

# Relationship Between Vaccine Knowledge and Attitudes of Undergraduate Nursing Students

Caitlyn D. Wilpstra

*University of Windsor, Faculty of Nursing, wilpstr@uwindsor.ca*

Jody L. Ralph

*University of Windsor, Faculty of Nursing, jody.ralph@uwindsor.ca*

Kathryn D. Lafreniere

*University of Windsor, Department of Psychology, lafren1@uwindsor.ca*

Linda J. Patrick

*University of Windsor, Faculty of Nursing, lpatric@uwindsor.ca*

Follow this and additional works at: <https://qane-afi.casn.ca/journal>



Part of the [Higher Education Commons](#), and the [Nursing Commons](#)

## Recommended Citation

Wilpstra, Caitlyn D.; Ralph, Jody L.; Lafreniere, Kathryn D.; and Patrick, Linda J. (2022) "Relationship Between Vaccine Knowledge and Attitudes of Undergraduate Nursing Students," *Quality Advancement in Nursing Education - Avancées en formation infirmière*: Vol. 8: Iss. 2, Article 2.

DOI: <https://doi.org/10.17483/2368-6669.1318>

This Article is brought to you for free and open access by Quality Advancement in Nursing Education - Avancées en formation infirmière. It has been accepted for inclusion in Quality Advancement in Nursing Education - Avancées en formation infirmière by an authorized editor of Quality Advancement in Nursing Education - Avancées en formation infirmière.

---

## Relationship Between Vaccine Knowledge and Attitudes of Undergraduate Nursing Students

### Cover Page Footnote

This article is based on the thesis completed by Wilpstra (2020). | Cet article est basé sur le mémoire de Wilpstra (2020).

Even before the COVID-19 pandemic, vaccine-hesitant attitudes had been identified among health care professionals (Karafillakis et al., 2016; Wilson, Zaytseva, et al., 2020). These findings are noteworthy because health care providers have been found to be the most positive, influential source of vaccine information for the general public (Yaqub et al., 2014). As both future immunizers and health promoters, undergraduate nursing students are an important subpopulation of health care providers. With the rising threat to global health of vaccine hesitancy (World Health Organization [WHO], 2019), the supposition that nursing students are adequately prepared to vaccinate and eagerly endorse immunizations must be reassessed (Yaqub et al., 2014).

## Background

Immunization is a crucial public health intervention that has prevented many diseases and deaths worldwide (WHO, n.d.). Despite the overwhelming success of vaccinations, a growing trend threatens to reverse the progress of widespread immunization. *Vaccine hesitancy* refers to an attitude of apprehension and doubt surrounding the safety, efficacy, and necessity of vaccinations (Yaqub et al., 2014). While the COVID-19 pandemic has likely contributed toward overall vaccine hesitancy (Fridman et al., 2021; Pullan & Dey, 2021), researchers have noted that vaccine-hesitant attitudes among health care providers are multifaceted (Karafillakis et al., 2016; Wilson, Zaytseva, et al., 2020). Likewise, many factors affect health care providers' willingness to support and recommend vaccinations (WHO Regional Office for Europe, 2013). Considering the present threat of vaccine hesitancy to global health (WHO, 2019), two factors that are frequently mentioned in the current scholarly literature were examined in this study: vaccine knowledge and vaccine attitudes.

*Vaccine knowledge* refers to awareness of vaccination and encompasses both level of knowledge and accuracy of knowledge surrounding vaccination (SAGE Working Group on Vaccine Hesitancy, 2014b). Knowledge of vaccination consists of facts that are supported by evidence-based science, such as vaccination safety, efficacy, and effects on the immune system (Zingg & Siegrist, 2012). Lower levels of vaccine knowledge have been associated with increased vaccine hesitancy (Zarobkiewicz et al., 2017; Zingg & Siegrist, 2012). Likewise, increased vaccine knowledge among health care providers has been linked with higher patient vaccination rates (Strohfus et al., 2017) and overall competence in vaccination skills (Nikula et al., 2009).

For this study, *vaccine attitudes* refer to thoughts and beliefs surrounding the acceptability of vaccinations (Wilpstra, 2020). Health care providers' attitudes toward immunization matter as clients' opinions of vaccination may be negatively impacted by the hesitant attitudes of their health care providers (SAGE Working Group on Vaccine Hesitancy, 2014a). The presence of negative or hesitant vaccination attitudes among health care providers has been associated with reluctance to recommend vaccinations to patients (Del Duca et al., 2021) and decreased population coverage rates of childhood measles and pertussis vaccinations in Germany (Weigel et al., 2014).

Undergraduate nursing students are a unique population of health care providers, representing both future immunizers and health promoters. In general, they are younger than their working counterparts (Loulergue & Launay, 2014). The Pew Research Center (2021) has identified that young adults between 18 and 29 years of age are leading users of social media. Canadian vaccination experts found that inaccurate, anti-vaccination content on websites—including social media—is a leading source of vaccine hesitancy among Canadians (Dubé et al., 2016). Exposure to this content may potentially affect nursing students' vaccination beliefs.

Furthermore, nursing students are still developing their ability to seek out and use evidence-based knowledge sources (Cosme et al., 2018).

While COVID-19 vaccinations have dominated headlines recently, routine immunizations are and will continue to be an important focus during and after the COVID-19 pandemic. Research findings suggest that childhood vaccinations were severely disrupted during the early months of the COVID-19 pandemic, increasing the risk of future outbreaks of vaccine-preventable diseases (Bramer et al., 2020; Nuzhath et al., 2021). Therefore, the purpose of this study was to assess knowledge of, and attitudes toward, routine vaccinations in undergraduate baccalaureate nursing students at a southwestern Ontario university using pre-existing instruments with satisfactory psychometric properties. Students' self-reported vaccination influences were also examined.

Current scholarly literature suggests that nursing students possess low levels of general vaccination knowledge, with lower knowledge scores than both medical and pharmacy students (Dybsand et al., 2019; Pelly et al., 2010) and practising nurses (Nikula et al., 2012). Dybsand et al. (2019) discovered that only 24.7% of the baccalaureate nursing students in their study were able to answer at least four questions correctly on a five-item basic vaccine knowledge test, compared to 73.4% of medical students. In a study involving health care programs at universities in Nova Scotia, students at a school of nursing were found to have the lowest mean vaccine knowledge scores at 11.1/21 or 52.9% (Pelly et al., 2010). Nikula et al. (2012) identified that public health nursing students nearing graduation possessed lower vaccine knowledge than their working counterparts, scoring on average 7% lower on a general vaccine knowledge test. Only Tuells et al. (2021) reported that their sample of baccalaureate nursing students possessed a satisfactory level of vaccine knowledge, but without knowing the maximum potential score on their knowledge instrument, this declaration is difficult to quantify. The lack of articles on general vaccine knowledge among nursing students demonstrates a need for additional research to assess current students' learning needs.

Nursing students' attitudes toward vaccination are largely unknown. Dybsand et al. (2019) and Lepiller et al. (2020) noted that nursing students had somewhat more hesitant attitudes toward vaccination than did other health care students, including medical and pharmacy students. For example, in Dybsand et al.'s study, 34.2% of nursing students believed that children's immune systems are placed under stress by the current childhood vaccination schedule, compared to 4.3% of medical students. Among the four items used to measure vaccine hesitancy in this sample of health care students, this was the only item with a statistically significant difference between the two groups (Dybsand et al., 2019). By contrast, Baldolli et al. (2020) found no significant differences regarding vaccination perceptions or hesitancy between nursing students and other health care students.

Yörük (2020) reported that 10% of students in a mixed sample of nursing and midwifery students possessed vaccine-hesitant attitudes surrounding childhood vaccines. In this study, hesitancy was equated with self-report of uncertain or negative attitudes toward vaccines (Yörük, 2020). Pelly et al. (2010) stated that health care students' attitudes surrounding vaccination were "worrisome" (p. 6), but they did not provide complete results of their attitudinal survey, except to correlate specific attitudinal statements with mean vaccine knowledge scores. Conversely, Tuells et al. (2021) found that their baccalaureate nursing sample possessed generally positive vaccine attitudes, but they did not provide the scoring range of their vaccine attitudes instrument. It must be noted that literature specific to nursing students was scarce, and many of the studies did not contain sufficient details on the psychometric properties of their instruments.

Current research suggests that an association between vaccine knowledge and vaccine attitudes exists; higher vaccine knowledge has been consistently associated with more accepting or less hesitant vaccination attitudes among health care students and providers (Cvjetkovic et al., 2017; Kernéis et al., 2017; Pelly et al., 2010; Zarobkiewicz et al., 2017). However, apart from Cvjetkovic et al.'s (2017) multivariate model of vaccine attitudes, studies providing correlation coefficients were not located, and only Pelly et al.'s (2010) research was specific to nursing students. Yörük (2020) found that health care classes and health care workers, whose disciplines were not specified, were the leading sources of vaccine information for nursing and midwifery students, whereas family and friends were predominant vaccination influences identified by nursing students in Tuells et al.'s (2021) study. However, no other research on nursing students' vaccination influences was located, and Dybsand et al. (2019) expressly highlighted a need for research on this topic.

Given the influence of health care providers on patients' vaccination decisions (Yaqub et al., 2014) and the scarcity of vaccine research specific to nursing students, the research questions in this study were as follows:

1. On a test of general knowledge of vaccination, what percentage of questions are answered correctly by fourth-year nursing students?
2. On a survey of vaccine acceptance in the same sample of students, what is the average vaccine acceptance score for the overall instrument and for each of the five subscales?
3. Is there a correlation between the vaccine knowledge score and the vaccine acceptance score?
4. What sources of vaccine information do the students consider to be most influential?

It was hypothesized that a positive correlation would exist between students' vaccine knowledge scores and vaccine acceptance scores (Wilpstra, 2020).

### **Methods**

The study used a descriptive research design with correlational methodology to obtain quantitative data on baccalaureate nursing students' vaccination knowledge, attitudes, and influences. The sample consisted of fourth-year nursing students enrolled in a required nursing course at a university in southwestern Ontario. At this school of nursing, all vaccination-related content was taught in the second and third years of the baccalaureate nursing program. The data were collected during an in-class, online survey in February 2020, before the widespread impact and restrictions of COVID-19. Research ethics clearance was obtained from the university's research ethics board.

Recruitment for the study occurred through an online announcement on the course's learning management system one week in advance and in person on the day of the survey. A letter of information informing participants of the study procedures, potential risks and benefits, and privacy and confidentiality measures was attached to the recruitment announcement on the learning management system. On the day of the survey, the primary researcher explained to the participants the research study and process of obtaining informed consent. A QR code and online link to the Qualtrics survey were released to the participants; however, the researchers (who were not current faculty for this course/cohort) and the course professors were not present during data collection to ensure that no undue influence or coercion existed for the students to participate. After the researchers and course professor left the room, a secretary from the university provided

the survey password to unlock the survey and was available to answer questions regarding access to the questionnaires. The survey began with a consent form, matching the letter of information, that required a response from the participants before they could access the study questionnaires. The students were given approximately 10 minutes to complete the survey, and the de-identified data were automatically collected by the Qualtrics software once the surveys were submitted by the students (Wilpstra, 2020).

The survey instruments consisted of the Vaccination Knowledge Scale and the Vaccine Acceptance Instrument. The one-dimensional Vaccination Knowledge Scale uses nine true/false questions to assess general vaccine knowledge, including topics such as the efficacy and necessity of vaccines, the development of immunity through vaccination, and common vaccine misconceptions (Zingg & Siegrist, 2012). For example, the first question states, “Vaccines are superfluous, as diseases can be treated (e.g., with antibiotics)” (Zingg & Siegrist, 2012, p. 3773), and the final question is, “Vaccinations increase the occurrence of allergies” (Zingg & Siegrist, 2012, p. 3773). (Note: the two examples above are incorrect statements that are reverse scored.) The Vaccination Knowledge Scale was developed using a Mokken scale analysis and has a satisfactory Loevinger’s scalability coefficient of  $H = .45-.48$  (Mokken, 1971; Zingg & Siegrist, 2012). The scale is considered to be highly reliable with  $p = .79-.80$  and a test-retest reliability of  $r = .70$  (Zingg & Siegrist, 2012). The total score for the instrument is determined by ascribing 1 point for each correct answer and 0 points for each incorrect answer or the selection of “do not know,” resulting in a potential score of 0–9.

The Vaccine Acceptance Instrument consists of a 20-item Likert scale that addresses the attitudinal components of vaccine acceptance (Sarathchandra et al., 2018). The 20 items are divided into the following five subscales: “perceived safety of vaccines,” “perceived effectiveness and necessity of vaccines,” “acceptance of the selection and scheduling of vaccines,” “positive values and affect toward vaccines,” and “perceived legitimacy of authorities to require vaccinations” (Sarathchandra et al., 2018, p. 1). Scores for individual items range from 1 for “least accepting” answers to 7 for “most accepting” answers. This generates a possible score of 20–140 for the overall instrument. The instrument is considered to be valid and reliable with extensive pilot testing to ensure construct validity. The reliability of both the full instrument and the five subscales is considered to be high (Grove, 2017) with a Cronbach’s  $\alpha$  of .96 for the full instrument and .81–.91 for the subscales (Sarathchandra et al., 2018).

Correlation between the two variables was assessed using Pearson’s correlation. In addition to completing the Vaccination Knowledge Scale and Vaccine Acceptance Instrument, students were asked to provide select demographic information and answer a single descriptive question regarding vaccination influences. This question was composed by the authors based on common vaccine information sources referred to in the scholarly literature (Betsch & Wicker, 2012; Dubé et al., 2016; Frawley et al., 2018; McMurtry et al., 2015). The participants were asked to choose one source of vaccine information that they consider to be most influential to them. The list of influences included *health care providers, nursing school, government/official websites, social media, my parent(s), other family member(s), friends, news media, and other*, with the option to provide any response not included in the survey question (Wilpstra, 2020).

## Results

Of the 239 students registered in a mandatory fourth-year nursing course, 145 participated in the research study, resulting in a 60.7% response rate. Females composed 91.7% of the sample

( $n = 133$ ), and the average age of participants was 23.8 years ( $SD \pm 5.3$ , range 20–51 years). Among the population of fourth-year nursing students at the university, 85.8% were female, and the average age was 24.6 years ( $SD \pm 6.2$  years). While parental status was not available for the population, the similarities between the two groups suggest that the sample is representative. See Table 1 for a detailed description of the sample and population demographic information (Wilpstra, 2020).

**Table 1**

*Demographic Information of Fourth-Year Nursing Student Sample ( $n = 145$ ) and Population ( $N = 239$ )*

Variable	Sample total	Population total
	$n$ (%)	$N$ (%)
Gender		
Female	133 (91.7)	205 (85.8)
Male	12 (8.3)	32 (13.4)
Unknown	0 (0)	2 (0.8)
Age (years)		
20–24	118 (81.4)	182 (76.2)
25–29	12 (8.3)	28 (11.7)
30–34	6 (4.1)	11 (4.6)
35–39	3 (2.1)	5 (2.1)
$\geq 40$	6 (4.1)	13 (5.4)
Parental status		
Parent	12 (8.3)	unknown
Not a parent	133 (91.7)	unknown

The mean score obtained on the Vaccination Knowledge Scale was 7.8/9 or 86.7% (range 0–9,  $SD \pm 1.5$ ). The median score was 8. On the Vaccine Acceptance Instrument, the mean score was 123.3/140 (range 49–140,  $SD \pm 16.1$ ), and the median score was 127. When the results of the Vaccine Acceptance Instrument were divided by subscale, the category of “positive values and affect toward vaccines” (Sarathchandra et al., 2018, p. 1) had the highest mean score at 26.5/28 (range 13–28,  $SD \pm 2.9$ ), while “perceived legitimacy of authorities to require vaccinations” (p. 1) demonstrated the lowest mean score at 23.3/28 (range 4–28,  $SD \pm 5.0$ ). See Table 2 for the results of the Vaccine Acceptance Instrument subscales. Furthermore, the mean Vaccination Knowledge Scale scores and the mean Vaccine Acceptance Instrument scores were found to have a strong positive correlation (Cohen, 1988; Grove & Ciper, 2017, as cited in Ciper, 2017),  $r(143) = .69$ ,  $p < .001$ . Figure 1 displays the correlation between the Vaccination Knowledge Scale scores and the Vaccine Acceptance Instrument scores as a scatterplot with the regression line (Wilpstra, 2020).

**Table 2**

*Vaccine Acceptance Instrument Subscale Results (n = 145)*

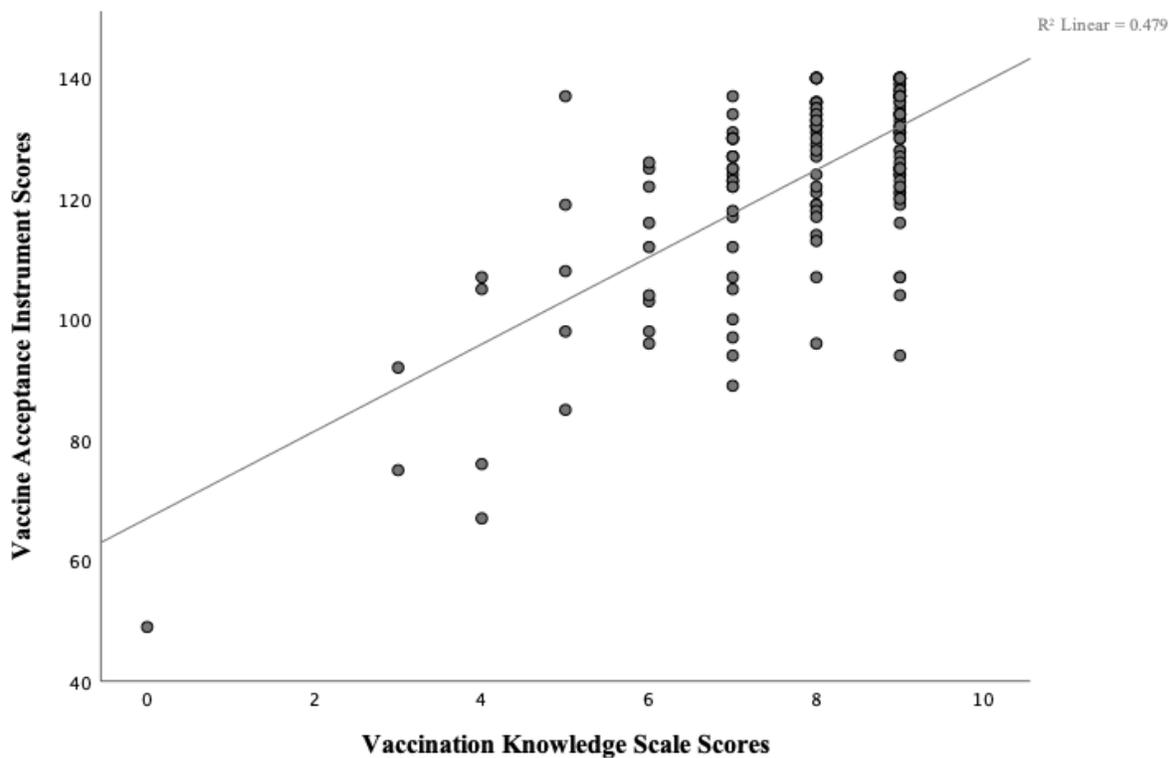
Subscale <sup>a</sup>	Mean (SD)	Median	Range
“Perceived safety of vaccines”	24.5 (± 3.9)	25	10–28
“Perceived effectiveness and necessity of vaccines”	24.9 (± 3.6)	26	9–28
“Acceptance of the selection and scheduling of vaccines”	24.2 (± 4.4)	25	7–28
“Positive values and affect toward vaccines”	26.5 (± 2.9)	28	13–28
“Perceived legitimacy of authorities to require vaccinations”	23.3 (± 5.0)	25	4–28

*Note.* Potential score of each subscale is 0–28.

<sup>a</sup> All subscales from Sarathchandra et al., 2018, p. 1.

**Figure 1**

*Scatterplot With Regression Line for Vaccination Knowledge Scale Scores and Vaccine Acceptance Instrument Scores*



Nearly half of the participants (46.2%,  $n = 67$ ) considered *nursing school* to be the leading vaccination influence in their lives. *Health care providers* (29.7%,  $n = 43$ ), *government/official websites* (15.9%,  $n = 23$ ), and *parents* (5.5%,  $n = 8$ ) were also reported as important vaccine information sources. The remainder of participants (2.7%) selected either *news media*, *social media*, or *friends* as their leading vaccination influences (Wilpstra, 2020).

### Discussion

The results of the Vaccination Knowledge Scale suggest that the participants possessed high levels of general vaccination knowledge near the end of their undergraduate nursing education. Their mean vaccination knowledge score of 86.7% was higher than results obtained on comparable vaccination knowledge tests among similar populations of nursing students. For example, final year baccalaureate nursing students at one nursing school in Nova Scotia had a mean vaccination knowledge score of 52.9% (Pelly et al., 2010), while graduating public health nursing students in Finland scored an average of 76% on a test of immunization knowledge (Nikula et al., 2012). Dybsand et al. (2019) found that only 24.7% of their baccalaureate nursing students answered at least four questions correctly on a five-item general vaccine knowledge test, whereas 85.5% of the students in the present study obtained a comparable score of at least 7 out of 9 correct answers on the Vaccination Knowledge Scale. Compared to the students in this study, Dybsand et al.'s participants were notably heterogeneous, with students' years of study not specified and multiple program streams included in the sample. Furthermore, the knowledge questions included in Nikula et al.'s (2012) survey were highly specific to safe vaccine administration. Despite these differences, the high mean knowledge score obtained in the present study suggests that the students possessed satisfactory and above-average general vaccination knowledge as they commenced independent nursing practice (Wilpstra, 2020).

The participants in the current study also demonstrated generally positive vaccination attitudes, but the results were somewhat varied and nuanced. These findings are consistent with contemporary literature on vaccine attitudes among health care students. For example, Dybsand et al. (2019) assessed baccalaureate nursing students' vaccination attitudes with items comparable in content to the Vaccine Acceptance Instrument, and Baldolli et al. (2020) assessed perceptions of vaccine safety and efficacy among a sample of French health care students including nursing students. Similar to Dybsand et al.'s and Baldolli et al.'s findings, the participants' vaccine attitudes in the present study were largely accepting, with the majority of students in all three studies agreeing that vaccines are safe and efficacious. Wilson, Avery, et al. (2020) also reported that the majority of nursing students in their sample rated the safety of vaccinations as high.

However, the participants in the present study demonstrated some hesitancy in the subscale assessing the role of government in mandating vaccines. While this topic has been minimally studied among nursing students, Lepiller et al. (2020) found that 73.3% of the French nursing students in their study supported non-compulsory rather than mandatory immunization. Conversely, 84.1% of third- and fourth-year Spanish nursing students in Tuells et al.'s (2021) sample agreed or strongly agreed with mandatory vaccinations. Similar studies of medical students and residents have likewise revealed various levels of support for mandatory vaccination (Arora et al., 2019; Cvjetkovic et al., 2017; Kunze & Schweinzer, 2020).

In all the preceding studies, data collection occurred before the COVID-19 pandemic. While COVID-19 vaccine mandates for health care workers and students are frequently discussed in news media, only one research study was found that investigated nursing students' attitudes

toward COVID-19 mandates (Manning et al., 2021). Manning et al. (2021) found that nursing students and faculty at a U.S. college of nursing identified concerns surrounding mandatory COVID-19 vaccines as a recurrent theme in an open-ended qualitative survey question. However, no quantitative data were associated with this finding, and no other studies on nursing students' attitudes toward mandatory COVID-19 immunizations were identified. As COVID-19 vaccine mandates continue to evolve for both nursing students and practising nurses, understanding students' hesitancy surrounding trust in authorities and their "perceived legitimacy... to require vaccinations" (Sarathchandra et al., 2018, p. 3) is paramount for promoting confidence in and acceptance of COVID-19 vaccines.

The Vaccine Acceptance Instrument captured a particular area of uncertainty among the nursing students that has been infrequently studied among health care providers. Nearly one third (31.7%) of the students were unsure if vaccines contain dangerous amounts of mercury. Picchio et al. (2019) described a similar proportion (29.8%) of their mixed nursing and physician sample expressing uncertainty of the risks of thimerosal (the mercury-based preservative) in vaccines. Notably, Picchio et al.'s participants were all pediatric health care providers involved in vaccine administration, which demonstrates that this is a pervasive area of uncertainty and an opportunity for nursing educators to provide targeted teaching regarding the safety of particular vaccine ingredients (Wilpstra, 2020).

As hypothesized, the participants' vaccination knowledge scores were found to have a strong positive correlation with their vaccine acceptance scores. Other studies of nursing and medical students also reported that a correlation or association exists between vaccination knowledge and attitudes (Cvjetkovic et al., 2017; Kernéis et al., 2017; Pelly et al., 2010; Zarobkiewicz et al., 2017). However, correlation coefficients were not provided in these studies, although Cvjetkovic et al. (2017) found a statistically significant positive association between vaccine knowledge and vaccine attitudes in a multivariate model explaining variance in vaccine attitudes. Overall, the general agreement in previous literature supports the current findings of a correlation between the students' vaccination knowledge scores and vaccine acceptance scores (Wilpstra, 2020).

The majority of participants selected *nursing school* as a leading vaccine influence, suggesting that students consider their undergraduate nursing education important in shaping their views and opinions surrounding vaccination. These results are congruent with Yörük's (2020) finding that health care classes were the leading vaccine information source among a sample of nursing and midwifery students. The results also align with Arora et al.'s (2019) and McMurtry et al.'s (2015) studies, which found that undergraduate education is an influential source of vaccine information among medical students and residents. By contrast, in Betsch and Wicker's (2012) research on vaccine knowledge, medical students identified *health professionals* as a leading health information source. It is interesting to note that the participants in both the present study and Yörük's study of nursing and midwifery students selected *health care providers* as the second most common vaccination influence or information source. Social media and parents/family members were identified as vaccination influences less frequently than expected based on the findings of other research studies (Dubé et al., 2016; McMurtry et al., 2015; Tuells et al., 2021). These unexpectedly low numbers may have resulted from the phrasing of the question itself, which asked participants to select a single leading vaccination influence. It is possible that parents and social media impact students' vaccination views somewhat subconsciously and therefore were not selected as primary vaccination influences (Wilpstra, 2020).

### Implications for Education

The results of this study suggest that graduating baccalaureate nursing students in one program possess relatively high levels of general vaccine knowledge; however, nursing educators should not assume that all students readily or fully endorse vaccinations (Yaqub et al., 2014). Nursing educators should also consider that possession of accurate vaccine knowledge alone does not guarantee students' acceptance of all aspects of vaccination. Students may be fully accepting of some aspects of vaccination but hesitant or misinformed about others. Specific uncertain or hesitant attitudes may require targeted vaccination education, particularly regarding the safety of vaccine ingredients, such as mercury. The study results also found that undergraduate nursing educators play an important role in shaping vaccination views and opinions, as nearly half of the students selected *nursing school* as the leading vaccination influence in their lives. Moreover, because the vaccination knowledge and acceptance scores were positively correlated, providing thorough and factual vaccine education can improve students' acceptance of vaccines. Nursing educators have a prime opportunity to positively influence vaccine knowledge and attitudes throughout the four years of students' undergraduate nursing education and should consider targeting curriculum to dispel common vaccination misconceptions among nursing students.

### Implications for Research

The results of the present study demonstrate many possibilities for future research. This study examined fourth-year nursing students who had already completed all courses covering vaccinations, and their baseline vaccine knowledge and acceptance levels remain unknown. Researchers should quantitatively investigate the impact that nursing school itself has upon vaccine knowledge and attitudes by measuring knowledge and acceptance levels at baseline and throughout the four-year university program. A longitudinal research study could be performed to investigate whether vaccine knowledge and attitudes change over time, particularly in light of the COVID-19 pandemic. As a single-site study, this research should be expanded to multiple schools of nursing across Canada or internationally to examine whether location has an effect on vaccination attitudes. Finally, targeted education programs for some of the common vaccine misconceptions identified in this study should be studied as a potential strategy to improve vaccine knowledge and acceptance.

### Limitations

The study used a convenience sample and took place at a single school of nursing where specific vaccinations are required to attend clinical placements. The research participants also possessed overall high levels of vaccine knowledge and acceptance, with few students demonstrating truly low knowledge or acceptance scores. Consequently, the results may preclude insight into nursing students with lower levels of vaccine knowledge and acceptance. As a single-site study, the results may reflect the timing of vaccine-related education in this specific school of nursing, where vaccination content is taught in the second and third years of the nursing program. Another limitation may have occurred in the process of assessing vaccination influences. It is possible that students selected *nursing school* as their leading vaccination influence because this influence was foremost in their minds as they completed the survey during class time. It is also possible that *nursing school* was viewed as the most socially desirable answer to this question. Therefore, the setting of the data collection should be considered when interpreting the results.

Several limitations were also noted with the instruments selected for use in this study. The Vaccination Knowledge Scale measures general vaccine knowledge rather than specific vaccine

knowledge (Zingg & Siegrist, 2012), and obtaining high knowledge scores on this instrument does not guarantee vaccination proficiency in clinical practice. The Vaccine Acceptance Instrument specifically measures attitudes surrounding childhood vaccinations (Sarathchandra et al., 2018), and this may have impacted participants' responses to certain questions as most participants were not parents themselves. However, there is a paucity of valid and reliable instruments available for research use that measure general vaccine knowledge and attitudes. Despite the limitations of the instruments used, a major strength of this study is that it used valid and reliable instruments for both measures (Wilpstra, 2020).

### **Conclusion**

Vaccine hesitancy is a growing threat to public health worldwide (WHO, 2019), and health care workers are not immune from hesitant beliefs (Yaqub et al., 2014). This study examined nursing students' vaccine knowledge and acceptance at the end of their four-year baccalaureate nursing education. The participants were found to have high vaccine knowledge and acceptance scores, and the two scores were positively correlated. However, the results also demonstrated a range of attitudes toward various aspects of immunization. By promoting high-quality, accurate vaccination education, nursing educators can potentially shape the future clinical practice of their students as they care for clients, families, and communities and contribute to an accurate and positive discourse surrounding vaccination.

## References

- Arora, G., Lehman, D., Charlu, S., Ross, N., Ardy, A., Gordon, B., & Pannaraj, P. S. (2019). Vaccine health beliefs and educational influences among pediatric residents. *Vaccine*, 37(6), 857–862. <https://doi.org/10.1016/j.vaccine.2018.12.038>
- Baldolli, A., Michon, J., Verdon, R., & Fournier, A. (2020). Vaccination perception and coverage among healthcare students in France in 2019. *BMC Medical Education*, 20, Article 508. <https://doi.org/10.1186/s12909-020-02426-5>
- Betsch, C., & Wicker, S. (2012). E-health use, vaccination knowledge and perception of own risk: Drivers of vaccination uptake in medical students. *Vaccine*, 30(6), 1143–1148. <https://doi.org/10.1016/j.vaccine.2011.12.021>
- Bramer, C. A., Kimmins, L. M., Swanson, R., Kuo, J., Vranesich, P., Jacques-Carroll, L. A., & Shen, A. K. (2020). Decline in child vaccination coverage during the COVID-19 pandemic—Michigan Care Improvement Registry, May 2016-May 2020. *American Journal of Transplantation*, 20(7), 1930–1931. <https://doi.org/10.1111/ajt.16112>
- Cipher, D. J. (2017). Using statistics to examine relationships. In J. R. Gray, S. K. Grove, & S. Sutherland (Eds.), *Burns and Grove's the practice of nursing research: Appraisal, synthesis, and generation of evidence* (8th ed., pp. 545–555). Elsevier.
- Cosme, S., Milner, K. A., & Wonder, A. (2018). Benchmarking of prelicensure nursing students' evidence-based practice knowledge. *Nurse Educator*, 43(1), 50–53. <https://doi.org/10.1097/NNE.0000000000000398>
- Cvjetkovic, S. J., Jeremic, V. L., & Tiosavljevic, D. V. (2017). Knowledge and attitudes toward vaccination: A survey of Serbian students. *Journal of Infection and Public Health*, 10(5), 649–656. <https://doi.org/10.1016/j.jiph.2017.05.008>
- Del Duca, E., Chini, L., Graziani, S., Sgrulletti, M., Moschese, V., & the Italian Pediatric Immunology and Allergology Society (SIAIP) Vaccine Committee. (2021). Pediatric health care professionals' vaccine knowledge, awareness and attitude: A survey within the Italian Society of Pediatric Allergy and Immunology. *Italian Journal of Pediatrics*, 47, Article 183. <https://doi.org/10.1186/s13052-021-01090-9>
- Dubé, E., Gagnon, D., Ouakki, M., Bettinger, J. A., Guay, M., Halperin, S., Wilson, K., Graham, J., Witteman, H. O., MacDonald, S., Fisher, W., Monnais, L., Tran, D., Gagneur, A., Guichon, J., Saini, V., Heffernan, J. M., Meyer, S., Driedger, S. M., ... the Canadian Immunization Research Network. (2016). Understanding vaccine hesitancy in Canada: Results of a consultation study by the Canadian Immunization Research Network. *PLoS One*, 11(6), Article e0156118. <https://doi.org/10.1371/journal.pone.0156118>
- Dybsand, L. L., Hall, K. J., & Carson, P. J. (2019). Immunization attitudes, opinions, and knowledge of healthcare professional students at two Midwestern universities in the United States. *BMC Medical Education*, 19, Article 242 (2019). <https://doi.org/10.1186/s12909-019-1678-8>
- Frawley, J. E., Foley, H., & McIntyre, E. (2018). The associations between medical, allied and complementary medicine practitioner visits and childhood vaccine uptake. *Vaccine*, 36(6), 866–872. <https://doi.org/10.1016/j.vaccine.2017.12.036>

- Fridman, A., Gershon, R., & Gneezy, A. (2021). COVID-19 and vaccine hesitancy: A longitudinal study. *PLoS One*, *16*(4), Article e0250123. <https://doi.org/10.1371/journal.pone.0250123>
- Grove, S. K. (2017). Measurement concepts. In J. R. Gray, S. K. Grove, & S. Sutherland (Eds.), *Burns and Grove's the practice of nursing research: Appraisal, synthesis, and generation of evidence* (8th ed., pp. 363–393). Elsevier.
- Karafillakis, E., Dinca, I., Apfel, F., Cecconi, S., Würz, A., Takacs, J., Suk, J., Pastore Celentano, L., Kramarz, P., & Larson, H. J. (2016). Vaccine hesitancy among healthcare workers in Europe: A qualitative study. *Vaccine*, *34*(41), 5013–5020. <https://doi.org/10.1016/j.vaccine.2016.08.029>
- Kernéis, S., Jacquet, C., Bannay, A., May, T., Launay, O., Verger, P., & Pulcini, C. (2017). Vaccine education of medical students: A nationwide cross-sectional survey. *American Journal of Preventive Medicine*, *53*(3), e97–e104. <https://doi.org/10.1016/j.amepre.2017.01.014>
- Kunze, U., & Schweinzer, H. (2020). Self-reported vaccination status and attitudes towards mandatory vaccinations for health care workers among medical students. *Vaccine*, *38*(35), 5695–5699. <https://doi.org/10.1016/j.vaccine.2020.06.046>
- Lepiller, Q., Bouiller, K., Slekovec, C., Millot, D., Mazué, N., Pourchet, V., Balice, R., Garrien-Maire, F., Simon, E., Wintenberger, V., Guillaume, A., Monaton, M. F., Van Eis, B., Bertrand, X., Bennabi, D., Moulin, T., Anxionnat, R., & Nerich, V. (2020). Perceptions of French healthcare students of vaccines and the impact of conducting an intervention in health promotion. *Vaccine*, *38*(43), 6794–6799. <https://doi.org/10.1016/j.vaccine.2020.08.036>
- Loulergue, P., & Launay, O. (2014). Vaccinations among medical and nursing students: Coverage and opportunities. *Vaccine*, *32*(38), 4855–4859. <https://doi.org/10.1016/j.vaccine.2014.01.014>
- Manning, M. L., Gerolamo, A. M., Marino, M. A., Hanson-Zalot, M. E., & Pogorzelska-Maziarz, M. (2021). COVID-19 vaccination readiness among nurse faculty and student nurses. *Nursing Outlook*, *69*(4), 565–573. <https://doi.org/10.1016/j.outlook.2021.01.019>
- McMurtry, A., Wilson, K., Clarkin, C., Walji, R., Kilian, B. C., Kilian, C. C., Lohfeld, L., Alolabi, B., Hagino, C., & Busse, J. W. (2015). The development of vaccination perspectives among chiropractic, naturopathic and medical students: A case study of professional enculturation. *Advances in Health Sciences Education*, *20*, 1291–1302. <https://doi.org/10.1007/s10459-015-9602-4>
- Mokken, R. J. (1971). *A theory and procedure of scale analysis with applications in political research*. Mouton.
- Nikula, A., Puukka, P., & Leino-Kilpi, H. (2012). Vaccination competence of graduating public health nurse students and nurses. *Nurse Education Today*, *32*(8), 850–856. <https://doi.org/10.1016/j.nedt.2011.10.008>
- Nikula, A. E., Rapola, S. P. T., Hupli, M. I., & Leino-Kilpi, H. T. (2009). Factors strengthening and weakening vaccination competence. *International Journal of Nursing Practice*, *15*(5), 444–454. <https://doi.org/10.1111/j.1440-172X.2009.01781.x>

- Nuzhath, T., Ajayi, K. V., Fan, Q., Hotez, P., Colwell, B., Callaghan, T., & Regan, A. K. (2021). Childhood immunization during the COVID-19 pandemic in Texas. *Vaccine*, 39(25), 3333–3337. <https://doi.org/10.1016/j.vaccine.2021.04.050>
- Pelly, L. P., Pierrynowski MacDougall, D. M., Halperin, B. A., Strang, R. A., Bowles, S. K., Baxendale, D. M., & McNeil, S. A. (2010). THE VAXED PROJECT: An assessment of immunization education in Canadian health professional programs. *BMC Medical Education*, 10, Article 86 (2010). <https://doi.org/10.1186/1472-6920-10-86>
- Pew Research Center. (2021). *Social media fact sheet*. <https://www.pewinternet.org/fact-sheet/social-media/>
- Picchio, C. A., Carrasco, M. G., Sagué-Vilavella, M., & Rius, C. (2019). Knowledge, attitudes and beliefs about vaccination in primary healthcare workers involved in the administration of systematic childhood vaccines, Barcelona, 2016/17. *Eurosurveillance*, 24(6), Article 1800117. <https://doi.org/10.2807/1560-7917.ES.2019.24.6.1800117>
- Pullan, S., & Dey, M. (2021). Vaccine hesitancy and anti-vaccination in the time of COVID-19: A Google Trends analysis. *Vaccine*, 39(14), 1877–1881. <https://doi.org/10.1016/j.vaccine.2021.03.019>
- SAGE Working Group on Vaccine Hesitancy. (2014a). *Appendices to the report of the SAGE working group on vaccine hesitancy*. World Health Organization. [https://www.who.int/immunization/sage/meetings/2014/october/2\\_SAGE\\_Appendicies\\_Background\\_final.pdf?ua=1](https://www.who.int/immunization/sage/meetings/2014/october/2_SAGE_Appendicies_Background_final.pdf?ua=1)
- SAGE Working Group on Vaccine Hesitancy. (2014b). *Report of the SAGE Working Group on Vaccine Hesitancy*. World Health Organization. [https://www.who.int/immunization/sage/meetings/2014/october/1\\_Report\\_WORKING\\_GROUP\\_vaccine\\_hesitancy\\_final.pdf](https://www.who.int/immunization/sage/meetings/2014/october/1_Report_WORKING_GROUP_vaccine_hesitancy_final.pdf)
- Sarathchandra, D., Navin, M. C., Largent, M. A., & McCright, A. M. (2018). A survey instrument for measuring vaccine acceptance. *Preventive Medicine*, 109, 1–7. <https://doi.org/10.1016/j.ypmed.2018.01.006>
- Strohfus, P. K., Kim, S. C., Palma, S., Duke, R. A., Remington, R., & Roberts, C. (2017). Immunizations challenge healthcare personnel and affects immunization rates. *Applied Nursing Research*, 33, 131–137. <https://doi.org/10.1016/j.apnr.2016.11.005>
- Tuells, J., Egoavil, C. M., Morales-Moreno, I., Fortes-Montoya, E., Salazar-García, C., & Rodríguez-Blanco, N. (2021). Knowledge, attitudes, and sources of information on vaccines in Spanish nursing students: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 18(7), Article 3356. <https://doi.org/10.3390/ijerph18073356>
- Weigel, M., Weitmann, K., Rautmann, C., Schmidt, J., Bruns, R., & Hoffmann, W. (2014). Impact of physicians' attitude to vaccination on local vaccination coverage for pertussis and measles in Germany. *European Journal of Public Health*, 24(6), 1009–1016. <https://doi.org/10.1093/eurpub/cku013>
- Wilpstra, C. (2020). *Vaccine knowledge and vaccine attitudes of undergraduate nursing students* [Master's thesis, University of Windsor]. Scholarship at UWindsor Electronic Theses and Dissertations. <https://scholar.uwindsor.ca/etd/8491>

- Wilson, K. L., Avery, J. S., & Slack, J. (2020). Nursing students' perceptions and beliefs about immunizations: A descriptive study. *Nurse Education Today*, 92, Article 104491. <https://doi.org/10.1016/j.nedt.2020.104491>
- Wilson, R., Zaytseva, A., Bocquier, A., Nokri, A., Fressard, L., Chamboredon, P., Carbonaro, C., Bernardi, S., Dubé, E., & Verger, P. (2020). Vaccine hesitancy and self-vaccination behaviors among nurses in southeastern France. *Vaccine*, 38(5), 1144–1151. <https://doi.org/10.1016/j.vaccine.2019.11.018>
- World Health Organization. (n.d.). *Vaccines and immunization*. <https://www.who.int/topics/immunization/en/>
- World Health Organization. (2019). *Ten threats to global health in 2019*. <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>
- World Health Organization Regional Office for Europe. (2013). *The guide to tailoring immunization programmes (TIP): Increasing coverage of infant and child vaccination in the WHO European Region*. World Health Organization. [http://www.euro.who.int/\\_data/assets/pdf\\_file/0003/187347/The-Guide-to-Tailoring-Immunization-Programmes-TIP.pdf?ua=1](http://www.euro.who.int/_data/assets/pdf_file/0003/187347/The-Guide-to-Tailoring-Immunization-Programmes-TIP.pdf?ua=1)
- Yaqub, O., Castle-Clarke, S., Sevdalis, N., & Chataway, J. (2014). Attitudes to vaccination: A critical review. *Social Science & Medicine*, 112, 1–11. <https://doi.org/10.1016/j.socscimed.2014.04.018>
- Yörük, S. (2020). Factors associated with childhood vaccine hesitancy and measles vaccine hesitancy among healthcare students. *Nursing & Health Sciences*, 22(4), 1030–1037. <https://doi.org/10.1111/nhs.12762>
- Zarobkiewicz, M. K., Zimecka, A., Zuzak, T., Cieślak, D., Roliński, J., & Grywalska, E. (2017). Vaccination among Polish university students. Knowledge, beliefs and anti-vaccination attitudes. *Human Vaccines & Immunotherapeutics*, 13(11), 2654–2658. <https://doi.org/10.1080/21645515.2017.1365994>
- Zingg, A., & Siegrist, M. (2012). Measuring people's knowledge about vaccination: Developing a one-dimensional scale. *Vaccine*, 30(25), 3771–3777. <https://doi.org/10.1016/j.vaccine.2012.03.014>