 (1.33)
Calculation	5.66 (1.37)	5.57 (1.41)	5.65 (1.34)	5.91 (1.27)
Collective responsibility	4.95 (1.45)	5.42 (1.23)	5.09 (1.26)	3.68 (1.27)
Official vaccine information sources	4.76 (1.37)	5.04 (1.23)	4.95 (1.21)	3.98 (1.47)

Table 1. *Cont.*

Characteristic	Overall N = 936	COVID-19 Status		
		Acceptant *n* = 600	Hesitant *n* = 101	Resistant *n* = 235
Unofficial vaccine information sources	3.94 (1.39)	4.06 (1.39)	4.15 (1.07)	3.53 (1.45)
Misinformation (conspiracy mentality)	2.62 (1.19)	2.35 (1.01)	2.39 (1.09)	3.43 (1.29)

3.2. Inferential Statistics

3.2.1. Factors Influencing Hesitancy Toward COVID-19 Vaccination

A multinomial logistic regression model was utilized to examine which factors are different between hesitant individuals and those who are either acceptant or resistant. The model demonstrates that none of the sociodemographic variables significantly influence being in either the acceptant or resistant group ($p < 0.05$). Perceiving a higher level of constraints was associated with being less likely to be "acceptant" (OR: 0.68, CI: [0.57, 0.79]) or "resistant" (OR: 0.74, CI: [0.59, 0.89]). Higher acceptance is significantly associated with a higher sense of collective responsibility, OR: 1.37, Cl: [1.08, 1.78] and OR: 0.69, CI: [0.50, 0.91] when transitioning from hesitant to acceptant and hesitant to resistant, respectively. Being more resistant was significantly associated with having lower confidence, OR: 0.60, CI: [0.47, 0.75]. Interestingly, complacency is found to reduce the odds of being resistant, OR: 0.70, Cl: [0.54, 0.87]. The results are visualized in Figure 3.

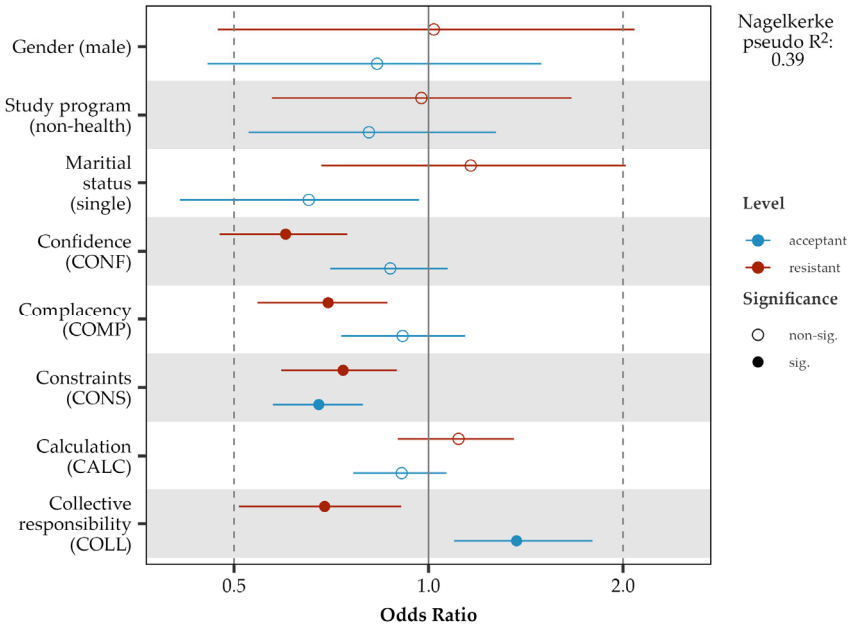

Figure 3. The multinomial logistic regression model shows the influence of 5Cs and sociodemographic variables on VB. The baseline category is "hesitant". Note that a variable was considered significant when the non-parametric bootstrapping interval does not overlap with 1. The multinomial model had a good fit (Nagelkerke pseudo-$R^2 \approx 0.3900$).

3.2.2. Factors Influencing the 5Cs Antecedents of Hesitancy Toward COVID-19 Vaccine

The multivariate regression model identifying factors associated with each of the 5Cs is shown in Figure 4. Higher confidence in the COVID-19 vaccine is associated with being male (β: 0.47, Cl: [0.27, 0.67], $p < 0.001$), being informed from both official channels (β: 0.31, Cl: [0.24, 0.37], $p < 0.001$) and unofficial channels (β: 0.12, Cl: [0.06, 0.18], $p < 0.001$) for information, and having lower levels of misinformation/conspiracy mentality (β: −0.67, Cl: [−0.74, −0.61], $p < 0.001$). Being complacent about the severity of COVID-19 and

the importance of its vaccine is positively associated with relying on official sources of information (β: 0.13, CI: [0.06, 0.21], $p < 0.001$) and negatively with having higher levels of conspiracy mentality (β: −0.58, CI: [−0.66, −0.50], $p < 0.001$). Perceiving higher constraints to be vaccinated is positively associated with relying more on both official (β: 0.08, CI: [0.00, 0.15], $p = 0.040$) and unofficial sources of information (β: 0.07, CI: [0.00, 0.14], $p = 0.040$) and having higher conspiracy mentality (β: 0.28, CI: [0.21, 0.35], $p < 0.001$). Being more immersed in seeking out information about the COVID-19 vaccine and weighing its benefits over risks (calculation) is negatively associated with being male (β: −0.38, CI: [−0.2, −0.13], $p = 0.003$) but positively associated with relying on official channels of communication (β: 0.17, CI: [0.09, 0.26], $p < 0.001$) as well as having a higher level of conspiracy mentality (β: 0.09, CI: [0.01, 0.17], $p = 0.030$). Having a higher sense of collective responsibility (i.e., willingness to get vaccinated to protect others) is positively associated with relying on official channels of information about the vaccine (β: 0.29, CI: [0.23, 0.36], $p < 0.001$) and negatively associated with having higher levels of conspiracy mentality (β: −0.57, CI: [−0.63, −0.50], $p < 0.001$). The multivariate model is summarized in Figure 4.

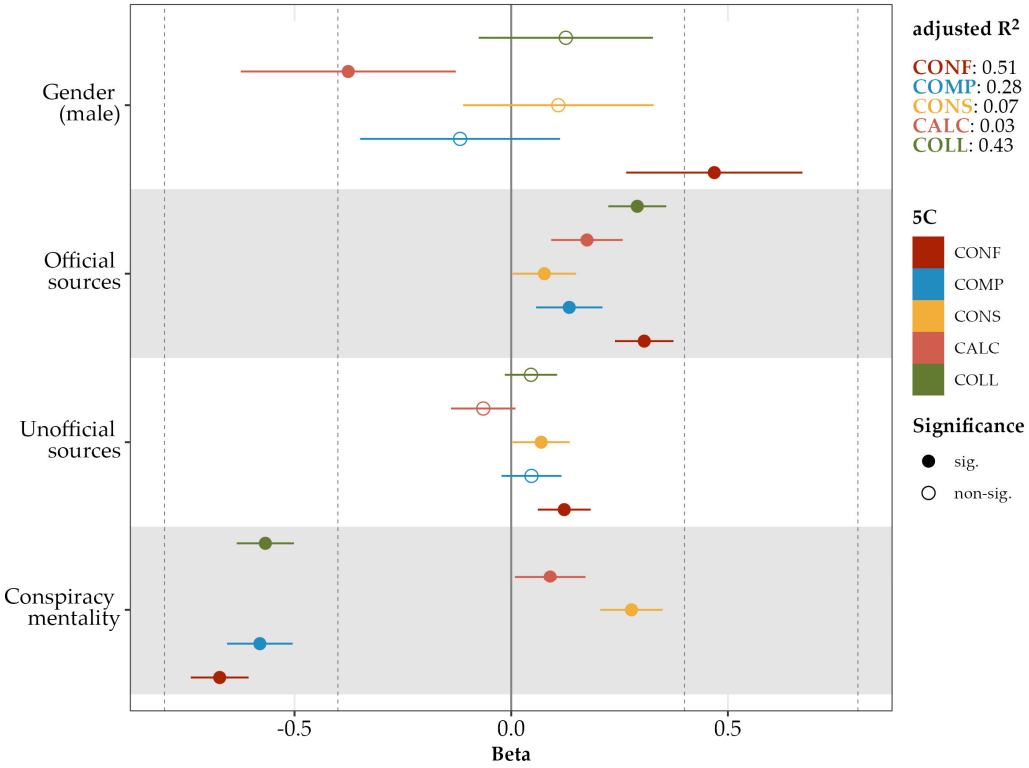

Figure 4. Multivariate multiple regression analysis to predict the influence of different variables on the 5Cs.

Amongst all the 5Cs, the variance in confidence among the participants is best explained by the predictors, followed by collective responsibility with adjusted R^2 values of 51% and 43%, respectively. While the variance observed in complacency is appreciably explained by the model (adjusted R^2 = 28%), the least variance could be explained in calculation (adjusted R^2 = 3%) and constraints (adjusted R^2 = 7%).

4. Discussion

We investigated the psychological and sociodemographic predictors of COVID-19 vaccination behavior among university students in Ukraine. The relationship between the five psychological drivers (5Cs) of VH and informational and demographic variables was examined. Our findings amplify the significant roles of collective responsibility and

practical constraints as key determinants of COVID-19 vaccine uptake among this cohort. Complacency, interestingly, demonstrated a counterintuitive association by reducing the likelihood of active resistance, indicating that passive indecision and deliberate refusal may reflect distinct psychological processes. This study also revealed psychological antecedents of vaccine hesitancy, particularly confidence and collective responsibility, to be strongly shaped by information sources and misinformation. Generally, official sources promote trust, while unofficial or conspiratorial thinking increases hesitancy. Notably, higher constraints were unexpectedly linked to both official and unofficial information reliance. Calculative behavior was paradoxically associated with both trust in official sources and susceptibility to misinformation, stressing the complex interplay between information-seeking and belief systems.

This study of 936 university students revealed that 36% had not received COVID-19 vaccines, which makes attainment of herd immunity difficult and puts the population at risk of the infection. This is in line with published studies that reported over half of the Ukrainian population to be vaccine hesitant and 43% opposed to COVID-19 shots [5,23,26]. Sociodemographic variables showing no significant influence on vaccination behavior (VB) (i.e., acceptant, hesitant, and resistant) align with broader research suggesting that psychological variables, rather than demographic factors, drive vaccine decisions, especially during conflict disruptions [37]. In the context of Ukraine, the war has intensified disinformation campaigns and heightened reliance on psychological defenses, possibly diminishing the influence of traditional demographics on vaccination choices [38]. The prolonged armed conflict in Afghanistan, for example, has intensified disinformation and reinforced psychological resistance to vaccination, thereby diminishing the influence of conventional sociodemographic factors and shifting vaccine decision-making toward mistrust-driven and ideologically rooted behaviors [39]. These findings add on to existing literature by showing that in conflict-affected and high-misinformation environments, interventions should pivot from demographic targeting toward addressing cognitive and informational factors. This is possible via improving trust, countering misinformation, and reinforcing social responsibility to effectively tackle vaccine hesitancy.

Our research outcomes align with prior literature and also introduce novel insights. Specifically, the positive influence of collective responsibility on vaccine acceptance supports previous research, demonstrating its role as a strong motivator of VB [40–43]. However, the unexpected negative association between complacency and resistance contradicts conventional studies linking complacency to increased vaccine refusal [44,45]. This finding might show that people stick to their usual habits instead of actively refusing vaccines. According to psychological theories, when people think a risk is low, they tend to make quick, automatic decisions rather than carefully thinking things through [46]. Indecisive vaccine attitudes, similarly, link low-risk perception with uncertainty, not resistance [47]. The divergence may also likely reflect a critical distinction in conflict-stifled Ukraine, where there is passive hesitancy, driven by the perceived irrelevance of vaccination amid more immediate threats, versus active resistance rooted in skepticism. Furthermore, the finding that perceived constraints reduced both acceptance and resistance parallels evidence from crisis contexts where logistical barriers suppress behavioral extremes, pushing individuals toward indecision [48,49].

Our finding that lower confidence in the COVID-19 vaccines was a significant predictor of resistance reinforces the central role of the psychological constructs, particularly trust, in shaping vaccination behavior. It aligns with studies in Ghana and others, where low trust in vaccine safety was a key driver of hesitancy [45,50–52]. These results suggest that in both stable and unstable contexts, boosting vaccine confidence is critical to reducing resistance and improving uptake. Unofficial sources and misinformation, though

untrusted, seem to suggest an unusual influence on the 5Cs' psychological antecedents. This can possibly be explained by studies postulating conflicts throwing persons into a state of uncertainty—not knowing which source has their best interest, and thus, ultimately, increasing one's hesitancy or resistance levels towards vaccinations [53,54]. First, our results discuss the association between higher vaccine confidence and use of unofficial information sources. Second, our results suggest that the negative influence of conspiracy mentality/misinformation on complacency contradicts traditional concerns that unofficial sources and misinformation promote hesitancy. Recent studies suggest that, in conflict settings, individuals may turn to peer networks, independent influencers, or community channels that, though unofficial, can sometimes disseminate accurate or reassuring information [55–58]. Third, our results explain the observed positive influence of official sources on greater complacency, perceived constraints, and calculation. This pattern may also reflect information fatigue, where continuous exposure to official COVID-19 messaging may fail to engage students who feel saturated or disconnected from state-level messaging during prolonged crises [59,60]. Moreover, this aligns with recent research showing that conspiracy believers may still perceive the disease as serious but reject vaccines due to institutional distrust, not a lack of concern about the virus itself [61,62]. Winter et. al. (2021) also postulate that subjective norms (perceptions of close persons beliefs) moderate the link between conspiracy mentality and vaccination intentions and thus mitigate the negative impact of misinformation on vaccination acceptance [63].

Male students showed higher confidence in COVID-19 vaccines but were less likely to engage in detailed information seeking, consistent with prior evidence [52,63–66]. This suggests the male gender exhibits greater baseline trust in vaccines, likely influenced by cultural norms and gender-centric expectations like risk tolerance and social health responsibilities, while women engage in critical information processing before making health decisions. These findings project the need for gender-sensitive vaccine communication strategies. Confidence in COVID-19 vaccinations increased with reliance on official sources and declined in the presence of misinformation/conspiracy beliefs. A pattern supported by recent studies showing that trust in health institutions and conspiracy mentality shape vaccine acceptance [4,66]. Conversely, perceived constraints were elevated among individuals who depended on unofficial sources and those with a stronger conspiracy mentality, a finding consistent with research showing misinformation exacerbates psychological and logistical barriers [67,68]. Furthermore, the positive relationship between collective responsibility and the use of official information sources, along with its inverse association with conspiracy beliefs, allies with evidence that positive vaccination behaviors thrive in environments of trusted information and diminish under conspiracy influence [32,69,70]. Among the 5Cs, confidence and collective responsibility showed the highest explained variance. Mirroring patterns observed in large-scale pre-, during-, and post-pandemic studies using the 5Cs model [41,44]. It also supports existing literature showing that these two constructs are the strongest predictors of vaccination intentions and behaviors across diverse populations [52]. In contrast, calculation showed the lowest explanatory power, which reflects findings that this construct is often influenced by complex (i.e., unmeasured structural or emotional factors) and context-specific dynamics [32].

Our findings are particularly relevant within the Ukrainian context, where the war has contributed to a systemic burden on healthcare services, limiting access to routine immunization and reducing institutional outreach capacity. This strain worsens existing logistical constraints and disrupts continuity in health communication, further undermining vaccine uptake. The results highlight the intricate interplay of psychological, informational, and structural factors in shaping vaccination VB during wartime. It also suggests that interventions should address both cognitive motivations and passivity driven by fatigue,

displacement, or competing priorities (practical access issues) in populations under duress. Healthcare providers should address practical barriers by improving the accessibility and convenience of vaccination services, particularly for students balancing academic demands. Policymakers could strengthen public messaging that emphasizes community protection, using trusted and diverse channels to counter misinformation. University administrators are advised to embed evidence-informed strategies into campus life through curricula, peer-led initiatives, and student support services to cultivate informed vaccine acceptance within the university community. Interventions should also distinguish between active resistance and passive disengagement, using emotionally and cognitively accessible messaging to re-engage complacent individuals with risk awareness and civic responsibility.

Limitations of Study

As with all cross-sectional designs, our study is limited in its ability to establish causal relationships between predictors and vaccination behavior. Temporal ordering cannot be determined, and associations should be interpreted with caution. The use of self-reported vaccination status may have introduced social desirability bias, especially in the context of public health norms and institutional expectations, possibly leading to overreporting of vaccine acceptance. Additionally, items measuring complacency may have been interpreted differently by vaccinated individuals, whose retrospective perception of COVID-19 risk may have biased their responses.

The exclusive use of digital data collection poses further limitations, as students with limited internet access, low digital literacy, or those displaced by the war may have been excluded (groups potentially more hesitant or resistant to vaccination). This introduces selection bias and limits the representativeness of the sample. Moreover, this study focused only on students in non-occupied Ukrainian territories, restricting generalizability to those in conflict zones or non-university populations. Non-response bias is also possible, as students with strong vaccine attitudes may have been more likely to participate, potentially skewing results.

We recommend future research to incorporate longitudinal and mixed-methods designs to better capture changes in vaccine attitudes over time. Further studies are needed to enhance causal inference and reach underrepresented subgroups.

5. Conclusions

Our study offers critical understanding into the psychological and informational determinants of COVID-19 vaccine hesitancy among Ukrainian university students during a time of war. It confirms that the 5Cs psychological antecedents (except calculation) are significantly associated with COVID-19 VB (i.e., acceptant, hesitant, and resistant). Higher confidence and collective responsibility predicted acceptance, while greater constraints were linked to hesitancy and resistance. These associations project the need to address both belief-based and structural barriers to vaccinations. Notably, low trust in official sources and high exposure to misinformation significantly eroded confidence and increased complacency, reinforcing global evidence on the damaging role of misinformation, yet contextualized here within a conflict-affected population.

Unexpectedly, reliance on official information sources positively influences increased levels of complacency, perceived constraints, and calculation, which suggests information fatigue may hinder intended public health outcomes. Additionally, higher vaccine confidence was also associated with the use of unofficial sources, such as peer networks and independent influencers, indicating that informal mediums may convey contextually resonant health information. The inverse relationship between conspiracy mentality and complacency challenges the prevailing view that conspiratorial beliefs promote hesi-

tancy in the context of war. Sociodemographic variables showed limited predictive power, highlighting a greater influence of psychological and informational variables in shaping vaccination decisions.

These study outcomes point to the importance of context-sensitive public health interventions that go beyond demographic targeting to focus on rebuilding confidence and reducing both cognitive and practical barriers. Finally, communication strategies such as effective public health messaging in war settings need rethinking beyond institutional channels and engaging with informal networks to rebuild trust and relevance.

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