Published in final edited form as:

J Community Health. 2021 February ; 46(1): 13–21. doi:10.1007/s10900-020-00833-9.

Young Adult Human Papillomavirus and Influenza Vaccine Coverage: A Comparison Across College Enrollment Status

Kara Mathewson¹, Maria Sundaram¹, Robert A. Bednarczyk^{1,2,3}

¹Rollins School of Public Health, CNR 7019, Emory University, 1518 Clifton Rd NE, Atlanta, GA 30322, USA

²Cancer Prevention and Control Program, Winship Cancer Institute, Emory University, 1365-C Clifton Road NE, Atlanta, GA, USA

³Emory Vaccine Center, Emory University, 954 Gatewood Road, Atlanta, GA, USA

Abstract

To determine human papillomavirus and influenza vaccine coverage among young adults in the US and assess differences in vaccine uptake by college enrollment status, we conducted an online survey of young adults aged 18–26 ($n = 417$) using Survey Monkey, with recruitment occurring through Amazon’s Mechanical Turk (MTurk) platform. We collected data on self-reported preventive health behaviors, including vaccine receipt, current college enrollment status, and other demographics. Overall, 49% of participants reported receiving at least one dose of human papillomavirus vaccine and 57% reported receiving at least one influenza vaccine over the past three years. Vaccine coverage estimates did not differ between college-enrolled and non-enrolled respondents. Low vaccine coverage rates demonstrate the need to improve vaccine strategies for young adults. The strongest predictor of vaccine receipt was having received a provider recommendation. There does not appear to be healthcare utilization differences related to ability to access care through student health or community-based settings. Additional research is needed to develop interventions to improve vaccination coverage among young adults, both currently enrolled and not enrolled in college.

Keywords

Young adults; College enrollment; Vaccination; Community health

The transition from adolescence to young adulthood is marked by a greater level of independence and a new role in health-related decision-making [1]. This is an important time period for preventive care measures recommended for this age group—such as vaccinations—as well as forming lifelong behaviors and attitudes regarding preventive care. Young adults aged 18–26 make up about 12.5% of the US population [2], and are generally worse off in terms of health status and behavior, risk perceptions, and access to care compared to adolescents and adults aged 26–34 [3]. Despite the importance of preventive care among young adults, preventive service use is low, including vaccine coverage.

Vaccine coverage for young adults aged 18–26 is low. The 2013 National Health Interview Survey found that only 25% of those aged 18–24 reported receiving the flu shot [4]. Another study found that only 17% of young adults aged 18–26 reported receiving a flu shot [5]. Flu vaccine coverage among this group remains low, especially in comparison with the tetanus vaccine. Between 63–74% of those aged 18–24 reported having received a tetanus vaccination in the past 10 years [4]. HPV vaccine is also recommended for young adults through age 26, however, in 2018, only 53.6% of females and 27% of males aged 18–26 reported having received at least one dose of HPV vaccine [6]. Prior studies of HPV vaccine uptake among college-aged students have documented coverage of at least one dose ranging from 25 to 61.5% [7–11].

Young adults aged 18–26 are not a homogenous group. One of the major splits within this group is post-secondary education enrollment status. In 2013, approximately 40% of young adults aged 18–24 were enrolled in post-secondary education [12]. These different sub-groups have implications for preventive care including vaccinations, especially in terms of access. College enrolled young adults may have varied access depending on whether their college has a student health center; however, there has not been a large-scale analysis comparing vaccination coverage by college enrolled and non-enrolled young adults. To address this, we conducted a survey among young adults aged 18–26 living in the United States, with a primary goal to assess differences in HPV and influenza vaccine uptake by current college enrollment status.

Methods

Study Sample

Between November 2017 and December 2017, we conducted a cross-sectional survey of young adults, aged 18–26, on preventive health care perceptions and behaviors. Emory University's institutional review board approved the protocols for this study.

Participants were recruited from Amazon's Mechanical Turk (MTurk), an online platform where individuals are paid to complete online surveys [13]. Eligible participants were young adults aged 18–26 who resided in the United States and had a Human Intelligence Task (HIT) approval rate greater than or equal to 95% for all MTurk work. An MTurk worker's HIT approval rate indexes the percentage of tasks that are approved by requesters relative to the number of tasks completed by the worker. It is a rating that allows researchers to know a worker's past performance on other surveys and tasks. The purpose of using this type of qualification is to try to ensure that the responses will be reliable and credible [14].

Once MTurk workers accepted the task on the MTurk website, they were provided a link to the survey on Survey Monkey where they were asked two screening questions (country of residence and age) to assess eligibility. If the worker was eligible to continue, they were directed to a consent page that informed them of their rights as a participant in the study and provided them with contact information if they had questions or concerns about the study. Participants who consented to participate indicated consent electronically, and record of consent provision was recorded. We compensated all individuals who completed the two

screeners questions \$0.05 and eligible participants who also completed the survey received an additional \$1.25.

Survey

An online, anonymous survey was developed using Survey-Monkey (SurveyMonkey, Inc.). There were 66 questions on the survey that assessed participants' preventive health care perceptions and behaviors, including questions to assess vaccine confidence. The survey consisted of several sections: Health Care Utilization [15], Preventive Care, Vaccine Confidence Measures [16], Risk Perceptions, Present Bias [17], Information Seeking, and Social Media [15]. The survey contained multiple choice questions, some of which were multiple-part questions. For the purpose of this study, we focused on self-reported vaccine coverage and vaccine confidence.

The primary exposure of interest for this analysis was enrollment in post-secondary education. If participants indicated current enrollment in post-secondary education, they were directed to a question about type of school (i.e. 2-year college, vocational training, 4 year college/university, graduate school).

The main outcome measures were self-reported HPV and influenza vaccination status. For HPV vaccine coverage, the outcome of interest was initiation of the HPV vaccine series. Self-reported coverage of the HPV vaccine was assessed without distinction between the bivalent, quadrivalent, and 9-valent vaccines. If participants reported that they received any dose of the HPV vaccine, they were asked follow-up questions regarding age of series initiation and number of doses they had received. Participants were also asked to report how many times they had received an influenza vaccine during the past three years. For the purpose of this analysis we looked at influenza vaccine coverage as a dichotomous variable, categorized into those who received at least one dose of influenza vaccine in the past three years and those who received no doses of influenza vaccine in the past three years.

Statistical Analysis

Data were downloaded into Microsoft Excel and imported into SAS v9.4 (The SAS Institute, Cary NC) for data management and analysis. Descriptive statistics were computed to assess distributions and frequencies. We assessed HPV and influenza vaccine coverage by college enrollment status and demographic variables using prevalence ratios (PR) with 95% confidence intervals. We also modeled coverage of HPV vaccine and influenza vaccine using a modified Poisson regression approach to identify contributing demographic variables while controlling for other factors [18, 19]. An initial list of variables that were hypothesized to be associated with vaccine receipt were modeled using a backward elimination strategy. We have presented two models-one containing all covariates initially hypothesized for inclusion ('fully adjusted model') and one containing only those covariates retained after backward elimination model building ('reduced model'). Additionally, we calculated vaccine confidence measures and assessed differences by college enrollment status and vaccine receipt. We assessed confidence using adapted questions from the Parent Attitudes about Childhood Vaccines (PACV) survey short scale [20]. In this survey, individuals answer "yes", "no", or "I don't know" to prompts like: "I trust the information I receive about

shots.” High-confidence answers are given 0 points, don’t-know answers given 1, and low-confidence answers given two points. The points are then summed across 5 questions. Individuals scoring 0–4 are considered to have low hesitance; individuals with scores 5–6 considered to have medium hesitance; and individuals with scores 7–10 considered to have high hesitance.

Results

Study Sample

From November to December 2017, 2000 MTurk workers followed our Survey Monkey link and completed the first screener question. 1494 individuals were ineligible for the study, and of the remaining 506 eligible individuals, 82% (n = 417) completed at least half of the survey questionnaire. These 417 participants were the final sample included in the analysis. Of our final sample, 49% were enrolled in post-secondary education (n = 205). Those enrolled in post-secondary education were primarily enrolled in 4-year colleges and universities (53%) and 2-year colleges (25%). The remainder indicated that they were enrolled in graduate school (17%) and technical or vocational training (5%). Approximately 70% of the respondents were female (n = 290). Respondents were predominantly white and non-Hispanic and the mean age for respondents was 23 years old (Table 1).

HPV Vaccine Coverage

Of the 417 participants, 49% of participants reported ever receiving at least one dose of HPV vaccine. HPV vaccine coverage was slightly higher among college-enrolled participants (52%) than non-enrolled participants (46%), though this difference was not statistically significant (aPR 1.00, 95% CI 0.87, 1.15) (Table 2). A higher percent of females reported receiving at least one dose of HPV vaccine (59%) compared to males (25%). Among those who reported receiving HPV vaccine, young adults not currently enrolled in college were more likely to report receiving three doses of vaccine (48% of those not enrolled in college compared to 41% of those enrolled) but also more likely to have only received one HPV vaccine dose (25% of those not enrolled in college compared to 19% of those enrolled). Notably, young adults enrolled in college were more likely to not know how many doses they received (21% of those enrolled in college compared to 14% of those not enrolled in college).

Influenza Vaccine Coverage

Of the 417 participants, 57% reported that they had received at least one dose of influenza vaccine in the past three years. College-enrolled participants (62%) had higher coverage for receipt of at least one influenza vaccine than non-college-enrolled participants (53%); however, this difference was not significant (aPR 1.15, 95% CI 0.98, 1.35) (Table 3). Of those who received at least one influenza vaccine in the past three years, 39% reported receiving an influenza vaccine three times, 29% reported receiving it two times, and 32% reported only receiving the vaccine once (Tables 4, 5).

Provider Impact

Participants who received a provider recommendation for HPV vaccine were more likely to receive at least one dose of HPV vaccine, when adjusting for other factors (aPR 8.57, 95% 5.44, 13.52) (Table 2). A similar association was documented for the influenza vaccine (aPR 2.99, 95% CI 1.98, 4.54) (Table 3). In these analyses, provider recommendations for both the influenza and HPV vaccines were the only statistically significant predictor for receiving either vaccine. In addition to having a provider recommendation, participants who indicated that they had a primary care doctor were more likely to have received the influenza vaccine in the past three years (aPR 1.32, 95% CI 1.06, 1.63) (Table 3).

Vaccine Confidence

Vaccine confidence was also assessed. Seven respondents were excluded in this analysis due to incompleteness of these survey questions ($n = 410$). Overall, college enrolled young adults had lower vaccine hesitancy (67% low hesitancy) than non-enrolled young adults (59% low hesitancy) (Table 4). There were also differences in vaccine receipt between college enrolled and non-enrolled young adults by PACV category. Of participants who indicated high hesitancy, those who were college enrolled were more likely to have reported receiving the influenza vaccine (63%) than non-enrolled participants (46%), however this was not statistically significant.

Comment

This study identified low coverage with HPV vaccine (49%) and influenza vaccine (57%) among young adults aged 18–26 in the United States. These rates differ slightly from those reported in the ACHA National College Assessment (61.5% for HPV vaccine and 51.1% for influenza vaccine) [11] and are lower than the Healthy People 2020 goal of 80% for both the HPV and influenza vaccines. These results did not indicate a significant difference of HPV or influenza vaccine coverage for young adults enrolled in post-secondary education compared to those not enrolled.

Although vaccine coverage with HPV and influenza vaccines did not significantly differ between college enrolled young adults and non-enrolled young adults, these low coverage rates demonstrate the need to improve vaccine strategies for this group. HPV is easily transmitted through skin-to-skin contact, which is a common mode of transmission among young adults due to increased sexual activity in this population [21, 22]. Lyons et al. (2015) found that 40% of young adults age 22 reported having at least one recent casual sex partner [22]. With about half of the 14 million new HPV infections that occur in the U.S. each year occurring in people aged 15–24 years [23], there is a need to improve HPV vaccine uptake and catch-up vaccination in emerging young adults.

Influenza is an often-overlooked disease in younger adults; although influenza is usually perceived to be a high-risk disease for older adults and younger children, it does cause serious disease in young adults [24]. During the 2017–2018 influenza season, approximately 22% of influenza-positive patients were aged 5–24 years [25]. However, young adults seem to have a low perception of influenza risk which influences decisions to receive influenza

vaccine. An analysis of the National Flu Survey data from 2011 to 2012 found that the most common reasons cited for not receiving influenza vaccine were the perceptions that they were “unlikely to get very sick from the flu” and “never get the flu” [26]. In a study looking at influenza vaccine uptake at a large public university, the most common reasons for not receiving influenza vaccine were, “too lazy to bother getting it” and “don’t need it because I’m healthy” [27]. These studies indicate that young adults, enrolled in college or not, may not understand the risk of transmission of influenza even when someone is asymptomatic. Furthermore, young adults in college settings may be at higher risk to transmit influenza due to close contact between students. If unvaccinated, they also risk exposing older adults and younger children when they travel home for holidays. This further highlights the need to improve coverage of influenza vaccine among this group.

The results from this study also confirm the existing gap in HPV coverage between males and females. In a 2015 study at a public university in California, HPV vaccine coverage among college males aged 18–26 was only 12% [28]. Despite improved coverage over the past few years, this has been a slow increase. This disparity between males and females points to the need for interventions that target the differing needs of these sub-groups, including differences in discussions about vaccination during primary care visits. Furthermore, interventions to close the HPV vaccine coverage gap between males and females should consider framing messages towards males in order to reduce the burden of HPV cancers and diseases. Dillard and Spear (2010) and Ratanasiripoing (2015) found that HPV and HPV vaccine knowledge among college students is lacking [28, 29]. This provides evidence that future interventions must also address knowledge gaps surrounding HPV infection and vaccination.

In this study, we found that provider recommendation was associated with receipt of vaccinations. This is consistent with previous findings that demonstrate that a provider recommendation is strongly associated with preventive care service receipt, including vaccination [30, 31]. However, strong, consistent recommendations for vaccinations are not always given, especially for HPV vaccine [32]. In addition to the need for better understanding healthcare seeking behaviors among young adults, all healthcare professionals should take advantage of every patient visit to provide patients with recommended vaccines or refer them to providers who can offer the vaccines to minimize missed opportunities.

Both having a primary care doctor and a provider recommendation were associated with influenza vaccine receipt. This study did not assess differences in access to primary care providers between college enrolled and non-enrolled young adults. However, avenues to care are an important consideration for improving vaccine coverage in these populations. The Affordable Care Act’s (ACA) expanded coverage has increased private insurance coverage for young adults with coverage gains being larger among nonstudents than students [33]. However, college-enrolled students are more likely to be covered under their parents’ insurance and benefit the most from this policy [34]. Differences in insurance coverage impact young adults’ access to care. Additionally, college-enrolled and non-enrolled young adults may have different health care facilities available to them. College students may have access to student health centers, but the services offered by these facilities vary from school to school. On the other hand, college students covered by their parents’ insurance may face

logistical barriers to receiving care if they attend school away from home. There is a need to develop tailored messages, designed to address differences in health care access, to promote vaccination among young adults.

HPV and influenza vaccinations are offered through multiple venues in the US, including primary care physicians, student health services, pharmacies, and local health departments. Given the current requirement for individuals to have health insurance coverage in the Affordable Care Act, coupled with requirements for insurance coverage of immunizations without cost-sharing, cost should not be a limitation to vaccine receipt. However, vaccination in the US, particularly for young adults, may have other logistical issues, including lack of primary care visits, lack of widespread immunization outreach activities, and fragmented reporting of immunization coverage through state-level immunization information systems. Our findings provide a point of comparison for future studies to assess young adult vaccination, particularly with regard to access through student health services programs.

The results of this study also indicate some differences in vaccine hesitancy between college enrolled and non-enrolled young adults. Level of education is a factor that may be associated with vaccine confidence; however, studies show conflicting effects. Several studies show that adults with less formal education have more concerns about vaccine safety [35, 36], which can influence vaccine confidence. On the other hand, in a study by Opel et al., parents with higher levels of education were more likely to be concerned about the safety of vaccines than those with lower levels of education [37]. There is a need to further investigate how post-secondary institutions may affect decisions about vaccination.

Limitations

A limitation of this study includes the relatively small sample due to time restrictions of the study. In addition to this, the sample was predominantly female (70%) and therefore the small sample of males may impact the power of these analyses. This gender difference is a limitation in the use of MTurk. However, this platform has been validated against other reliable data sources and shown to provide high-quality data [13]. Studies have shown that populations accessed through MTurk are at least as representative to the U.S. population as traditional subject pools [13, 38–40]. Self-reported data on preventive health care utilization, including vaccine history, is another limitation. Self-reported vaccination status is subject to recall bias [41]. Furthermore, this analysis did not explain the reasons for receipt or nonreceipt of vaccinations. To create intervention strategies to increase vaccine uptake in these populations, future studies must understand the reasons for vaccine nonreceipt.

This study did not assess the difference of college-enrolled vaccination coverage based on characteristics of colleges and universities, but these characteristics are likely an important consideration for evaluating access to care for this population and should be further investigated. For example, it has been shown that private schools have higher rates of health care utilization than public schools [42]. To improve vaccine coverage and other preventive care service utilization among young adults, we need to gain a better understanding about how and where these populations access primary care and preventive services.

Not assessing temporality between recommendation and receipt of vaccination is another important limitation to address. 60% of respondents reported that they had received a recommendation for HPV vaccine and nearly 80% received a recommendation for influenza vaccine. However, uptake remains low in this population. A frequently cited reason for not intending to receive HPV vaccination is the concern about vaccine costs and insurance coverage [43, 44]. Providers must address access options and affordability when recommending preventive services to young adults, especially for HPV vaccination.

In contrast, concerns about cost have not been as commonly cited in regard to influenza vaccination. Findings from a study at a large public university showed that almost one third of students surveyed said they were “too lazy to bother getting it [influenza vaccine].” [27] To address this barrier, influenza vaccination campaigns on college campuses need to be more easily accessible. Schools should consider vaccinating students in common gathering spaces, where large numbers of students visit daily. During a 2016 outbreak of meningitis at a large Wisconsin university, free meningitis vaccines were given at an on-campus recreational facility and about 70% of undergraduates were vaccinated over a two-week period [45, 46]. This demonstrates the potential success this type of strategy could have for influenza vaccine delivery for college-enrolled young adults.

Conclusions

Overall, HPV and influenza vaccine coverage among young adults ages 18–26 is low. To better understand preventive care use among these groups, we must investigate avenues to care for student and non-student young adults. Future interventions should focus on tailored education to address influenza and HPV perceptions, including issues of perceived risk, cost, availability, and accessibility.

Acknowledgements

The authors have no conflicts of interest to declare. Dr. Bednarczyk is supported by National Institutes of Health (Grant K01AI106961). Dr. Sundaram is supported by the Emory Vaccinology Training Program of the National Institute of Allergy and Infectious Diseases (Award T32AI074492). No external funding was used for conducting The Young Adult Health Care Study. The authors would like to thank Avnika B. Amin and Cameron Warner for technical assistance in the survey administration process.

References

1. Committee on Improving the Health, S., and Well-Being of Young Adults; Board on Children, Youth, and Families; Institute of Medicine; National Research Council. (2015). Investing in the Health and Well-Being of Young Adults (Richard CS Bonnie J, and Heather Breiner Ed.). Washington, DC: National Academies Press, US.
2. United States Census Bureau. (2011). Census Briefs: Age and Sex Composition, 2010. Retrieved from <https://www.census.gov/content/dam/Census/library/publications/2011/dec/c2010br-03.pdf>.
3. Neinstein L (2012). The new adolescents: An analysis of health conditions, behaviors and risks and access to services among emerging adults. Retrieved from Los Angeles, CA: http://www.usc.edu/student-affairs/Health_Center/thenewadolescents/doc/TheNewAdolescents_Final_Locked.pdf.
4. Pazol K, Robbins CL, Black LI, Ahrens KA, Daniels K, Chandra A, & Gavin LE (2017). Receipt of selected preventive health services for women and men of reproductive age-United States, 2011–2013. MMWR Surveillance Summaries, 66(20), 1–31. 10.15585/mmwr.ss6620a1

5. Lau JS, Adams SH, Irwin CE Jr., & Ozer EM (2013). Receipt of preventive health services in young adults. *Journal of Adolescent Health*, 52(1), 42–49. 10.1016/j.jadohealth.2012.04.017
6. Boersma P, B. L (2020). Human papillomavirus vaccination among adults aged 18–26, 2013–2018. Retrieved from Hyattsville, MD.
7. Marchand E, Glenn BA, & Bastani R (2012). Low HPV vaccine coverage among female community college students. *Journal of Community Health*, 37(6), 1136–1144. 10.1007/s10900-012-9572-x [PubMed: 22669623]
8. Williams WW, Lu PJ, O'Halloran A, Bridges CB, Pilishvili T, Hales CM, & Markowitz LE (2014). Noninfluenza vaccination coverage among adults—United States, 2012. *Morbidity and Mortality Weekly Report*, 63(5), 95–102. [PubMed: 24500288]
9. Kim J, & Nan X (2015). Consideration of future consequences and HPV vaccine uptake among young adults. *Journal of Health Communication*, 20(9), 1033–1040. 10.1080/10810730.2015.1018583 [PubMed: 26214344]
10. Licht AS, Murphy JM, Hyland AJ, Fix BV, Hawk LW, & Mahoney MC (2010). Is use of the human papillomavirus vaccine among female college students related to human papillomavirus knowledge and risk perception? *Sexually Transmitted Infections*, 86(1), 74–78. 10.1136/sti.2009.037705 [PubMed: 19841004]
11. American College Health Association-National College Health Assessment II: Undergraduate Student Executive Summary Spring 2019. (2019). Retrieved from Silver Spring, MD.
12. National Center for Education Statistics. (2015). Table 303.55. Total Fall Enrollment in Degree-Granting Postsecondary Institutions, by Control and Level of Institution, Attendance Status, and Age of Student: 2013. Retrieved from http://nces.ed.gov/programs/digest/d14/tables/dt14_303.55.asp?current=yes.
13. Buhrmester M, Kwang T, & Gosling S (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Sage Journals*, 6(1), 3–5.
14. Peer E, Vosgerau J, & Acquisti A (2014). Reputation as a sufficient condition for data quality on Amazon Mechanical Turk. *Behavior Research Methods*, 46(4), 1023–1031. 10.3758/s13428-013-0434-y [PubMed: 24356996]
15. National Cancer Institute. Health Information National Trends Survey Questionnaires: 2003–2017. Retrieved from <https://hints.cancer.gov/view-questions-topics/all-hints-questions.aspx>.
16. Frew PM, Murden R, Mehta CC, Chamberlain AT, Hinman AR, Nowak G, ..., Bednarczyk RA (2019). Development of a US trust measure to assess and monitor parental confidence in the vaccine system. *Vaccine*, 37(2), 325–332. doi:10.1016/j.vaccine.2018.09.043. [PubMed: 30503657]
17. Weber EU, Johnson EJ, Milch KF, Chang H, Brodscholl JC, & Goldstein DG (2007). Asymmetric discounting in intertemporal choice: A query-theory account. *Psychological Science*, 18(6), 516–523. 10.1111/j.1467-9280.2007.01932.x [PubMed: 17576265]
18. Zou G (2004). A modified poisson regression approach to prospective studies with binary data. *American Journal of Epidemiology*, 159(7), 702–706. 10.1093/aje/kwh090 [PubMed: 15033648]
19. Petersen MR, & Deddens JA (2008). A comparison of two methods for estimating prevalence ratios. *BMC Medical Research Methodology*, 8(1), 9. doi:10.1186/1471-2288-8-9. [PubMed: 18307814]
20. Opel DJ, Taylor JA, Zhou C, Catz S, Myaing M, & Mangione-Smith R (2013). The relationship between parent attitudes about childhood vaccines survey scores and future child immunization status: A validation study. *JAMA Pediatrics*, 167(11), 1065–1071. 10.1001/jamapediatrics.2013.2483 [PubMed: 24061681]
21. Centers for Disease Control and Prevention. (2016). Human Papillomavirus (HPV): How do people get HPV? Retrieved from <https://www.cdc.gov/hpv/parents/whatis HPV.html>.
22. Lyons HA, Manning WD, Longmore MA, & Giordano PC (2015). Gender and casual sexual activity from adolescence to emerging adulthood: Social and life course correlates. *Journal of Sex Research*, 52(5), 543–557. 10.1080/00224499.2014.906032 [PubMed: 24992285]
23. Markowitz LE, Dunne EF, Saraiya M, Chesson HW, Curtis CR, Gee J, & Unger ER (2014). Human papillomavirus vaccination: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recommendations and Reports*, 63(Rr-05), 1–30.

24. Arriola CS, Brammer L, Epperson S, Blanton L, Kniss K, Mustaquim D, & Jhung M (2014). Update: Influenza activity-United States, September 29, 2013-February 8, 2014. *Morbidity and Mortality Weekly Report*, 63(7), 148–154. [PubMed: 24553198]
25. Budd AP, Wentworth DE, Blanton L, Elal AIA, Alabi N, Barnes J, & Jernigan D (2018). Update: Influenza Activity-United States, October 1, 2017-February 3, 2018. *Morbidity and Mortality Weekly Report*, 67(6), 169–179. 10.15585/mmwr.mm6706a1 [PubMed: 29447145]
26. Santibanez TA, & Kennedy ED (2016). Reasons given for not receiving an influenza vaccination, 2011–12 influenza season, United States. *Vaccine*, 34(24), 2671–2678. doi:10.1016/j.vaccine.2016.04.039. [PubMed: 27118168]
27. Bednarczyk RA, Chu SL, Sickler H, Shaw J, Nadeau JA, & McNutt LA (2015). Low uptake of influenza vaccine among university students: Evaluating predictors beyond cost and safety concerns. *Vaccine*, 33(14), 1659–1663. 10.1016/j.vaccine.2015.02.033 [PubMed: 25728320]
28. Ratanasiripong NT (2015). Factors related to human papillomavirus (HPV) vaccination in college men. *Public Health Nursing*, 32(6), 645–653. 10.1111/phn.12198 [PubMed: 25879799]
29. Dillard JP, & Spear ME (2010). Knowledge of human papillomavirus and perceived barriers to vaccination in a sample of US female college students. *Journal of American College Health*, 59(3), 186–190. 10.1080/07448481.2010.493189 [PubMed: 21186448]
30. Ylitalo KR, Lee H, & Mehta NK (2013). Health care provider recommendation, human papillomavirus vaccination, and race/ethnicity in the US National Immunization Survey. *American Journal of Public Health*, 103(1), 164–169. 10.2105/ajph.2011.300600 [PubMed: 22698055]
31. Lu PJ, Yankey D, Jeyarajah J, O'Halloran A, Meyer SA, Elam-Evans LD, & Reagan-Steiner S (2017). Impact of provider recommendation on tdap vaccination of adolescents aged 13–17 years. *American Journal of Preventive Medicine*, 53(3), 373–384. 10.1016/j.amepre.2017.03.022 [PubMed: 28495221]
32. Vadaparampil ST, Malo TL, Sutton SK, Ali KN, Kahn JA, Casler A, & Giuliano AR (2016). Missing the target for routine human papillomavirus vaccination: Consistent and strong physician recommendations are lacking for 11- to 12-year-old males. *Cancer Epidemiology, Biomarkers & Prevention*, 25(10), 1435–1446. 10.1158/1055-9965.epi-15-1294
33. Sommers BD, Buchmueller T, Decker SL, Carey C, & Kronick R (2013). The Affordable Care Act has led to significant gains in health insurance and access to care for young adults. *Health Affairs (Millwood)*, 32(1), 165–174. 10.1377/hlthaff.2012.0552
34. Han X, Zhu S, & Jemal A (2016). Characteristics of young adults enrolled through the affordable care act-dependent coverage expansion. *Journal of Adolescent Health*, 59(6), 648–653. 10.1016/j.jadohealth.2016.07.027
35. Shui IM, Weintraub ES, & Gust DA (2006). Parents concerned about vaccine safety: Differences in race/ethnicity and attitudes. *American Journal of Preventive Medicine*, 31(3), 244–251. 10.1016/j.amepre.2006.04.006 [PubMed: 16905036]
36. Prislun R, Dyer JA, Blakely CH, & Johnson CD (1998). Immunization status and sociodemographic characteristics: The mediating role of beliefs, attitudes, and perceived control. *American Journal of Public Health*, 88(12), 1821–1826. 10.2105/ajph.88.12.1821 [PubMed: 9842380]
37. Opel DJ, Taylor JA, Mangione-Smith R, Solomon C, Zhao C, Catz S, & Martin D (2011). Validity and reliability of a survey to identify vaccine-hesitant parents. *Vaccine*, 29(38), 6598–6605. doi:10.1016/j.vaccine.2011.06.115. [PubMed: 21763384]
38. Goodman JK, Cryder CE, & Cheema A (2013). Data collection in a flat world: The strengths and weaknesses of Mechanical Turk samples. *Journal of Behavioral Decision Making*, 26(3), 213–224. 10.1002/bdm.1753
39. Huff C, & Tingley D (2015). “Who are these people?” Evaluating the demographic characteristics and political preferences of MTurk survey respondents. *Research & Politics*, 2(3), 2053168015604648. doi:10.1177/2053168015604648.
40. Berinsky AJ, Huber GA, & Lenz GS (2017). Evaluating online labor markets for experimental research: Amazon.com’s Mechanical Turk. *Political Analysis*, 20(3), 351–368. 10.1093/pan/mpr057

41. Brusco NK, & Watts JJ (2015). Empirical evidence of recall bias for primary health care visits. *BMC Health Services Research*, 15, 381. doi:10.1186/s12913-015-1039-1. [PubMed: 26373712]
42. Turner JC, & Keller A (2015). College health surveillance network: Epidemiology and health care utilization of college students at US 4-year universities. *J Am Coll Health*, 63(8), 530–538. 10.1080/07448481.2015.1055567 [PubMed: 26086428]
43. Zimet GD, Weiss TW, Rosenthal SL, Good MB, & Vichnin MD (2010). Reasons for non-vaccination against HPV and future vaccination intentions among 19–26 year-old women. *BMC Women's Health*, 10, 27. 10.1186/1472-6874-10-27 [PubMed: 20809965]
44. Patel DA, Zochowski M, Peterman S, Dempsey AF, Ernst S, & Dalton VK (2012). Human papillomavirus vaccine intent and uptake among female college students. *J Am Coll Health*, 60(2), 151–161. doi:10.1080/07448481.2011.580028. [PubMed: 22316412]
45. Johnson O (2016, 12 5). UW-Madison meningitis outbreak spurs widespread vaccination. *Minnesota Daily*. Retrieved from <http://www.mndaily.com/article/2016/12/meningitis-outbreak-in-madison-calls-for-new-vaccine>.
46. University of Wisconsin-Madison: University Health Services. (2016). UW-Madison confirms third case of meningococcal disease; free vaccine offered to students. Retrieved from <https://news.wisc.edu/uw-madison-identifies-possible-third-case-of-meningococcal-disease-free-vaccine-today-for-undergraduates/>.

Demographic and preventive care characteristic comparisons of young adults aged 18–26 in the United States recruited from Amazon Mechanical Turk, November–December 2017

Table 1

Characteristic	Overall	Enrolled in College, N (%)	Not Enrolled in College, N (%)	χ^2 p-value
HPV vaccine (1 dose), n (%)	417 (100%)	205 (49.16%)	212 (50.84%)	0.1719
Yes	203 (48.8)	107 (52.2)	96 (45.5)	
No	213 (51.2)	98 (47.8)	115 (54.5)	
Missing	1	0	1	
Flu Shot (1 past 3 years), n (%)				0.0543
Yes	232 (57.28)	123 (62.12)	109 (52.66)	
No	173 (42.72)	75 (37.88)	98 (47.34)	
Missing	12	7	5	
Sex, n (%)				0.3687
Male	126 (30.29)	66 (32.35)	60 (28.3)	
Female	290 (69.71)	138 (67.65)	152 (71.7)	
Missing	1	1	0	
Hispanic, n (%)				0.414
Yes	67 (16.07)	36 (17.56)	31 (14.62)	
No	350 (83.93)	169 (82.44)	181 (85.38)	
Race, n (%) [*]				0.2019
White	280 (67.15)	128 (62.44)	152 (71.70)	
Black or African American	46 (11.03)	26 (12.68)	20 (9.43)	
Asian	33 (7.91)	21 (10.24)	12 (5.66)	
Multiple races (selected more than 1 race)	34 (8.15)	16 (7.80)	18 (8.49)	
Other	24 (5.76)	14 (6.83)	10 (4.72)	
Education, n (%)				< 0.0001
Less than high school graduate/GED	3 (0.72)	1 (0.49)	2 (0.95)	
High school graduate/GED	58 (13.98)	16 (7.84)	42 (19.91)	
Some college or associates degree	204 (49.16)	133 (65.2)	71 (33.65)	
Bachelor's degree	126 (30.36)	42 (20.59)	84 (39.81)	

Characteristic	Overall	Enrolled in College, N (%)	Not Enrolled in College, N (%)	χ^2 p-value
Graduate degree	24 (5.78)	12 (5.88)	12 (5.69)	
Missing	2	1	1	
Age, n (%)				< 0.0001
18–22	156 (37.41)	109 (53.17)	47 (22.17)	
Mean (SD)	20.68 (1.3)	20.49 (1.30)	21.13 (1.21)	
23–26	261 (62.59)	96 (46.83)	165 (77.83)	
Mean (SD)	24.64 (1.10)	24.5 (1.11)	24.73 (1.08)	
Primary care doctor, n (%)				0.4004
Yes	291 (69.78)	147 (71.71)	144 (67.92)	
No	126 (30.22)	58 (28.29)	68 (32.08)	

Table 2

Bivariate and multivariate predictors of human papillomavirus vaccine receipt (at least one dose) among young adults in the United States, recruited from Amazon Mechanical Turk, November-December 2017

Characteristics	Overall (N, %)	Received Vaccine, N (%)	Bivariate Analysis PR (95% CI) ^a	Multivariate Analysis-Fully adjusted model aPR (95% CI) ^a	Multivariate Analysis-Reduced model aPR (95% CI) ^a
n = 417					
<i>College enrollment</i>					
Enrolled	205 (49.16)	107 (52.2)	1.15 (0.94, 1.40)	0.99 (0.85, 1.14)	1.00 (0.87, 1.15)
Not enrolled	212 (50.84)	96 (45.5)	Referent	Referent	Referent
<i>Sex, n (%)</i>					
Male	126 (30.29)	32 (25.40)	Referent	Referent	-
Female	290 (69.71)	170 (58.82)	2.32 (1.69, 3.17)	1.30 (1.03, 1.66)	-
<i>Race, n (%)</i>					
White	280 (67.15)	136 (48.75)	Referent	Referent	-
Black or African American	46 (11.03)	26 (56.52)	1.16 (0.88, 1.54)	1.13 (0.87, 1.47)	-
Asian	33 (7.91)	15 (45.45)	0.93 (0.63, 1.38)	1.25 (1.06, 1.49)	-
Multiple races (selected more than 1 race)	34 (8.15)	13 (38.24)	0.78 (0.50, 1.22)	0.85 (0.60, 1.19)	-
Other	24 (5.76)	13 (54.17)	1.17 (0.79, 1.73)	1.41 (1.03, 1.92)	-
<i>Age</i>					
18–22	156 (37.41)	75 (48.08)	0.98 (0.80, 1.20)	1.02 (0.88, 1.18)	-
23–26	261 (62.59)	128 (49.23)	Referent	Referent	-
<i>Primary care coctor</i>					
Yes	291 (69.78)	154 (53.10)	1.37 (1.07, 1.74)	1.02 (0.85, 1.22)	-
No	126 (30.22)	49 (38.89)	Referent	Referent	-
<i>Provider recommendation for HPV vaccine</i>					
Yes	231 (55.93)	185 (80.09)	8.57 (5.43, 13.54)	8.05 (5.05, 12.82)	8.57 (5.44, 13.52)
No	182 (44.07)	17 (9.34)	Referent	Referent	Referent

^aPrevalence ratio (95% confidence interval)

Table 3

Bivariate and multivariate predictors of influenza vaccine receipt (at least one dose in the past three years) among young adults in the United States, recruited from Amazon Mechanical Turk, November-December 2017

Characteristics	Overall (N, %)	Received 1 Flu shot over past 3 years, N (%)	Bivariate analysis PR (95% CI) ^a	Multivariate analysis-fully adjusted model aPR (95% CI) ^a	Multivariate analysis-reduced model aPR (95% CI) ^a
<i>College enrollment</i>	n = 417	232 (57.28%)			
Enrolled	205 (49.16)	123 (62.12)	1.18 (0.99, 1.40)	1.14(0.97, 1.34)	1.15 (0.98, 1.35)
Not enrolled	212 (50.84)	109 (52.66)	Referent	Referent	Referent
<i>Sex, n (%)</i>					
Male	126 (30.29)	69 (56.10)	Referent	Referent	-
Female	290 (69.71)	162 (57.65)	1.03 (0.85, 1.24)	0.96 (0.81, 1.14)	-
<i>Race, n (%)</i>					
White	280 (67.15)	161 (58.76)	Referent	Referent	-
Black or African American	46 (11.03)	21 (50.0)	0.85 (0.62, 1.17)	0.89 (0.65, 1.22)	-
Asian	33 (7.91)	22 (70.97)	1.21 (0.94, 1.54)	1.23 (0.99, 1.53)	-
Multiple races (selected more than 1 race)	34 (8.15)	14(41.18)	0.70 (0.46, 1.06)	0.76 (0.52, 1.13)	-
Other	24 (5.76)	14(58.33)	0.99 (0.70, 1.41)	1.11 (0.79, 1.54)	-
<i>Age</i>					
18–22	156 (37.41)	83 (55.33)	0.95 (0.79, 1.13)	0.95 (0.80, 1.12)	-
23–26	261 (62.59)	149 (58.43)	Referent	Referent	-
<i>Primary care doctor</i>					
Yes	291 (69.78)	182 (64.08)	1.55 (1.23, 1.95)	1.32 (1.06, 1.63)	-
No	126 (30.22)	50(41.32)	Referent	Referent	-
<i>Provider recommendation for flu Shot</i>					
Yes	326 (78.74)	213 (66.15)	3.01 (1.99,4.57)	2.76 (1.82,4.17)	2.99 (1.98,4.54)
No	88 (21.26)	18 (21.95)	Referent	Referent	Referent

^aPrevalence ratio (95% confidence interval)

Table 4

Vaccine confidence (PACV category) by college enrollment among young adults aged 18–26 in the United States recruited from Amazon Mechanical Turk, November-December 2017

	PACV Category	Low hesitance N (%)	Medium hesitance	High hesitance	Chi Square p value
College enrollment	College enrolled	137 (67.2)	33 (16.2)	34(16.7)	0.1937
	Not enrolled	121 (58.7)	39(18.9)	46 (22.3)	

HPV and influenza vaccine receipt by college enrollment and vaccine confidence (PACV category) for young adults aged 18–26 in the United States recruited from Amazon Mechanical Turk, November-December 2017

Table 5

Hesitance level	College enrollment	Received HPV vaccine		Chi square p-value	Received influenza vaccine?		Chi-square p-value
		Yes	No		Yes	No	
Low	No	60 (43.8)	61 (50.4)		82 (46.6)	38 (50.0)	
	Yes	77 (56.2)	60 (49.6)	0.3483	94 (53.4)	38 (50.0)	0.7185
Medium	No	14 (46.7)	25 (59.5)		15 (50.0)	23 (57.5)	
	Yes	16 (53.3)	17 (40.5)	0.4012	15 (50.0)	17 (42.5)	0.7030
High	No	18 (56.3)	28 (58.3)		11 (45.8)	34 (63.0)	
	Yes	14 (43.8)	20 (41.7)	>0.999	13 (54.2)	20 (37.0)	0.2444