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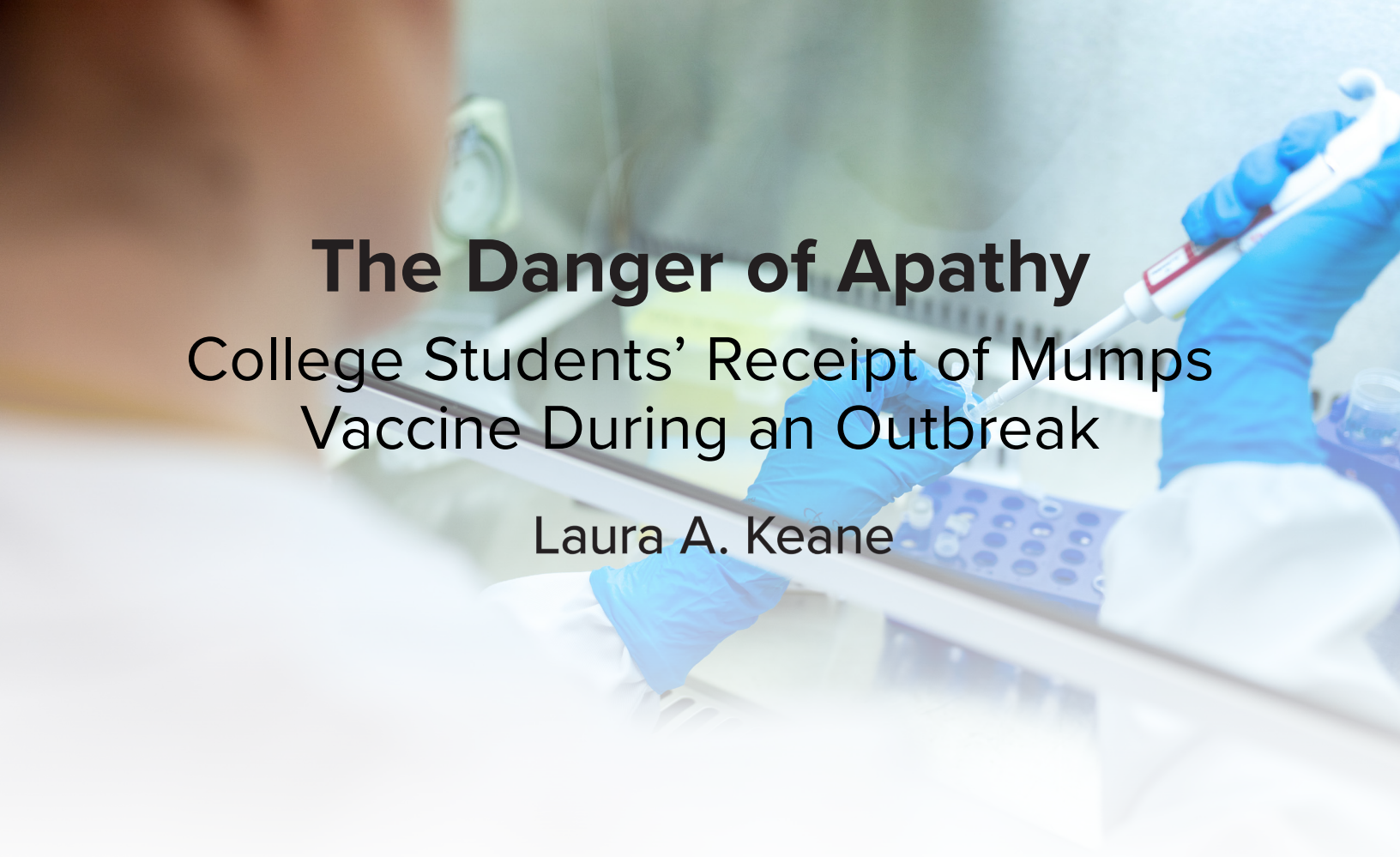

The Danger of Apathy

College Students' Receipt of Mumps Vaccine During an Outbreak

Laura A. Keane

Abstract

A mumps outbreak occurred on the James Madison University campus in Harrisonburg, Virginia, during the Spring 2018 semester. For many students, it was the first time they had to decide on their own whether or not to receive a vaccine. This explanatory, cross-sectional study examined the relationships between students' general vaccine acceptance; measles, mumps, and rubella (MMR) vaccine acceptance; vaccine knowledge; and intent to receive/receipt of the MMR booster. A survey was distributed in Fall 2019 to students in two health courses (n = 243). For students enrolled during the Spring 2018 semester, the survey evaluated perceptions and behaviors regarding the MMR vaccine; for those not enrolled in Spring 2018, the survey evaluated perceptions of a hypothetical outbreak. As a whole, the surveyed population had a positive attitude towards vaccines, and 97.4% (n = 149) of participants responding to the hypothetical scenario said they would receive a booster shot if recommended when presented the opportunity. Still, attitude alone is not enough to persuade an individual to receive a vaccine. Only 39.7% (n=33) of the participants enrolled in Spring 2018 elected to receive the MMR vaccine, while 60.3% (n = 51) did not receive the vaccine, with the most popular reason being lack of time. The results indicate more efforts are needed to increase the perceived importance of vaccinations and perceived susceptibility to the consequences of not getting vaccinated.

A mumps outbreak occurred on the James Madison University (JMU) campus in Harrisonburg, Virginia, during the Spring 2018 semester. For many of the students, it was the first time they had to decide on their own whether or not to receive a vaccine. In Virginia, as in every other U.S. state, the law requires that parents and guardians of K-12 students provide proof of measles, mumps, and rubella (MMR) immunization before their students can attend public schools (Virginia Department of Health, 2020; Immunization Action Coalition, 2019; Iowa Department of Public Health, 2017); similarly, as in other states, Virginia law requires that all students in public baccalaureate-granting institutions be immunized against measles, mumps, and rubella prior to enrollment (Code of Virginia, n.d.-a).

Even though MMR is a required vaccination for most U.S. college students, mumps outbreaks still occur regularly on college campuses (Marlow et al., 2019). JMU, a mid-sized public state university, experienced a mumps outbreak in Spring 2018, and the *JMU News* website noted that "the Virginia Department of Health, in consultation with the Centers for Disease Control and Prevention, is recommending that students, faculty and staff receive a third dose of the mumps vaccine" (Wyatt, 2018). Free vaccination clinics were hosted by JMU's University Health Center and the Virginia Department of Health for all members of the JMU community to receive a third booster MMR vaccine (Wyatt, 2018).

This study investigated the behaviors and perceptions of college-aged students regarding their decision to receive or not receive the MMR vaccine booster through a series of questionnaires from validated instruments.

Literature Review

The MMR Vaccine and Mumps

The MMR vaccine was approved for use in the United States by the Food and Drug Administration (FDA) in 1971 and as a two-dose sequence is 88% effective against mumps (CDC, 2020a; CDC, 2019b). The CDC (2020b) recommends that the first dose in the sequence be administered to children at 12–15 months of age and the second dose before kindergarten, when children are 4–6 years old. In 2017, 91.1% of children in the United States and 97.6% of children in Virginia aged 19–35 months received the MMR vaccine (CDC, 2018a, 2018c). When a mumps outbreak occurs, the CDC (2019b) notes that public health authorities might recommend a third booster dose to higher-risk groups. During an outbreak, a third dose of the MMR vaccine can help prevent spread as evidence shows lower infection rates among those who receive the booster than those who do not (Nelson et al., 2013; Ogbuanu et al., 2012; CDC, 2018b).

Mumps is transmitted through saliva droplets with patients initially presenting with swollen salivary glands, fevers, muscle aches, headaches, and fatigue (CDC, 2019c). Affected individuals show symptoms 12 –25 days after exposure and are contagious days before and up to five days after salivary gland swelling begins (CDC, 2019d). Complications such as testicular swelling, encephalitis, meningitis, miscarriage, arthritis, deafness, pancreatitis, or orchitis can occur (CDC, 2019a).

Child Vaccine Uptake and Refusal

Reasons parents vaccinate their children are due to altruism, bandwagoning, and the perception that not receiving a vaccine is worse than receiving it (Poland & Jacobson, 2001).

Legally acceptable reasons for not vaccinating before school enrollment must be medical, religious, or philosophical (National Conference of State Legislation, 2019). Similarly, Virginia Law §22.1-271.2 allows vaccine refusal for medical reasons or if vaccination goes against an individual's religious beliefs/practices (Code of Virginia, n.d.-b). The CDC (2018b) recommends that individuals with allergies, weakened immune systems from cancer or HIV/AIDS, tuberculosis, conditions causing bleeding or bruising easily, a history of immune disorders, or who are pregnant should avoid receiving the MMR vaccine.

In a 2001 study of 1,600 parents of children under 6 years old in the United States, 25% of parents believed a child's immune system was weakened by too many vaccines, while only 23% believed the more immunizations their children received the better it was for their health (Poland & Jacobson, 2001). In this study, parents' main reason for not vaccinating their children was based on omission bias: where omission bias refers to the belief that "a bad outcome is worse if it occurred due to an active choice to do something rather than as a consequence of not doing something" (Poland & Jacobson, 2001, p. 2443).

Smith et al. (2008) found that non-Hispanic Black children, children who had siblings, children who lived outside the Northeast region, and children who went to public health clinics were less likely to receive the MMR vaccine. Children of single mothers and children of mothers with relatively less education were also less likely to receive the MMR vaccination (Smith et al., 2008).

Wakefield et al. (1998) sparked opposition to the MMR vaccine with a since-retracted study linking MMR vaccination to late onset autism spectrum disorder and bow-

el disease. In 1998, when the article first came out, MMR vaccine refusal was at 8% (Smith et al., 2008). In 2000, the Wakefield et al. article received a lot of undue media attention, and vaccine refusal rose to 10%, the highest refusal rate between 1995-2004 (Dannetun et al., 2005). It is now established the study was flawed with falsified data (Rao & Andrade, 2011).

Adult Vaccine Uptake and Refusal

Raude et al. (2010) found that out of 275 people, the majority opting to receive a vaccine in France did so for self-protection at 45%, followed by protecting significant others at 28%. Bonfiglioli et al. (2013) found Italian health care workers received vaccines based on knowledge level and age. In contrast, Galarce et al. (2010) found that perceived vaccine safety was the best vaccine predictor.

Factors influencing decisions to vaccinate include socioeconomic status, knowledge of the vaccine, and family/friend influence (Evans et al., 2001; Larson et al., 2001; Topuzoglu et al., 2005). Topuzoglu et al. (2005) found the higher the socioeconomic status, the more likely individuals were to receive a vaccine. In British focus groups, beliefs regarding risks and benefits associated with vaccination, confidence and trust in their health care provider, media influence, and government policy all affected participants' vaccination choices (Evans et al., 2001). When parents were asked about factors that influenced them to vaccinate their children, media influence was second only to school requirements (Dorell et al., 2010). Larson et al. (2014) found social norms, peer influence, and the quality of participants' health knowledge to be influential.

In the past, when more people witnessed the consequences of infectious diseases, like smallpox and polio, vaccination was held at a higher standard (Ehreth, 2003). More recently, individuals have not perceived the risk these pathogens carry, and many choose not to vaccinate even with high infection rates (Ehreth, 2003). Other reasons for vaccine refusal include distrust in public health officials, fears of adverse side effects, and uncertainty regarding effectiveness (Galarce et al., 2010). When individuals choose to not receive a vaccine, they increase the chances of pathogens mutating and reduce the chances of eradicating infectious diseases by lowering herd immunity (Andre, 2003; Ehreth, 2003).

College Student Vaccine Uptake and Refusal

The University of Missouri surveyed 296 students about behaviors on the H1N1 vaccine and concluded vaccine efficacy followed by disease severity were most influential in receiving vaccines (Ravert et al., 2012). In a later study, it was found that among female college students, knowledge and perceived susceptibility had the biggest impact on vaccination decisions (You et al., 2020). Demographics, vaccine beliefs, and vaccine information had no clear influence on decisions, as multiple studies displayed mixed results (Evans et al., 2001; Larson et al., 2014; You et al., 2020).

Research Questions

After reviewing the literature surrounding vaccination, it is evident that more research needs to be collected on additional populations and motives, particularly during a mumps outbreak. There is limited information on college students and vaccinations, given that most of their vaccines are completed by the time they enter college. Recent literature focuses on what motivates parents to vaccinate their children and the effects of receiving a third MMR shot during an outbreak, rather than on what influences college-aged students as they decide whether to receive vaccinations. To understand the motivations behind college-aged students' vaccination decisions when they were confronted with an imminent threat, the current study asked the following research questions:

1. What were college students' motivations to receive/not receive a third MMR booster post-outbreak?

2. Does vaccine acceptance differ between individuals who did/would receive the vaccine and those who did/would not?

3. Do perceptions of the MMR vaccine differ between individuals who did/would receive the vaccine and those who did/would not?

Methodology

Study Design

An explanatory, cross-sectional study was conducted from September through October of 2019 using Qualtrics. The questionnaire evaluated undergraduates' perceptions and behaviors related to receiving the MMR vaccine during an outbreak through closed-ended questions. Students not present during the Spring 2018 mumps outbreak at JMU were assessed regarding their perceptions of a hypothetical outbreak.

Sampling

After being approved by JMU's Institutional Review Board, the online survey was distributed to all ~320 students enrolled in General Education Health courses. Participants in this convenience sample had a week to fill out the survey, and extra credit was offered for

participation. If participants did not want to complete the survey, extra credit was offered in the form of an alternative assignment.

Of the 243 surveys completed, 37.0% of participants (n = 90) were enrolled and 63.0% of participants (n = 153) were not enrolled at JMU during Spring 2018 when the mumps outbreak occurred. Over half the participants were freshmen (51.0%, n = 124), while 12.8% were sophomores (n = 31), 28.4% were juniors (n = 69), and 7.0% were seniors (n = 17). Two participants did not answer the question regarding their academic year. The majority of participants (63.0%, n = 153) were in a health-related major or minor, leaving 36.2% (n = 88) of participants with a non-health-related major or minor. Two participants did not answer the question regarding major. Individuals who identified as female accounted for 78.6% (n = 191) of responses, while individuals who identified as male accounted for 18.7% (n = 45) of responses. Individuals who identified as non-binary accounted for 0.8% (n = 2) of responses; 1.2% (n = 3) chose not to specify gender identity and .8% (n = 2) did not answer the question.

Instruments and Scoring

The questionnaire administered to all participants was drawn from three different instruments, with additional questions created by the researcher.

Attitudes

A 12-item Vaccine Attitude Examination Scale developed by Martin and Petrie (2017) measured attitudes of college students on vaccinations. This questionnaire was formatted as 12 Likert scale questions asking participants to rank how they feel about vaccinations. Scoring was completed by summing all responses (minimum = 12; maximum = 72). The first three questions employ reverse coding, with higher scores indicating a higher anti-vaccine attitude. Martin and Petrie (2017) tested for rest-retest reliability, reporting a Cronbach's alpha of 0.91 and an r value of 0.84.

Knowledge

An 11-item questionnaire developed by Zingg and Siegrist (2012) measured college-aged students' knowledge about vaccinations. The questionnaire was formatted as 11 multiple choice questions asking participants to identify what they believed regarding vaccination. A score of 1 was recorded for each correct response and a score of 0 for each incorrect or unknown response. Questions 1, 4, 5, 7, and 9 were reverse coded. The total score was computed by summing the number of correct responses, with higher scores indicating higher knowledge of vaccines. Zingg and Siegrist (2012) tested for test-retest reliability, reporting an r value of 0.70.

MMR Beliefs

A 20-item Measles, Mumps and Rubella Vaccination Survey developed by Hamilton-West in 2006 measured attitudes of college students specifically regarding the MMR vaccination. The survey was formatted as 20 Likert scale questions. Responses ranged from 1–5 with possible summed response scores ranging from 20–100. Questions 2, 4, 6, 8, 10, 12, 14, 16, 18, 19, and 20 were reverse coded, and all questions were summed, with higher scores indicating greater MMR acceptance. Hamilton-West (2006) reported a Cronbach's alpha of 0.7 for the scale.

Vaccination Reasons

The two questions developed were based on data collected by Raude et al. (2010), who reported on reasons why persons over the age of 16 received or did not receive vaccinations for H1N1 (e.g., self- protection, required by work, lack of time). These researcher-developed MMR-focused multiple choice questions asked participants to identify the primary reasons why they received or did not receive the MMR vaccination. Participants were directed to different versions of the questions based on whether they had the option to receive the vaccine in 2018.

Influences

A question developed by the researcher was based on Dorell et al. (2010), who in turn drew on the CDC's 2010 National Immunization Survey. The researcher-developed, MMR-focused multiple choice question asked participants to identify which factors influenced their decision to receive or not receive a vaccination (e.g., school requirements, TV/media, parents' attitudes, news coverage, religious influences). Participants were directed to an appropriate question on the questionnaire based on whether they had the option to receive the vaccine in 2018.

Results

Frequencies were analyzed to identify how much of the surveyed population fit into particular categories and were used to examine vaccination reasons and influences for survey participants who did or did not and would or would not receive a MMR vaccine. Frequencies were performed for gender, year in school, health-related major or minor, JMU enrollment status in Spring 2018, willingness to receive the vaccine, vaccine receipt, reasons enrolled participants did/did not get vaccinated, hypothetical reasons unenrolled participants would/would not get vaccinated. Descriptive statistical analysis was performed to identify a minimum, maximum, mean, and standard deviation for the Vaccine Knowledge scale, vaccine attitudes scale, and MMR Attitudes Scale.

Among enrolled students at the time of the outbreak, independent *t*-tests were run to compare vaccination attitudes, MMR vaccine acceptance, and MMR vaccine perceptions between students who did and did not receive the vaccine. Among students not enrolled during the outbreak, independent *t*-tests were run to compare vaccination attitudes, MMR vaccine acceptance, and MMR vaccine perceptions between students who believe they would or would not receive the vaccine in the event of an outbreak. A p value ≤ 0.05 was considered to be statistically significant for all tests.

Of the 153 participants not enrolled at JMU during the spring semester of 2018, 149 (97.4%) reported they would receive a booster MMR shot if an outbreak occurred and the booster shot was provided for free on JMU's campus. The main reason they would vaccinate was for self-protection (79.2%, n = 118), followed by trust in the vaccine/compliance with the recommendation (11.4%, n = 17), requirement of major, work, school (6.7%, n = 10), and protection of others (2.7%, n = 4; see Table 1). The four participants (2.6%) who said they would not receive the vaccine each identified different reasons for their choice: belief the vaccine is dangerous, belief they already had the disease, preference for alternative methods of prevention, and distrust of media and pharmaceuticals.

Of the 90 participants who were present at JMU in the spring of 2018, 88 answered the question about whether they received the MMR vaccine, and 84 were eligible to receive the vaccine. Only 39.3% of participants who were present and eligible to receive MMR actually received the vaccine (n = 33), and 60.7% participants (n = 51) eligible to receive the vaccine did not receive the vaccine. Those who chose to receive the vaccine did so primarily for self-protection (51.5%, n = 17), followed by a requirement by major, work or school (21.2%, n = 7) and trust in the vaccine (21.2%, n = 7) (see Table 1). Two participants (6.1%) received the vaccine for other reasons. Fifty-two participants did not receive the vaccine, with the most popular reason being they did not have time (59.6%, n = 31), followed by the belief they were not at risk of contracting the mumps (9.7%, n = 5), belief the vaccine is dangerous (1.7%, n = 1), preference for alternative method of prevention %, n = 1), and medical or lay recommendation against the vaccine (1.7%, n = 1). In the option for "other," nine participants either wrote "didn't care enough to get one," "fear of needles outweighs fear of mumps/death," or "my doctor recommended against getting the mumps booster" (17.3%, n = 9). Four participants claimed they were unaware of the outbreak or the location of vaccine clinics (7.8%, n = 4).

Table 1. *Reasons for Vaccine Uptake*

Group	Enrolled	Not Enrolled	Total
Self protection	17	118	135
Trust in the vaccine; compliance with recommendation	7	17	24
Required by work, major, or school	7	10	17
Protection of others	2	4	6
Total	33	149	182

The participants were knowledgeable about vaccines and vaccine use with a mean of 9.1 questions being answered correctly out of 11.0 (SD = 2.0). For vaccine attitudes, the mean was 31.9 out of a scale of 58.0 (SD = 11.2), indicating participants were somewhat accepting of vaccines. MMR attitudes had a mean of 69.7 out of a scale of 98.0 (SD = 10.6), indicating relatively high levels of vaccine acceptance. Independent *t*-tests were used to compare differences in vaccine attitudes, MMR attitudes, and vaccine knowledge by vaccine receipt or hypothetical receipt. Those who would receive the vaccine had lower scores on the vaccine attitudes scale (M = 32.0, SD = 10.1) than those who would not receive the vaccine (M = 53.0, SD = 6.4), $t(148) = -4.1$, $p < .001$, indicating more positive attitudes towards vaccines among those who would get vaccinated. Students who would get vaccinated had significantly higher scores on the MMR attitudes scale (M = 68.3, SD = 9.7) compared to students who would not get vaccinated (M = 52.3, SD = 4.5), $t(143) = 2.8$, $p < .01$, indicating more positive MMR attitudes among those who would receive the vaccine. Knowledge scores between

those who would and would not vaccinate could not be compared, as too few individuals who would not vaccinate did not complete the knowledge questionnaire.

Among students enrolled at JMU during the outbreak, those who received the vaccine had lower scores on the vaccine attitudes scale (M = 28.1, SD = 12.0) than those who would not receive the vaccine (M = 32.3, SD = 12.0), $t(85)$ = -1.6, p = 0.114, indicating more positive attitudes towards vaccines among those who received the vaccination; however, this difference was not significant. Vaccine Attitude Examination Scale results demonstrated students who vaccinated had significantly higher scores on the MMR attitudes scale (M = 77.6, SD = 11.5) compared to students who did not get vaccinated (M = 69.7, SD = 10.0), $t(77)$ = 3.2, p =.002, indicating more positive MMR attitudes among those who received the vaccine. Students who vaccinated had lower scores on the knowledge scale (M = 9.2, SD = 1.8) compared to students who did not get vaccinated (M = 9.5, SD = 1.4), $t(21)$ = -0.507, p = 0.617; however, this was not statistically significant. All scales and results are shown in Table 2.

For those enrolled at JMU during the outbreak, a chi-square test was run to determine if enrollment in a health-related major (e.g., Health Sciences, Dietetics, Nursing) had any influence on receiving a vaccine. There was no significant relationship in being enrolled in a health-related major when choosing to receive a vaccine (p = .518), suggesting that they were no more likely to get the vaccine than those enrolled in a different discipline. For those not enrolled during the outbreak, there was no statistical significance between students in different majors in their decisions to receive a vaccine (p = .655) (see Table 3). See Appendix for compiled results.

Table 3. *Chi Square of Major Compared to Vaccine Uptake for Students Both Enrolled and Unenrolled at Time of Vaccine Distribution.*

Group	Would/Did Receive Vaccine	Would Not/ Did Not Receive Vaccine	Total
Enrolled Health Major	27	5	29
Enrolled Non Health Major	44	10	54
Unenrolled Health Major	78	71	149
Unenrolled Non Health Major	2	2	4

Note. Enrolled = $\chi 2$ (88) = 0.072, p = 0.518; unenrolled = $\chi 2$ (153) = 0.009, p = 0.655.

Conclusion and Discussion

This study examined the relationships between general vaccine acceptance, MMR vaccine acceptance, vaccine knowledge, and intent to receive/receipt of the MMR among college-aged students. Participants said they would receive MMR boosters given a campus outbreak, but only 36.1% of the participants present at JMU during the outbreak received the vaccine when presented the opportunity. Attitudes were significantly different be-

Table 2. *Descriptive Statistics and Mean Differences*

	Enrolled *M* (*SD*)		Mean Difference	Not Enrolled *M* (*SD*)		Mean Difference
	Received Vaccine	No Vaccination		Would Vaccinate	Would Not Vaccinate	
Vaccine Attitudes Scale	28.1 (12.0)	32.3 (12.0)	4.2	32.0 (10.1)	53.0 (6.4)	21.0*
MMR Attitudes Scale	77.6 (11.5)	69.7 (10.0)	7.9*	68.3 (9.7)	52.3 (4.5)	16.0*
Knowledge Scale	9.2 (1.8)	9.5 (14)	0.3			

tween participants who were and were not enrolled during the outbreak; however, among those enrolled during the outbreak, MMR attitudes scores were similar, if not higher, than the non-enrolled group, but uptake of vaccination was low. When asked why they did not receive the vaccine, 59.6% of eligible participants present at JMU during the outbreak cited lack of time as the main reason. Of the individuals who received the vaccine, most did so for self-protection, which supports the findings from the Raude et al. (2010) study. The attitude scale of vaccines demonstrated the overall population was accepting of vaccines. While attitudes were more positive among those who received the vaccine, it seemed it is not enough to persuade an individual to vaccinate. Vaccine attitudes were slightly higher among those who vaccinated in the enrolled group compared to those who would vaccinate in the unenrolled group; however, the proportion who actually vaccinated was substantially less than those who said they would.

Interestingly, participants in a health-related major were no more likely than other majors to receive a vaccine. Few studies can be found regarding if this is common or unique to JMU; however, a study researching vaccine acceptance of the Dengue vaccine found farmers were more likely to receive a vaccine than employees with private employment and entrepreneurs (Harapan et al., 2016). Another study focused on the uptake of a hypothetical Ebola virus vaccine and found socioeconomic status (including occupation) was not consistent in determining vaccine uptake (Harapan et al., 2017). They found multiple variables affecting vaccine uptake decisions (Harapan et al., 2017). In addition to vaccine uptake being similar in non-health majors, the vaccine knowledge scale was lower for students in a health-related major than those who were not. This relatively low number is surprising as students enrolled in health-related majors are learning about vaccines and would be expected to know more about their importance and effects. The finding further suggests knowledge and exposure to information on vaccine effects do not spur action. Several studies were found relating to knowledge and vaccine uptake but were focused on health care professionals and medical students who were likely required to receive the vaccine by their program or work, making these studies inapplicable (Haridi et al., 2017; Looijmans-van den Akker et al., 2009).

While several studies have found vaccine knowledge plays an important role in uptake, apathy has been noted as a concern. A study using focus groups of college-aged males regarding the HPV vaccine found the males were dismissive, apathetic, and lacked awareness/knowledge of the vaccine, leading to a decreased uptake (Stanley et al., 2018). The difference in male versus female uptake was not looked at in the current study due to the disproportionate response rate regarding gender identity. Apathy has also been shown to play a role in low uptake of flu vaccines (Canning et al., 2005). In the current study, young, legally independent adults were dismissive toward the MMR vaccine, as they did not make time for it. More education and efforts are needed to increase the uptake in vaccines in this population. Previous studies on increasing vaccine uptake found healthcare professionals' opinions/recommendations have little impact while parental attitudes and knowledge have the most impact (Carter & Jones, 1985; Blyth et al., 2014).

Limitations

This study is not generalizable to other settings due to the small sample size and convenience sampling, with survey recipients drawn exclusively from Health 100 courses that count toward both a General Education requirement and the Health Sciences major. Obtaining a proportionate sample of students enrolled at JMU during the Spring 2018 semester was a limitation that may have decreased the significance and accuracy of the results. The survey had a higher percentage of female respondents in comparison to male respondents (78.6% female vs. 18.7% male), but JMU has more female students enrolled (58%) than males (42%) (James Madison University, 2020). Another major limitation in the study was including participants who were not enrolled at JMU during the time of the outbreak, limiting data collection to vaccine intentions only. A larger sample size of students who were enrolled during the outbreak would have increased the accuracy of the results. There is also the concern of recall bias, as the outbreak occurred two years before the survey was administered.

Suggestions for Future Research

Further research needs to be conducted at other universities in the United States where a vaccine can prevent the progression of disease outbreak. Future studies should use larger sample sizes to increase generalizability and measure attitudes using the Health Belief Model, which was developed to explain and predict health-related behaviors typically related to health services. Future research is need to develop and assess methods of decreasing student indifference toward vaccines and increasing uptake. On a college campus, vaccine uptake can increase by expanding clinic hours to accommodate classes schedules, allowing excused absences if students are scheduled for a vaccine, increased encouragement and education from professors and staff about the vaccine, clinics in more accessible areas, and more vaccination locations rather than just one.

Author's Note

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Laura A. Keane ('20) graduated magna cum laude with a degree in Health Sciences and minors in Biology, Pre-Physician Assistant, and Honors Interdisciplinary Studies. She is currently in the Physician Assistant Master's Program at James Madison University and will graduate in December 2022. Laura is grateful to Dr. Sarah Blackstone and the Honors College for all the guidance, advice, and encouragement. She would also like to thank the *JMURJ* Editorial Board for their dedication and support throughout the publication process.

References

Andre, F. E. (2003). Vaccinology: Past achievements, present roadblocks and future promises. *Vaccine, 21*(7-8), 593-595. https://doi.org/10.1016/S0264-410X(02)00702-8

Blyth, C. C., Richmond P. C., Jacoby, P., Thornton, P., Regan, A., Robins C., Kelly, H., Smith, D. W., & Effler, P. V. (2014). The impact of pandemic A(H1N1)pdm09 influenza and vaccine-associated adverse events on parental attitudes and influenza vaccine uptake in young children. *Vaccine, 32*, 4075-4081. https://doi.org/10.1016/j.vaccine.2014.05.055

Bonfiglioli, R., Vignoli, M., Guglielmi, D., Depolo, M., & Violante, F. S. (2013). Getting vaccinated or not getting vaccinated? Different reasons for getting vaccinated against seasonal or pandemic influenza. *BioMed Central, 13*(1), Article 1221. https://doi.org/10.1186/1471-2458-13-1221

Canning, H. S., Phillips, J., & Allsup, S. (2005). Health care worker beliefs about influenza vaccine and reasons for non-vaccination—A cross-sectional survey. *Journal of Clinical Nursing, 14*(8), 922-925. https://doi.org/10.1111/j.1365-2702.2005.01190.x

Carter, H., & Jones, I. G. (1985). Measles immunisation: Results of a local programme to increase vaccine uptake. *British Medical Journal, 290*(6483), 1717-1719. https://doi.org/10.1136/bmj.290.6483.1717

Centers for Disease Control and Prevention. (2018a). *Immunization.* https://www.cdc.gov/nchs/fastats/immunize.html

Centers for Disease Control and Prevention. (2018b). *1995 through 2017 childhood measles, mumps, and rubella (MMR) vaccination coverage trend report.* https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/mmr/trend/index.html

Centers for Disease Control and Prevention. (2019a). *Complications of mumps.* https://www.cdc.gov/mumps/about/complications.html

Centers for Disease Control and Prevention. (2019b). *Mumps vaccination.* https://www.cdc.gov/mumps/vaccination.html

Centers for Disease Control and Prevention. (2019c). *Signs & symptoms of mumps.* https://www.cdc.gov/mumps/about/signs-symptoms.html

Centers for Disease Control and Prevention. (2019d). *Transmission of mumps.* https://www.cdc.gov/mumps/about/transmission.html

Centers for Disease Control and Prevention. (2020a). *Measles, mumps, rubella (MMR) vaccine.* https://www.cdc.gov/vaccinesafety/vaccines/mmr-vaccine.html

Centers for Disease Control and Prevention. (2020b). Table 1. *Recommended child and adolescent immunization schedule for ages 18 years or younger*, United States, 2020. https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html

Code of Virginia. (n.d.-a). § 23.1-800. *Health histories and immunizations required; exemptions.* https://law.lis.virginia.gov/vacode/title23.1/chapter8/section23.1-800/

Code of Virginia. (n.d.-b). § 22.1-271.2. *Immunization requirements.* https://law.lis.virginia.gov/vacode/22.1-271.2/

Dannetun, E., Tegnell, A., Hermansson, G., & Giesecke, J. (2005). Parents' reported reasons for avoiding MMR vaccination. *Scandinavian Journal of Primary Health Care, 23*(3), 149-153. https://doi.org/10.1080/02813430510031306

Dorell, C., Yankey, D., Kennedy, A., & Stokley, S. (2010). Factors that influence parental vaccination decisions for adolescents, 13 to 17 years old: National immunization survey—Teen, 2010. *Clinical Pediatrics, 52*(2), 162-170. https://doi.org/10.1177/0009922812468208

Ehreth, J. (2003). The global value of vaccination. *Vaccine, 21*(7-8), 596-600. https://doi.org/10.1016/S0264-410X(02)00623-0

Evans, M., Stoddart, H., Condon, L., Freeman, E., Grizzell, M., & Mullen, R. (2001). Parents' perspectives on the

MMR immunisation: A focus group study. *British Journal of General Practice, 51*(472), 904-910. https://bjgp.org/content/51/472/904

Galarce, E. M., Minsky, S., & Viswanath, K. (2010). Socioeconomic status, demographics, beliefs and A(H1N1) vaccine uptake in the United States. *Vaccine, 29*(32), 5284-5289. https://doi.org/10.1016/j.vaccine.2011.05.014

Hamilton-West, K. (2006). Factors influencing MMR vaccination decisions following a mumps outbreak on a university campus. *Vaccine, 24*(24), 5183-5191. https://doi.org/10.1016/j.vaccine.2006.03.084

Harapan H., Anwar, S., Ferdian, M. N., Salwiyadi, S., Imanda, A. S., Azhars, R., Fika, D. F., Ilham, D., Timur, A. U., Sahputri, J., Maulana, R., Kurniawan, H., & Ughasoro, M. D. (2017). Public acceptance of a hypothetical Ebola virus vaccine in Aceh, Indonesia: A hospital-based survey. *Asian Pacific Journal of Tropical Disease, 7*(4), 193-198. https://doi.org.10.12980/apjtd.7.2017D6-386

Harapan, H., Anwar, S., Setiawan, A. M., & Sasmono, R. T. (2016). Dengue vaccine acceptance and associated factors in Indonesia: A community-based cross-sectional survey in Aceh. *Vaccine, 34*(32), 3670-3675. https://doi.org/10.1016/j.vaccine.2016.05.026

Haridi, H. K., Salman, K. A., Basaif, E. A., & Al-Skaibia, D. K. (2017). Influenza vaccine uptake, determinants, motivators, and barriers of the vaccine receipt among healthcare workers in a tertiary care hospital in Saudi Arabia. *Journal of Hospital Infection, 96*(3), 268–275. https://doi.org/10.1016/j.jhin.2017.02.005

Immunization Action Coalition. (2019). *State information: MMR vaccine mandates for child care and K-12.* https://www.immunize.org/laws/mmr.asp

James Madison University. (2020). *James Madison University: Facts and figures.* https://www.jmu.edu/about/fact-and-figures.shtml

Larson, H. J., Jarrett, H., Eckersberger, E., Smith, D. M. D., & Paterson, P. (2014). Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: A systematic review of published literature, 2007–2012. *Vaccine, 32*(19), 2150-2159. https://doi.org/10.1016/j.vaccine.2014.01.081

Looijmans-van den Akker, I., van Delden, J. J. M., Verheij, T. J. M., van Essen, G. A, van der Sande, M. A. B., Hulscher, M. E., & Hak, E. (2009). Which determinants should be targeted to increase influenza vaccination uptake among health care workers in nursing homes? *Vaccine, 27*(34), 4724–4730. https://doi.org/10.1016/j.vaccine.2009.05.013

Martin, L. R., & Petrie, K. J. (2017). Understanding the dimensions of anti-vaccination attitudes: the Vaccination Attitudes Examination (VAX) scale. *The Society of Behavioral Medicine, 51*(5), 652-660. https://doi.org/10.1007/s12160-017-9888-y

Marlow, M., Even, S., Hoban, M. T., Moore, K., Patel, M., & Marin, M. (2019). Universities' experience with mumps outbreak response and use of a third dose of MMR vaccine. *Journal of American College Health.* https://doi.org/10.1080/07448481.2019.1651730

National Conference of State Legislation. (2019, January 30). *States with religious and philosophical exemptions from school immunization requirements.* http://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx

Nelson, G. E., Aguon, A., Valencia, E., Oliva, R., Guerrero, M. L., Reyes, R., Lizama, A., Diras, D., Mathew, A., Camacho, E. J., Monforte, M.-N., Chen, T.-H., Mahamud, A., Kutty, P. K., Hickman, C., Bellini, W. J., Seward, J. F., Gallagher, K., & Fiebelkorn, A. P. (2013). Epidemiology of a mumps outbreak in a highly vaccinated island population and use of a third dose of measles-mumps-rubella vaccine for outbreak control—Guam 2009 to 2010. *Pediatric Infectious Disease Journal, 32*(4), 374-380. https://doi.org/10.1097/INF.0b013e318279f593

Ogbuanu, I. U., Kutty, P. K., Hudson, J. M, Blog, D., Abedi, G. R., Goodell, S., Lawler, J., McLean, H. Q., Pollock, L., Rausch-Phung, E. Schulte, C., Valure, B., Armstrong, G. L., & Gallagher, K. (2012). Impact of a third dose of measles-mumps-rubella vaccine on a mumps outbreak. *Pediatrics, 130*(6), e1567-e1574. https://doi.org/10.1542/peds.2012-0177

Poland, G. A., & Jacobson, R. M. (2001). Understanding those who don't understand: A brief review of the anti-vaccine movement. *Vaccine, 19*(17-19), 2440-2445. https://doi.org/10.1016/S0264-410X(00)00469-2

Rao, T. S., & Andrade, C. (2011). The MMR vaccine and autism: Sensation, refutation, retraction, and fraud. *Indian Journal of Psychiatry, 53*(2), 95–96. https://doi.org10.4103/0019-5545.82529

Raude, J., Caille-Brillet, A.-L., & Setbon, M. (2010). The 2009 pandemic H1N1 influenza vaccination in France: Who accepted to receive the vaccine and why? *Plos Cur-*

rents, 2, Article RRN1188. https://doi.org/10.1371/currents.RRN1188

Ravert, R. D., Fu, L. Y., & Zimet, G. D. (2012). Reasons for low pandemic H1N1 2009 vaccine acceptance within a college sample. *Advances in Preventive Medicine, 2012,* Article 242518. https://doi.org/10.1155/2012/242518

Smith, M. J., Ellenberg, S. S., Bell, L. M., & Rubin, D. M. (2008). Media coverage of the measles-mumps-rubella vaccine and autism controversy and its relationship to MMR immunization rates in the United States. *Pediatrics, 121*(4), 836-e843. https://doi.org/10.1542/peds.2007-1760

Stanley, S. J., Kim, S., & Pitts, M. J. (2018). Gender norms and discourses informing college men's perceptions of heteronormative sexual health responsibilities and HPV prevention. *Communication Quarterly, 66*(3), 225-244. https://doi.org/10.1080/01463373.2017.1356338

Topuzoglu, A., Ozaydin, G. A., Cali, S., Cebeci, D., Kalaca, S., & Harmanci, H. (2005). Assessment of sociodemographic factors and socio-economic status affecting the coverage of compulsory and private immunization services in Istanbul, Turkey. *Public Health, 119*(10), 862-869. https://doi.org/10.1016/j.puhe.2005.01.015

Virginia Department of Health. (2020). *School requirements: School and day care minimum immunization requirements.*http://www.vdh.virginia.gov/immunization/requirements/

Wakefield, A. J., Murch, S. H., Anthony, A., Linnell, J., Casson, D. M., Malik, M., Berelowitz, M., Dhillon, A. P., Thomson, M. A., Harvey, P., Valentine, A., Davies, S. E., & Walker-Smith, J. A. (1998). Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *The Lancet, 351*(9103), 637-641. https://doi.org/10.1016/S0140-6736(97)11096-0

Wyatt, B. (2018, April 10). Additional mumps vaccination recommended. *James Madison University News*. https://www.jmu.edu/news/2018/04/10-mumps-updates.html

You D., Han L., Li L., Hu J., Zimet G. D., Alias H., Danaee, M., Cai, L., Zeng, F., & Wong, L. P. (2020). Human papillomavirus (HPV) vaccine uptake and the willingness to receive the HPV vaccination among female college students in China: A multicenter study. *Vaccine, 8*(1). https://doi.org/10.3390/vaccines8010031

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

Appendix. *Compiled Results*

Variable	Test	Enrolled at Outbreak	Hypothetical Scenario
Vaccination Reason	Descriptive Statistics	39.7% received the vaccine 60.3% did not receive the vaccine	97.4% said would receive the vaccine if offered 2.6% said would not receive the vaccine
Influences	Descriptive Statistics	Vaccinated reasons: Self-protection: 51.5%, Requirement of major, work, school: 21.2%, Trust in the vaccine: 21.2%, Other: 6.1% Not vaccinated reasons: Did not have time: 55.4%, Belief not at risk of contracting: 8.9%, Belief vaccine is dangerous: 1.8%, Preference for alternative method of prevention: 1.8%, Medical or lay recommendation against the vaccine: 1.8%	Vaccinated reasons: Self-protection: 79.2%, Trust in vaccine/compliance in the recommendation: 11.4%, Requirement of major, work, school: 6.7%, Protection of others: 2.7% Not vaccinated reasons: Belief the vaccine is dangerous: 25%, Belief they already had the disease: 25%, Preference for alternative method of prevention: 25%, Distrust of media, pharmaceuticals: 25%
Attitude	Independent *t*-test	Those who received the vaccine had lower scores (M = 28.1, SD = 12.0) than those who would not receive the vaccine (M = 32.3, SD = 12.0), $t(85)$ = -1.6, p = 0.114	Those who would receive the vaccine had lower scores (M = 32.0, SD = 10.1) than those who would not receive the vaccine (M = 53.0, SD = 6.4), $t(148)$ = -4.1, p < .001
Knowledge	Independent *t*-test	Students who vaccinated had lower scores (M = 9.2, SD = 1.8) than students who did not get vaccinated (M = 9.5, SD = 1.4), $t(21)$ = -0.507, p = 0.617	Too few respondents
MMR Beliefs	Independent *t*-test	Students who vaccinated had higher scores (M = 77.6, SD = 11.5) than students who did not get vaccinated (M = 69.7, SD = 10.0), $t(77)$ = 3.2, p =.002	Those who would get vaccinated had higher scores on the MMR attitudes scale (M = 68.3, SD = 9.7) compared to students who would not get vaccinated (M = 52.3, SD = 4.5), $t(143)$ = 2.8, p < .01