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The association between attitudes toward vaccination and vaccine uptake among adolescents

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The association between attitudes toward vaccination and vaccine uptake among adolescents

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An abstract of
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Abstract

The association between attitudes toward vaccination and vaccine uptake among adolescents

By: Julia Ellenberg Painter, MPH

Recently, the ACIP expanded its recommended immunization schedule for adolescents to include three new vaccines (Tdap, HPV, MCV), and annual influenza vaccination. Little is known about the role adolescents' attitudes play in determining vaccine uptake. The purpose of this research was: 1) To conduct a systematic literature review of the evidence-base regarding adolescents' attitudes toward vaccination, and 2) To conduct a study assessing the association between attitudes toward influenza vaccination and vaccine uptake among rural adolescents.

Of 1,348 studies screened in the systematic review, 32 met inclusion criteria. Findings suggest that the evidence-base regarding adolescents' attitudes toward vaccinations is limited. Most studies examined adolescent's attitudes toward vaccination against HPV and other STIs, were cross-sectional with moderately-sized samples, and combined data from adolescents and young adults. No studies assessed adolescents' attitudes towards influenza vaccination. Despite limitations, the literature revealed that perceived risk of disease, perceived benefits and barriers to vaccination, fear of needles, and normative beliefs are salient factors in adolescents' acceptance of HPV/STI vaccines.

Second, adolescents were recruited from two counties participating in a school-based influenza vaccination intervention in rural Georgia (n=337). Surveys were distributed to adolescents at pre- and post-intervention time points to assess demographic, behavioral, and attitude variables. A cross-sectional analysis of baseline data revealed intention to receive an influenza vaccination was associated with perceived barriers (OR=0.77), injunctive norms (OR=1.23), and receipt of influenza vaccination last year (OR=6.21).

A four-step mediation analysis was used to test whether changes in psychosocial variables from baseline to follow-up mediated the relationship between study condition and influenza vaccine uptake. Step 1 of the analysis revealed a significant relationship between study condition and vaccine uptake (OR=1.77). Step 2 revealed a significant relationship between study condition and changes in psychosocial variables from baseline to follow-up. Steps 3 and 4 revealed that there was full mediation of the relationship between study condition and receipt of an influenza vaccination by intention to receive an influenza vaccination.

Research findings suggest that adolescents' attitudes, particularly perceived barriers and social norms, may impact vaccine uptake. Interventions to increase adolescent vaccination coverage may benefit from addressing adolescents' attitudes toward vaccination.

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CHAPTER #1:
INTRODUCTORY LITERATURE REVIEW

Efforts toward immunizing adolescents against vaccine-preventable diseases are rapidly increasing in the United States (Mahoney, 2010). Vaccine-preventable diseases are critical to address because they are both harmful and avoidable (National Vaccine Advisory Committee, 2008). For the first time in 2008, progress towards the *Healthy People 2010* target of 90% vaccine coverage for adolescents aged 13-15 was reached for certain vaccines, including ≥3 doses of HepB[1] (91.8%) and ≥2 doses of MMR (90.7%). Also of note, coverage increased from 80.2% in 2007 to 85.5% in 2008 for ≥1 dose of VAR (Centers for Disease Control and Prevention, 2009c). These coverage rates should be considered a public health success, and indicate the possibility of achieving increased coverage for other vaccinations, as well.

New adolescent vaccinations

Recently, the CDC's Advisory Committee on Immunization Practices (ACIP) expanded its recommended immunization schedule for adolescents to include three vaccines specifically targeted towards adolescents (Tdap, HPV, and MCV), annual vaccination against influenza, and additional vaccinations for high risk groups (PPSV and HepA) (Centers for Disease Control and Prevention, 2009c). Unfortunately, national coverage for many of these vaccinations remains below the optimal level and is highly `variable by state, race/ethnicity, and socioeconomic status (Centers for Disease Control and Prevention, 2009b). Thus, many adolescents and their contacts at risk for acquiring vaccine-preventable diseases (Centers for Disease Control and Prevention, 2009b). In

[1] Abbreviations for vaccinations are as follows: HepB = Hepatitis B; MMR = Measles, Mumps, and Rubella; VAR = Varicella (chicken pox), Tdap = Tetanus, diphtheria, and pertussis; HPV = Human Papillomavirus; MCV = Meningococcal vaccine; PPSV = Pneumococcal polysaccharide vaccine ; HepA = Hepatitis A; Influenza = Influenza

2008, only 37.2% of adolescent females had initiated the HPV vaccination series (≥1 dose), and 17.9% of females had received ≥3 doses (Centers for Disease Control and Prevention, 2009c). Although this represents an increase in coverage from 25.1% in 2007, coverage remains well below public health goals. Similarly, MCV vaccination coverage increased from 32.4% in 2007 to 41.8% in 2008, and coverage remained stable at 70.7% for ≥1 dose of Td or Tdap (Centers for Disease Control and Prevention, 2009c). Influenza vaccination coverage was particularly low in 2008-2009, with only 20.8% coverage among children 5-17 years of age (Centers for Disease Control and Prevention, 2009a).

Barriers to vaccinating adolescents

Increasing coverage of adolescent vaccinations is essential to reduce morbidity and mortality of vaccine-preventable diseases and their sequelae. Several studies have identified potential barriers to increasing adolescent immunization rates, including: vaccine cost (Davis, Zimmerman, Wheeler, & Freed, 2002; M. C. Lindley, Shen, Orenstein, Rodewald, & Birkhead, 2009); provider-related barriers such as storage and monitoring, vaccine knowledge, attitudes toward vaccination, and missed opportunities (Kimmel, 2010); vaccination venue, informed consent, and surveillance (National Vaccine Advisory Committee, 2008); adolescent health care utilization patterns (Rand et al., 2007); and vaccine acceptance among parents and adolescents (Brewer & Fazekas, 2007; Dempsey & Davis, 2006; Szilagyi et al., 2008). Strategies have been suggested to reduce many of these barriers, including subsidizing or reducing vaccine costs, enhancing physician's knowledge and attitudes regarding adolescent vaccination, and reducing missed opportunities (Kimmel, 2010). Frequently discussed strategies also include

addressing adolescent and parental concerns regarding vaccination (Kimmel, 2010; National Vaccine Advisory Committee, 2008; Szilagyi et al., 2008), and providing vaccinations in settings outside of medical homes, including schools (M. C. Lindley et al., 2008; Schaffer et al., 2008).

The role of adolescents' attitudes toward vaccination

These strategies highlight the need to better understand adolescent attitudes toward immunizations, and the role that these attitudes play in vaccine uptake. Although the laws regarding consent for vaccinations differs by state and health condition (English & Kenney, 2003), adolescents' participation in the consent process may play a role in various ways. First, in a national survey of immunization delivery of school-based health centers (SBHCs), a large majority (84%) reported administering vaccines to adolescent students (Daley et al., 2009). Of note, most SBHCs reported that adolescents were always or frequently seen without their parents present (86%), and the most frequently reported method of obtaining parental consent was sending consent forms home with students (76%). These findings indicate multiple avenues through which adolescents' attitudes may impact vaccination uptake, including: 1) whether adolescents choose to bring the consent forms home for their parents to sign, and, 2) even with parental consent, without a parent being physically present, the adolescent may choose not to return the consent form or receive the vaccine.

Additionally, beyond SBHCs, adolescence is a stage characterized by development of social an emotional maturity, an increasing sense of self, and development of autonomy (Lind, Anderson, & Oberle, 2003). Consequently, adolescents are more likely to take control of their own health-related attitudes and behaviors than

younger children (Coates, Peterson, & Perry, 1982). In fact, per the Patient-Self Determination Act, adolescents are increasingly encouraged to participate in medical decision making (McCabe, Rushton, Glover, Murray, & Leikin, 1996). This highlights the salience of adolescents' attitudes toward vaccination, which have been demonstrated to differ from parental attitudes with regard to adolescent vaccination (Woodhall et al., 2007; Gregory D. Zimet, Mays, Sturm, & Ravert, 2002; G. D. Zimet et al., 2005).

For example, Zimet et al found that parent-adolescent pairs were not likely to agree on who would be the primary decision-maker regarding vaccination sexually transmitted infections (STIs) (Gregory D. Zimet et al., 2002). While 42% of parents reported they would be the primary decision-maker, only 12% of adolescents saw their parents in this role. On the contrary, 36% of adolescents reported that they would be the primary decision-maker, yet only 10% of parents saw their children in this role. Other studies have shown that determinants of HPV vaccination acceptance differ among parents and adolescents (Woodhall et al., 2007), and that while adolescents may look to their parents for guidance concerning STI vaccination acceptance, their personal experiences may also be influential (G. D. Zimet et al., 2005). While differences in parental and adolescent attitudes toward non-STI vaccines have not been well studied, it is highly plausible that discordance would occur.

Given the increasing importance of adolescent vaccinations and the potential role that adolescents' own attitudes may play in vaccine uptake, it is important to develop a strong evidence base regarding adolescents' attitudes toward vaccination. Expanding our understanding of the role adolescents' attitudes play in vaccine acceptance is a critical

step in designing effective interventions to increase immunization coverage among this population.

Influenza vaccination

Adolescent attitudes toward influenza vaccination may be particularly important address. Despite ongoing vaccination efforts, influenza remains a significant health burden. Influenza epidemics in the United States lead to an annual average of 36,000 deaths from 1990 - 1999 and 226,000 hospitalizations from 1979 – 2001 (Thompson et al., 2004; Thompson et al., 2003). From 1999 – 2004, influenza and pneumonia have consistently been the only infectious diseases to rank among the top 10 leading causes of death in the United States (Anderson, 2001, 2002; Anderson & Smith, 2003, 2005; M. Heron, 2007; M. P. Heron & Smith, 2007; Kung, Hoyert, Xu, & Murphy, 2008). The most effective method for preventing influenza and its related complications is vaccination. (Fiore et al., 2007). Influenza immunization efforts in the United States have traditionally been focused on persons at greatest risk for severe complications, primarily individuals ≥ 65 years of age ("Update: Influenza vaccine supply and recommendations for prioritization during the 2005-06 influenza season," 2005). Despite a tripling of immunization coverage among individuals ≥ 65 of age since 1993, mortality rates have remained high; even after adjusting for the aging population and changing virulence (Simonsen et al., 2005). Given the continuing burden of influenza and the lack of reduction in mortality by vaccinating the elderly, alternative vaccination strategies are needed to better control disease transmission. In support of this assertion, the CDC's Advisory Committee on Immunization Practices (ACIP) recently voted to expand the

recommended ages for annual influenza vaccination of children to include all children from 6 months through 18 years of age (CDC, 2008; Fiore et al., 2007).

The importance of vaccinating school-age children against influenza

Vaccinating school-age children may benefit children, their families, and their community. Vaccinating school-aged children poses a promising strategy for protecting the elderly against influenza. Influenza vaccines are more effective at raising antibody titers and preventing influenza-related illness among children compared to the elderly (Centers for Disease Control and Prevention, 2005; Goodwin, Viboud, & Simonsen, 2006). Although school-age children are not considered to be at high risk of influenza mortality, annual morbidity is strikingly high, with illness attack rates in school children exceeding 10% in most years (Halloran & Longini, 2006). In addition, children are the primary transmitters of virus within communities; not only do school-age children have the highest attack rates in annual epidemics (Fox, Cooney, Hall, & Foy, 1982; Fox, Hall, Cooney, & Foy, 1982; Foy, Cooney, & Allan, 1976; Frank et al., 1983; W. Paul Glezen, 1982; Monto & Kioumehr, 1975), but infected children also shed virus for longer periods than adults (Belshe, Maassab, & Mendelman, 2004; Frank et al., 1981). The presence of children within a household is the most important determinant of influenza within a family (Fox, Cooney et al., 1982; Frank et al., 1983; Principi & Esposito, 2004). Empirical evidence suggests that universal vaccination of school-age children indirectly protects the elderly and other vulnerable community members by preventing viral transmission (W. P. Glezen, 2006). For example, recent ecologic studies in Japan reported reductions in pneumonia and influenza mortality during periods when school children were vaccinated routinely (Reichert et al., 2001). Studies in both Russia and the

United States have been shown to reduce influenza-like illness rates in schools, families, and communities in areas where immunization against influenza was promoted for school-age children (Ghendon, Kaira, & Elshina, 2005; J. C. King, Jr. et al., 2005; Monto, Davenport, Napier, & Francis, 1970; Piedra et al., 2005; Reichert et al., 2001; Rudenko et al., 1993). Furthermore, detailed mathematical simulations of influenza transmission indicate that vaccinating just 20% of U.S. school children would reduce overall mortality in adults over 65 years of age more successfully than vaccinating 90% of the elderly (Halloran & Longini, 2006).

In addition to controlling community transmission, immunizing school-age children directly impacts their risk of disease morbidity and subsequent utilization of medical services and medication (Izurieta et al., 2000; Kathleen Maletic Neuzil, Mellen, Wright, Mitchel, & Griffin, 2000; Kathleen Maletic Neuzil, Wright, Mitchel, & Griffin, 2000; K. L. O'Brien et al., 2000; M. A. O'Brien et al., 2004; Thompson et al., 2004). During the influenza season, it has been estimated that infection results in rates exceeding 6 office visits and 5 antibiotic courses per 100 school-age children per year (Kathleen Maletic Neuzil, Mellen et al., 2000). With respect to hospitalizations, studies have found excess rates of 1.6 and 1.9 cases per 10,000 person-months for children 5-17 years (Izurieta et al., 2000), and 4.1 excess cases per 10,000 children 5-15 years during the influenza seasons under investigation (Kathleen Maletic Neuzil, Mellen et al., 2000). While these rates are lower than in infants and the elderly, infections can lead to severe complications and even death (Bhat et al., 2005; Centers for Disease Control and Prevention, 2004). Furthermore, immunizing school-age children against influenza may substantially reduce their absenteeism from school and, collaterally, reduce the

likelihood of family members becoming infected and missing time from work either from their own illness or to take care of their ill children. During outbreaks, school absenteeism precedes work absenteeism (W. Paul Glezen, 1996), and for every 100 children followed during the influenza season, children missed 62 school days and parents missed 20 work days (K. M. Neuzil, Hohlbein, & Zhu, 2002). Thus, the burden of influenza-related illness is borne by children, their families, and their community.

Influenza vaccination among rural, low-income, and minority populations

Vaccinating school-age children may be especially important among rural, low-income, minority populations. Research has shown that disparities in vaccination coverage persist among rural, low-income, and minority populations. Rural areas have historically experienced higher poverty than urban or metro areas (USDA Economic Research Service, 2003). Senior adults who live in rural, medically underserved areas tend to be sicker and have poorer access to health care (Madhavan, Borker, Fernandes, Amonkar, & Rosenbluth, 2004). Lower influenza vaccination rates have been associated with living in a deprived area and minority status (Bryant, 2006; Coupland et al., 2007; O'Malley, 2006; Rangel et al., 2005; USDA Economic Research Service, 2003; Winston, 2006). African-Americans, in particular, consistently have lower influenza vaccination rates than other racial/ethnic groups (Bryant, 2006; Centers for Disease Control and Prevention, 2005; Collins, 1999; Figaro, 2005; Lashuay et al., 2000; O'Malley, 2006; Ostbye, 2003; Rangel et al., 2005; Winston, 2006). Although such disparities in influenza vaccination are clearly present in the elderly, it is unclear whether similar gaps persist among school-age children. There is evidence, however, clearly documenting disparities in other vaccinations among children. In 1999, The

National Vaccine Advisory Committee identified poverty and its associated factors as the most “powerful and persistent” barriers to immunization among children ("Strategies to sustain success in childhood immunizations. The National Vaccine Advisory Committee," 1999). Further research has documented persistently low vaccination coverage among children living in poverty, and that children living near poverty have coverage levels similar to children living below poverty (Klevens & Luman, 2001). Despite a decline in rural childhood poverty during the 1990s, the rural child poverty rate remains higher than the urban rate (19 % versus 15 %) (USDA Economic Research Service, 2003). Furthermore, in non-metro areas, African-American and Hispanic children are almost twice as likely to be poor as White children (USDA Economic Research Service, 2003). Given the sharp inequalities in vaccination coverage among rural, low-income, minority populations, interventions in such settings are highly warranted.

School-based influenza vaccination

School-based vaccination provides a potentially effective way to vaccinate school-age children. School-based vaccination programs may provide an efficient, effective strategy to immunize school-age children against influenza (Reynolds et al., 1999; Vernon, Bryan, Hunt, Allensworth, & Bradley, 1997). Because 95% of U.S. children attend school on a daily basis (Vernon et al., 1997), school-based vaccination has the potential to be a more effective mechanism for vaccinating large numbers of children and adolescents against influenza than individually scheduled physician visits (Luce et al., 2001).

One of the first school-based campaigns for influenza vaccination was carried out in the 1960s in Tecumseh, Michigan (Monto, Davenport, Napier, & Francis, 1969; Monto et al., 1970). This campaign, along with data derived from evaluations of immunization programs in Japan and Russia, suggests that school-based programs can achieve high vaccination rates, reaching between 50-86% of the target population (Ghendon et al., 2005; Monto et al., 1969, 1970; Reichert et al., 2001). In the US, recent school-based campaigns have attained vaccination rates approaching 50% (Carpenter, Unpublished presentation; J. C. King, Jr. et al., 2005; James C. King, Jr. et al., 2006; Piedra et al., 2005). While these programs have been effective in varying degrees, no campaign has specifically targeted adolescents. Because adolescents in middle- and high-school consistently have been the most difficult to reach (Carpenter, Unpublished presentation; Monto et al., 1969, 1970), increasing immunization rates in this population will likely require more targeted intervention approaches.

Although many recent influenza vaccination campaigns have been carried out successfully in primarily white, middle-class communities, efforts to enhance vaccination rates among African-American and low-income children have faced greater challenges (Carpenter, Unpublished presentation). Thus, there are gaps in the empirical literature with respect to evaluating the effectiveness and efficiency of school-based influenza vaccination programs for 1) adolescents and 2) rural, low socioeconomic status, minority populations (Weinick, Zuvekas, & Cohen, 2000).

While school-based programs may provide an excellent opportunity for vaccine delivery to students who may not otherwise be immunized, school-based programs also pose a unique set of challenges. Vaccination may not be a top priority for administrators

who establish school health priorities (M. C. Lindley et al., 2008). Limited funding, time, and staff resources; the need to document vaccinations; keeping track of grants and billing; and the need to obtain parental consent may also serve as barriers to school involvement with vaccination (M. C. Lindley et al., 2008). However, even if school staff and administrators are highly in favor of school-based vaccination, a key challenge still remains: adolescent volition. Providing vaccination outside of medical settings where adolescents are unaccompanied by a parent (i.e. school-based vaccination) could highlight discordant attitudes toward vaccination between parents and their children. Parental provision of informed consent may be a necessary, but not sufficient step in ensuring their child's vaccination. Without direct parental supervision, the child may opt out of vaccination. Thus, adolescent attitudes toward influenza vaccination may play a key role in immunization outcomes.

The role of adolescents' attitudes toward influenza vaccination

Attitudes toward influenza vaccination strongly influence vaccination behavior. Given that adolescents in school-based settings are generally unaccompanied by a parent, their own attitudes, independent of their parents' attitudes, may be significant predictors of vaccination behavior. Although there is a dearth of research detailing adolescent attitudes toward influenza vaccination, research among other populations lends credibility to the notion that attitudes play a key role in vaccination behavior. A recent review article by Ward et al. found that beliefs about vaccine safety, effectiveness, and side effects; perceived risks and consequences of contracting influenza; and perceived health status were key determinants of influenza vaccination among older adults (Ward & Draper, 2008). Further research suggests that access to care (Fiscella, 2002; Rangel et al., 2005),

lack of provider recommendation (Winston, 2006), attitudes towards vaccination (M. Lindley, Wortley, PM, Winston, CA, Bardenheier, BH, 2006; Winston, 2006), mistrust of the vaccine, and believing that the vaccine causes influenza (Chen, Fox, Cantrell, Stockdale, & Kagawa-Singer, 2007) play a role in influenza vaccination outcomes among African-American adults. In a literature review of influenza vaccination among healthcare workers, Hofman et al. found that fear of adverse effects, the misconception that vaccine causes influenza, low perceived risk, inconvenient vaccination schedules, perception that influenza is not a serious disease, beliefs about vaccine inefficacy, and fear of injections were barriers to vaccine uptake (Hofmann, Ferracin, Marsh, & Dumas, 2006). Protecting oneself, protecting patients, free and convenient vaccination, previous vaccination, and following peer examples facilitated influenza vaccination (Hofmann et al., 2006). Studies of parental attitudes toward child immunization have found that anticipating immunization barriers and perceiving that influenza vaccination is the social norm may impact vaccination (Daley et al., 2007), and African-American parents may be more likely than White parents to have negative attitudes toward immunizations and their child's health care-provider (Shui, 2006). Adolescent attitudes and beliefs have been demonstrated to influence myriad health behaviors, including diet, physical activity, alcohol consumption, smoking, and sexual behavior (Bassett, Chapman, & Beagan, ; DiClemente et al., 2004; Milligan et al., 1997).

In preliminary studies for the Parent Study, a series of focus groups were conducted during the summer of 2006 among key stakeholder groups of adults (Georgia PTA members, school administrators, school nurses) and high school students to ascertain existing attitudes and beliefs related to influenza and vaccination. In general,

participants in the adult focus groups believed that influenza is a significant health issue among school-age children, and expressed interest in preventing its spread. They also agreed that vaccination against influenza is an important mechanism for prevention. In contrast to the adults, the students did not believe that influenza was a significant health issue and indicated that they did not believe that there are intrinsic benefits to vaccination. The proposed study will survey a larger sample of students to determine whether the negative attitudes asserted by the adolescent focus group impact receipt of an influenza vaccination.

Conceptual Framework

Understanding adolescent attitudes toward vaccination requires the use of a theory that is appropriate for episodic or infrequent health behaviors, such as vaccination and screening. The Health Belief Model (HBM), which was initially developed to explain a public health screening program, (Janz, Champion, & Strecher, 2002) provides an apt framework for this study. A recent meta-analysis examining the relationship of the major HBM constructs (perceived susceptibility, severity, benefits, and barriers) to health screening found that each component had a significant relationship with measured outcomes (Kohler, Grimley, & Reynolds, 1999). However, additional research indicates that alternative theories, such as the Theory of Reasoned Action (TRA), which focuses on predictors of behavioral intention (D.E. Montano & Kasprzyk, 2008), and the Triandis Model (D. E. Montano, 1986) may be most appropriate for understanding influenza vaccination behavior (D. E. Montano, 1986). Based on evidence supporting the utility of multiple theories, this study incorporated constructs from two prominent behavior change theories: The HBM (Becker, 1974), and

the Integrated Behavioral Model (IBM) (D.E. Montano & Kasprzyk, 2008), which incorporates constructs from both the TRA and the Triandis Model.

Due to its utility in explaining vaccination behavior, the HBM and IBM were utilized to provide a theoretical foundation for guiding the development of the educational intervention materials (i.e., motivational and educational brochures and DVD) used in the parent study. Thus, measuring HBM and IBM constructs will allow for assessment of a change in theoretical mediators of vaccination behavior due to the educational intervention.

The HBM framework posits that individuals' attitudes and beliefs are predictive determinants of their health behavior. The HBM consists of six major components: 1) perceived susceptibility; 2) perceived severity; 3) perceived benefits; 4) perceived barriers; 5) cues to action; and 6) self-efficacy. The IBM suggests that 1) perceived behavioral control, 2) injunctive social norms, 3) descriptive social norms, and 4) intention to perform a behavior may also be salient issues to address. Figure 1.1 presents the HBM adapted model used to design the student questionnaire and guide the plan for data analysis.

Significance of the proposed study

To date, research has shown that: 1) National coverage for many adolescent vaccinations remains sub-optimal; and 2) There are many barriers to increasing vaccinations coverage. Also, in specific regards to influenza, research has shown that 1) Vaccinating school-age children against influenza may reduce the burden of influenza among children and the broader community; 2) Influenza vaccination may be especially important for low-income, rural, and minority populations; 3) Schools may be an

effective location for vaccine delivery to children; and 4) Attitudes and beliefs toward influenza vaccination may influence vaccination behavior.

Yet, little is known about the role of adolescents' attitudes in vaccine uptake. There is a gap in the empirical literature with respect to evaluating the effectiveness of school-based influenza vaccination programs for adolescent children, particularly a rural, low-income, and minority populations (Weinick et al., 2000). Correspondingly, there is also a gap in the literature regarding adolescent attitudes toward influenza vaccination and the role these attitudes may play in predicting vaccination behavior. The purpose of this research was: 1) To conduct a systematic literature review of the evidence-base regarding adolescents' attitudes toward vaccination, and 2) To conduct a study assessing the association between attitudes toward influenza vaccination and vaccine uptake among rural adolescents.

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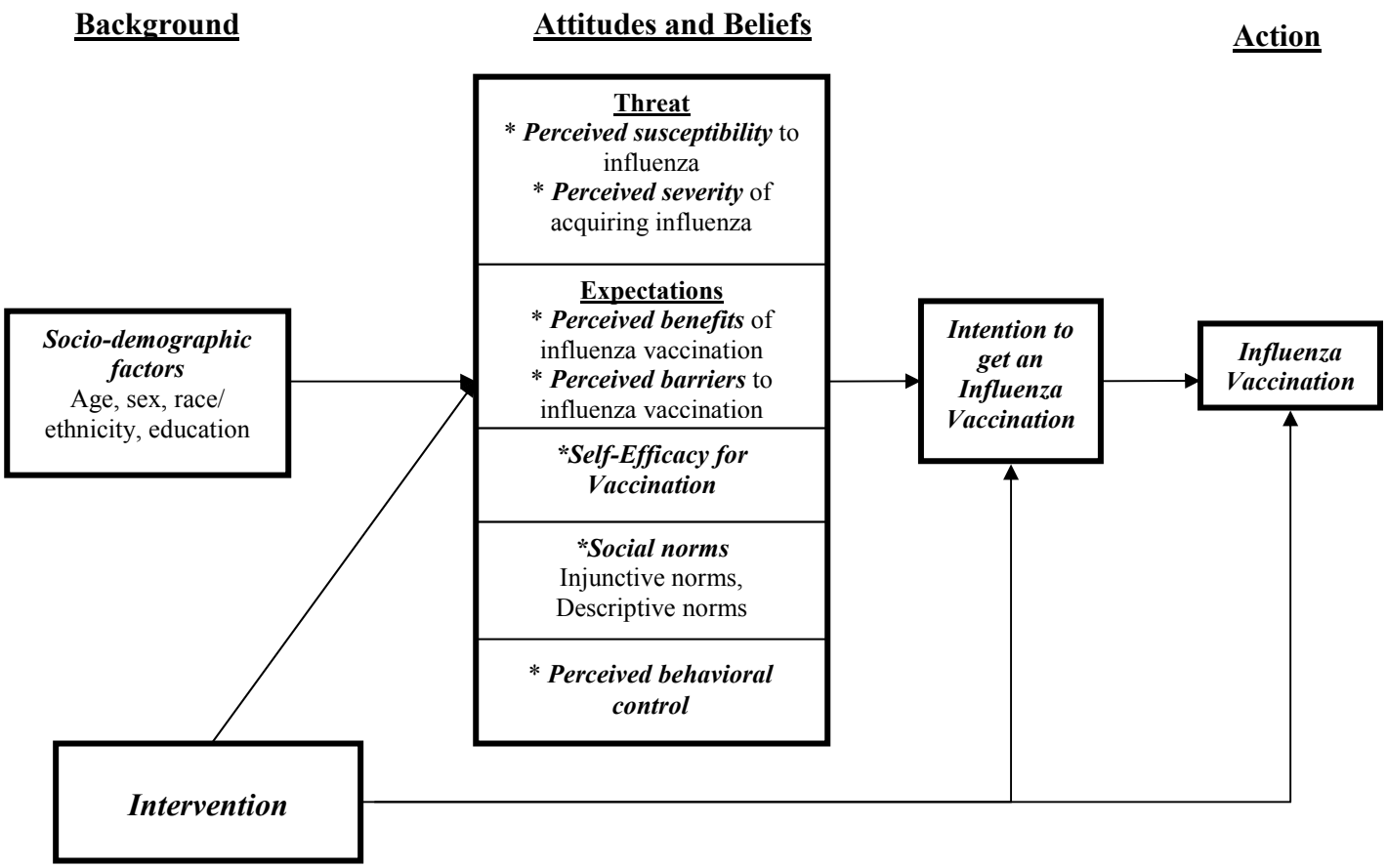
Figure 1.1. Theoretical framework based on the Health Belief Model and Integrated Behavioral Model



CHAPTER #2:
ADOLESCENT ATTITUDES TOWARD VACCINATIONS: A SYSTEMATIC REVIEW

ABSTRACT

Background: The ACIP recommends numerous vaccines for adolescents aged 11-17, yet immunization coverage remains sub-optimal. Although parental consent is required for most vaccinations, adolescents' own attitudes may impact vaccine uptake. The purpose of this study was to review the literature regarding adolescents' attitudes toward vaccination to inform efforts toward increasing adolescent vaccination rates.

Methods: Two researchers searched five databases for literature published in English from 1999–2009. Selection criteria included: 1) Original research 2) Surveyed adolescents (aged 11-17) regarding attitudes toward any vaccination, and 3) Analyzed adolescent data separately or combined with young adults. Included articles were coded for demographic and methodological information, as well as type of attitudes assessed and relevant significant associations.

Results: Of 1,348 titles and abstracts screened, 32 studies met inclusion criteria. There was almost perfect agreement between researchers in selecting studies (k=.897). Most studies assessed attitudes toward HPV or other STI vaccines. No studies assessed adolescents' attitudes towards influenza vaccination, and only one descriptive study assessed attitudes toward MCV and Tdap. Most studies were cross-sectional and many analyzed adolescents' data combined with young adult data. Despite limitations, current research suggests that perceived risk of disease, perceived benefits and barriers to vaccination, and normative beliefs may be salient factors in adolescents' acceptance of vaccinations.

Conclusions: There are a dearth of large, longitudinal, adolescent-focused studies assessing the association between adolescents' attitudes toward vaccination and vaccine uptake. Future research should include more rigorous study designs and expand the evidence-base regarding adolescent attitudes toward all recommended vaccines, particularly influenza and MCV.

INTRODUCTION

Efforts toward immunizing adolescents against vaccine-preventable diseases are rapidly increasing in the United States (Mahoney, 2010). Vaccine-preventable diseases are critical to address because they are both harmful and avoidable (National Vaccine Advisory Committee, 2008). Recently, the CDC's Advisory Committee on Immunization Practices (ACIP) expanded its recommended immunization schedule for adolescents to include three vaccines specifically targeted towards adolescents (Tdap, HPV, and MCV)[2], annual vaccination against influenza, catch-up for missed childhood vaccinations, (MMR, HepB, IPV, and Varicella), and additional vaccinations for high risk groups (PPSV and HepA) (Centers for Disease Control and Prevention, 2009c). Unfortunately, national coverage for many of these vaccinations, particularly the new adolescent-specific vaccines, remains below the optimal level and is highly variable by state, race/ethnicity, and socioeconomic status (Centers for Disease Control and Prevention, 2009b).

Increasing coverage of adolescent vaccinations is essential to reduce morbidity and mortality of vaccine-preventable diseases and their sequelae. Several studies have identified potential barriers to increasing adolescent immunization rates, including: vaccine cost (Davis, Zimmerman, Wheeler, & Freed, 2002; Lindley, Shen, Orenstein, Rodewald, & Birkhead, 2009); provider-related barriers such as storage and monitoring, vaccine knowledge, attitudes toward vaccination, and missed opportunities (Kimmel, 2010); vaccination venue, informed consent, and surveillance (National Vaccine

[2] Abbreviations for vaccinations are as follows: HepB = Hepatitis B; MMR = Measles, Mumps, and Rubella; VAR = Varicella (chicken pox), Tdap = Tetanus, diphtheria, and pertussis; HPV = Human Papillomavirus; MCV = Meningococcal vaccine; PPSV = Pneumococcal polysaccharide vaccine ; HepA = Hepatitis A; Influenza = Influenza

Advisory Committee, 2008); adolescent health care utilization patterns (Rand et al., 2007); and vaccine acceptance among parents and adolescents (Brewer & Fazekas, 2007; Dempsey & Davis, 2006; Szilagyi et al., 2008). Strategies have been suggested to reduce many of these barriers, including subsidizing or reducing vaccine costs, enhancing physician's knowledge and attitudes regarding adolescent vaccination, and reducing missed opportunities (Kimmel, 2010). Frequently discussed strategies also include addressing adolescent and parental concerns regarding vaccination (Kimmel, 2010; National Vaccine Advisory Committee, 2008; Szilagyi et al., 2008), and providing vaccinations in settings outside of medical homes, including schools (Lindley et al., 2008; Schaffer et al., 2008).

These strategies highlight the need to better understand adolescent attitudes toward immunizations, and the role that these attitudes play in vaccine uptake. Although the laws regarding consent for vaccinations differs by state and health condition (English & Kenney, 2003), adolescents' participation in the consent process may play a role in various ways. First, in a national survey of immunization delivery of school-based health centers (SBHCs), a large majority (84%) reported administering vaccines to adolescent students (Daley et al., 2009). Of note, most SBHCs reported that adolescents were always or frequently seen without their parents present (86%), and the most frequently reported method of obtaining parental consent was sending consent forms home with students (76%). These findings indicate multiple avenues through which adolescents' attitudes may impact vaccination uptake, including: 1) whether adolescents choose to bring the consent forms home for their parents to sign, and, 2) even with parental consent, without

a parent being physically present, the adolescent may choose not to return the consent form or receive the vaccine.

Additionally, beyond SBHCs, adolescence is a stage characterized by development of social an emotional maturity, an increasing sense of self, and development of autonomy (Lind, Anderson, & Oberle, 2003). Consequently, adolescents are more likely to take control of their own health-related attitudes and behaviors than younger children (Coates, Peterson, & Perry, 1982). In fact, per the Patient-Self Determination Act, adolescents are increasingly encouraged to participate in medical decision making (McCabe, Rushton, Glover, Murray, & Leikin, 1996). This highlights the salience of adolescents' attitudes toward vaccination, which have been demonstrated to differ from parental attitudes with regard to adolescent vaccination (Woodhall et al., 2007; Gregory D. Zimet, Mays, Sturm, & Ravert, 2002; G. D. Zimet et al., 2005).

For example, Zimet et al found that parent-adolescent pairs were not likely to agree on who would be the primary decision-maker regarding vaccination against sexually transmitted infections (STIs) (Gregory D. Zimet et al., 2002). While 42% of parents reported they would be the primary decision-maker, only 12% of adolescents saw their parents in this role. On the contrary, 36% of adolescents reported that they would be the primary decision-maker, yet only 10% of parents saw their children in this role. Other studies have shown that determinants of HPV vaccination acceptance differ among parents and adolescents (Woodhall et al., 2007), and that while adolescents may look to their parents for guidance concerning STI vaccination acceptance, their personal experiences may also be influential (G. D. Zimet et al., 2005). While differences in

parental and adolescent attitudes toward non-STI vaccines have not been well studied, it is highly plausible that discordance would occur.

Given the increasing importance of adolescent vaccinations and the potential role that adolescents' own attitudes may play in vaccine uptake, it is important to develop a strong evidence base regarding adolescents' attitudes toward vaccination. Expanding our understanding of the role adolescents' attitudes play in vaccine acceptance is a critical step in designing effective interventions to increase immunization coverage among this population. The purpose of this study was to review the literature regarding adolescents' attitudes toward vaccination to answer the following questions: 1) To what extent have adolescents' attitudes toward vaccinations been examined? 2) What associations have been found between adolescents' attitudes toward vaccination and vaccine acceptance and uptake?

METHODS

Two researchers searched PubMed, CINAHL, Web of Science, PsycINFO, and ERIC for literature published in English from 1999–2009. The search term used in each database was: (adolescent* OR teen*) AND (attitude* OR belief* OR perception* OR accept* OR intention*) AND (immuniz* OR vaccine* OR vaccination). References of included studies were also examined. Selection criteria included: 1) full-length original research articles; 2) published in English between 1999 and 2009 (including papers published electronically in 2009, ahead of print); 2) collected data from adolescents (aged 11-17) regarding attitudes and beliefs toward any vaccination via surveys, interviews, or focus groups; 3) analyzed adolescent data separately or in the aggregate with data from young adults (aged 18-30).

All relevant titles, abstracts, and if necessary, papers (n = 1,348) were reviewed by two researchers. Articles were excluded if they 1) were not original research articles, 2) did not collect data on attitudes and beliefs toward vaccination from adolescents (aged 11-17); 3) analyzed adolescent data in the aggregate with data from adults (aged 31+), or 4) focused exclusively on attitudes toward participation in vaccine-related clinical trials. After the initial screening, 32 articles were selected for inclusion. There was almost perfect agreement between researchers in selecting studies (k=.897). The researchers then independently coded all included articles for demographic and methodological information, as well as type of attitudes assessed and relevant significant associations. There was good agreement between researchers in coding articles (84%), and discrepancies were discussed and resolved by both researchers and a third reviewer.

RESULTS

Basic study information is presented in Table 2.1. Most studies assessed attitudes toward vaccination against HPV (17), Hepatitis B (7), or HIV (4). Other studies (one each) assessed adolescents' attitudes toward STI vaccines in general (including gonorrhea, genital herpes, HIV/AIDS), infectious diseases (including MCV, Polio, MMR, Tdap, Tb, Hib), and immunizations in general. Sixteen studies were conducted in the United States, seven in Europe, four in Asia, two in Scandinavia, and one each in Australia, Brazil, and South Africa. Most studies were cross-sectional (84%) and utilized survey data (84%). Slightly more than half of the studies included only females (53%), all but one of which focused on HPV vaccination. Participants' ages ranged from 11 – 28 years. Many studies analyzed adolescents' data in the aggregate with young adult data (63%). Several studies assessed other populations in addition to adolescents, such as

young adults, parents, or health care workers (Caskey, Lindau, & Alexander, 2009; Slonim et al., 2005; Woodhall et al., 2007; G. D. Zimet, Mays et al., 2000). However, if the adolescents' data was analyzed separately, then only adolescent data was included in the review. Twelve studies (38%) mentioned at least one health behavior theory, most commonly the Health Belief Model (59%).

HPV vaccination

More research has been published regarding adolescent attitudes toward HPV vaccination compared to other adolescent vaccinations. Of the 32 studies selected for inclusion, 17 (53%) focused on HPV. However, most of the published studies were cross-sectional with samples of less than 1,000 participants. Only one study was longitudinal (Conroy et al., 2009), and only one study used a sample size over 1,000 (Di Giuseppe, Abbate, Liguori, Albano, & Angelillo, 2008). Of the 17 studies that assessed adolescent attitudes toward HPV vaccination, nine assessed at least a bivariate level association between attitudes toward HPV vaccination and other variables (Table 2.2), while eight presented solely descriptive data (Table 2.3). Although there was little consistency in the measurement and assessment of adolescent attitudes toward HPV vaccination across studies, some noteworthy patterns emerged.

Five studies assessed attitudes toward vaccination as predictors of other vaccine-related outcomes, including vaccination intention (Chan, Yan Ng, Lo, Cheung, & Hung Chung, 2009; Kahn et al., 2008; Marlow, Waller, Evans, & Wardle, 2009), willingness to receive a vaccine (Di Giuseppe et al., 2008), and vaccine refusal (Woodhall et al., 2007) (Table 2.2). The attitudes most commonly assessed as predictor variables were: 1) perceived risk / susceptibility to HPV (Chan et al., 2009; Di Giuseppe et al., 2008; Kahn

et al., 2008; Marlow, Waller et al., 2009; Woodhall et al., 2007), significant in two studies (Chan et al., 2009; Di Giuseppe et al., 2008), 2) perceived barriers to vaccination (including knowledge, practical, and safety-related) (Kahn et al., 2008; Marlow, Waller et al., 2009; Woodhall et al., 2007), significant in two studies (Kahn et al., 2008; Marlow, Waller et al., 2009), 3) perceived benefits of vaccination (Di Giuseppe et al., 2008; Kahn et al., 2008; Marlow, Waller et al., 2009), significant in two studies (Di Giuseppe et al., 2008; Marlow, Waller et al., 2009), and normative beliefs (Chan et al., 2009; Kahn et al., 2008), significant in both studies. Only one study assessed adolescent attitudes as predictors of actual vaccine uptake (Conroy et al., 2009). Although several attitudes were assessed in this study (including perceived benefits, perceived barriers, fear of shots, perceived severity, self-efficacy, and vaccination intention), the only attitude variable significantly associated with receipt of an HPV vaccine was normative beliefs (Conroy et al., 2009). Ten of the HPV studies presented descriptive or qualitative data (Table 2.3). Common themes explored in these studies included identifying factors associated with HPV vaccine acceptance, particularly barriers and facilitators to HPV vaccination. Frequently identified barriers to vaccination included: fear of vaccination (including fear about pain, side effects, and adverse events) (Brabin et al., 2009; Forster, Marlow, Wardle, Stephenson, & Waller, 2009; Kwan et al., 2008; Weisberg, Bateson, McCaffery, & Skinner, 2009; Wong, 2008), concern about vaccine safety (Caskey et al., 2009; Forster et al., 2009; Kwan et al., 2008; Weisberg et al., 2009; Wong, 2008), high cost (Caskey et al., 2009; Kwan et al., 2008; Wong, 2008), believe that vaccine is not needed (Caskey et al., 2009; Forster et al., 2009; Kwan et al., 2008; Weisberg et al., 2009; Wong, 2008), and negative social norms / stigma (Brabin et al., 2009; Forster et al., 2009; Kwan

et al., 2008; Weisberg et al., 2009; Wong, 2008). Commonly mentioned facilitators to vaccination included protection against HPV / cervical cancer (Brabin et al., 2009; Hoglund, Tyden, Hannerfors, & Larsson, 2009), recommended by health care provider (Caskey et al., 2009; Wong, 2008), positive social norms (Caskey et al., 2009; Kwan et al., 2008), believe the vaccine is necessary or important (Forster et al., 2009; Weisberg et al., 2009), and perceived risk of disease (Forster et al., 2009; Hoglund et al., 2009).

Also of note, several studies assessed sexual messages conveyed by HPV vaccination (Brabin et al., 2009; Hoglund et al., 2009; Kwan et al., 2008; Marlow, Forster, Wardle, & Waller, 2009; Wong, 2008). The belief that other people are more likely to have unprotected sex if vaccinated was associated with lower education, black race, girls' belief that they are less sexually experienced than girls their own age (Marlow, Forster et al., 2009), and female gender (Hoglund et al., 2009). Adolescents' belief that that they themselves would be more likely to have unprotected sex if vaccinated was associated with lower knowledge (Marlow, Forster et al., 2009). Two qualitative studies identified promoting promiscuity and indication of "fooling around" as barriers to HPV vaccination (Kwan et al., 2008; Wong, 2008). Conversely, one study found that most girls believed that getting the HPV vaccine shows "you are serious about your health" and "reminds you of the risk of sexual contact" (Brabin et al., 2009).

Finally, prior to the development of an actual HPV vaccine, two studies assessed hypothetical acceptability of different vaccine types (Hoover, Carfioli, & Moench, 2000; Moreira et al., 2006). Both studies found an overwhelming preference for a vaccine that protects against 70% of cervical cancer and 100% of genital warts, compared to 85% of cervical cancer exclusively.

Hepatitis B vaccination

Although the evidence base regarding adolescent attitudes toward Hepatitis B (HepB) vaccination is small compared to HPV vaccination, the quality of published studies is arguably more rigorous. Of seven studies assessing adolescents' attitudes toward HepB vaccination, three are longitudinal (Middleman, Robertson, Young, Durant, & Emans, 1999; O'Rourke, Redlinger, & Steege, 2001; Stringer, Ratcliffe, & Gross, 2006) and one cross-sectional study both surveyed over 17,000 adolescents, and interviewed 96 (Slonim et al., 2005). Six studies assessed at least a bivariate association between attitudes toward HepB vaccination and other variables (Table 2.2), and one study presented only descriptive data (Table 2.3). Three studies assessed receipt of a HepB vaccine as an outcome variable (Lee et al., Middleman et al., 1999; O'Rourke et al., 2001). Two of those studies determined receipt of a HepB vaccine (decreased time to vaccination series completion (Middleman et al., 1999), and receipt of 1st and 2nd immunization (O'Rourke et al., 2001)), by medical records. One study assessed HepB vaccination by self-report (Lee et al.). There were no common significant predictors of HepB vaccination across studies. Two studies found significant demographic predictors: attending school vs. being in a juvenile detention center (Lee et al.) and female gender, white race, median income (Middleman et al., 1999). One study found significant attitude predictors, including perceived risk of contracting HepB, feeling a prior vaccine protects against HepB, and concern that people know that participants are being vaccinated (O'Rourke et al., 2001).

Three studies assessed attitude variables as outcomes, including vaccine acceptance (Slonim et al., 2005; Stringer et al., 2006), perceived importance of HepB

immunization to health (Schmidt & Middleman, 2001), and perceived likelihood of acquiring HepB (Schmidt & Middleman, 2001). Only one significant predictor of attitudinal outcomes emerged across studies: History of STD (Schmidt & Middleman, 2001; Slonim et al., 2005). Attitudes toward HepB vaccination were only assessed as predictors of vaccine acceptance in one study (Stringer et al., 2006), and none were significant in multivariate analyses.

Two studies assessed adolescent attitudes toward HepB vaccination descriptively: one presenting data from cross-sectional interviews (Butler, Mills, Yang, & Chen, 2005) and one qualitative (Slonim et al., 2005). In the small cross-sectional of Hmong youth, a majority of respondents believed shots can prevent disease, but half (50%) believed that shots can be harmful. The qualitative study, which supplemented a large cross-sectional survey, asked 96 adolescents for reasons someone would not get the HepB vaccine and what could be done to reduce barriers. The most commonly reported barriers were fear of needles and lack of knowledge. The most common suggestions for reducing barriers included education and having someone with HepB discuss the physical and mental manifestations and consequences of the disease.

HIV vaccination

Many studies regarding adolescent attitudes towards HIV vaccination focused on willingness to participate in clinical trials. Such studies were excluded from this review, because there is a fundamental difference between willingness to participate in scientific research and willingness to accept a vaccine that has been approved for use. However, four studies directly assessed adolescents' attitudes toward a hypothetical HIV/AIDS vaccine (Jaspan et al., 2006; Webb, Zimet, Mays, & Fortenberry, 1999; G. Zimet,

Fortenberry, & Blythe, 1999; G. D. Zimet, Blythe, & Fortenberry, 2000). Two studies assessed willingness to receive a safe and effective vaccine (Jaspan et al., 2006) and vaccine acceptability (G. Zimet et al., 1999) as outcome variables (Table 2.2). One study only assessed demographic variables as predictors of willingness to receive a safe and effective vaccine, none of which were significant (Jaspan et al., 2006). Another study assessed multiple attitude variables as predictors of HIV vaccine acceptability, including perceived susceptibility to HIV, perceived severity of AIDS, perceived benefits of getting an HIV vaccine, and several types of perceived barriers (G. Zimet et al., 1999). Among the entire sample, significant predictors of HIV vaccine acceptability included: perceived susceptibility to HIV, perceived benefits, fear of the vaccine, and not being in a high risk group. Among sexually experienced adolescents, significant predictors included: perceived susceptibility to HIV, perceived benefits, and fear of needles (G. Zimet et al., 1999).

Two descriptive studies assessed hypothetical acceptability of different vaccine types of HIV vaccines (Table 2.3) (Webb et al., 1999; G. D. Zimet, Blythe et al., 2000). Both studies suggested that adolescents would accept a vaccine with 90% efficacy, but would not accept a vaccine with 50% efficacy. One study assessed which aspects of a vaccine would have the strongest influence on vaccine acceptability. This study found that vaccine efficacy was the most important feature, followed by type of vaccine (synthetic or killed vs. live), vaccine cost, mode of delivery, and parental permission (G. D. Zimet, Blythe et al., 2000). The second hypothetical acceptability study asked participants if getting an AIDS vaccine would influence adolescents' sexual behavior. A

large majority (77%) believed that, after receiving a 90% effective vaccine, adolescents would increase HIV risk behaviors (Webb et al., 1999).

STI vaccination

One study assessed adolescent attitudes toward STI vaccines in general (G. D. Zimet et al., 2005). The general definition of "STI vaccines" included gonorrhea, genital herpes, and HIV/AIDS. The outcome variable, STI vaccine acceptance, was significantly associated with parental intent to vaccinate and having a close friend who has had sex. None of the attitudes assessed as predictor variables (perceived vulnerability to infection, anticipated anger associated with an STI, or anticipated anxiety associated with and STI) were significantly associated with STI vaccine acceptance (Table 2.2) (G. D. Zimet et al., 2005).

Non-sexually transmitted disease vaccination

Only one study, conducted in Ireland, assessed adolescent attitudes toward non-sexually transmitted diseases. This was a cross-sectional, descriptive study that surveyed adolescents regarding their attitudes toward vaccinations for multiple diseases, including: meningitis, polio, rubella, diphtheria, Hib, tetanus, measles, mumps, tuberculosis, and pertussis (Table 2.3) (Brown, 2009). Almost all participants (98%) perceived meningitis as very / fairly serious, followed by polio, rubella, and diphtheria. Only a few participants thought that vaccines are riskier than the diseases against which they protect (8%), and were most likely to perceive MCV and IPV vaccines as having moderate / high risk adverse effects. Alarmingly, 22% of adolescents thought MMR could cause autism, 4% thought it could cause both autism and Crohn's disease, and only 12% thought it caused neither (Brown, 2009). Females were significantly more likely to think MMR could cause

autism than males. Slightly over half of all participants considered their opinions about vaccination to be influenced by their parents, followed by the media, and then by doctors.

Immunizations in general

One study assessed the efficacy of an intervention geared towards increasing adolescent attitudes toward immunizations in general (Table 2.2) (Glik et al., 2004). Attitudes toward immunizations were significantly associated with receipt of the intervention, as well as fear of shots and baseline attitudes. Intention to receive adolescent immunizations was associated with frequent visits to the doctor, health concern, and change in knowledge from pre-test to post-test.

DISCUSSION

For the first time in 2008, progress towards the *Healthy People 2010* target of 90% vaccine coverage for adolescents aged 13-15 was reached for certain vaccines, including ≥3 doses of HepB (91.8%) and ≥2 doses of MMR (90.7%). Also of note, coverage increased from 80.2% in 2007 to 85.5% in 2008 for ≥1 dose of VAR (Centers for Disease Control and Prevention, 2009c). These coverage rates should be considered a public health success, and indicate the possibility of achieving increased coverage for other vaccinations, as well. Unfortunately, adolescent immunization coverage is currently sub-optimal for many vaccines, leaving adolescents and their contacts at risk for acquiring vaccine-preventable diseases (Centers for Disease Control and Prevention, 2009b). In 2008, only 37.2% of adolescent females had initiated the HPV vaccination series (≥1 dose), and 17.9% of females had received ≥3 doses (Centers for Disease Control and Prevention, 2009c). Although this represents an increase in coverage from 25.1% in 2007, coverage remains well below public health goals. Similarly, MCV

vaccination coverage increased from 32.4% in 2007 to 41.8% in 2008, and coverage remained stable at 70.7% for ≥1 dose of Td or Tdap (Centers for Disease Control and Prevention, 2009c). Influenza vaccination coverage was particularly low in 2008-2009, with only 20.8% coverage among children 5-17 years of age (Centers for Disease Control and Prevention, 2009a).

In order to increase vaccination rates, it is important to identify and address multiple barriers to vaccination, including adolescents' attitudes toward vaccination (National Vaccine Advisory Committee, 2008). The present study conducted a systematic review of the literature to examine the extent to which adolescents' attitudes toward vaccinations have been examined, and identify relationships have been found between adolescent attitudes toward vaccination and vaccine acceptance and uptake.

Because the ACIP's vaccination recommendations are relatively recent, the evidence base regarding adolescent attitudes toward vaccination is in its nascent stages, and needs to be strengthened. First, adolescent attitudes toward key recommended vaccinations are largely unstudied. According to the ACIP's recommended vaccination schedule, three new adolescent vaccinations, Tdap, HPV, and MCV, should be routinely administered to adolescents 11-12 years of age, with catch-up vaccinations administered between 13-18 years of age (Centers for Disease Control and Prevention, 2009c). Furthermore, annual influenza vaccinations should be administered to all adolescents 11-18 years of age. However, of those four vaccinations, only adolescent's attitudes toward HPV vaccination have been well studied. Over half (53%) of included studies focused on adolescents' attitudes toward HPV vaccination, while only one study assessed cross-sectional, descriptive data regarding adolescent attitudes toward non-sexually transmitted

diseases including MCV and Tdap. No studies regarding adolescent attitudes toward vaccines against non-sexually transmitted diseases have assessed even a bivariate association between attitudes and acceptance, or been conducted in the United States, and no published studies have assessed adolescent attitudes toward influenza vaccination.

Second, almost two-thirds of the included studies assessed and analyzed adolescent attitudes toward vaccination in the aggregate with young adult data. This is problematic for several reasons. According to the ACIP's recommended vaccination schedule, most adolescent vaccinations should ideally be given at 11-12 years of age, or annually in the case of influenza (Centers for Disease Control and Prevention, 2009c). Thus, by the time unvaccinated adolescents become young adults, they are already behind the recommended immunization schedule. Also, the consent process for adolescents and young adults is different. Young adults and college students over 18 years of age are legally able to make their own decisions about obtaining vaccination. While consent laws vary by state and vaccine type, adolescents age 11-17 oftentimes must obtain parental consent (English & Kenney, 2003). Thus, it is important to study the relative contribution of both adolescent and parental attitudes toward vaccine uptake.

Third, over eighty percent of the included studies were cross-sectional, and cross-sectional data are insufficient to establish a causal relationship between attitudes toward vaccination and vaccine acceptance or uptake. There is a need to conduct more longitudinal studies examining the role of adolescent attitudes toward vaccination uptake. These findings are consistent with a previous systematic review of attitudes toward HPV vaccination among adolescents, parents, and young adults (Brewer & Fazekas, 2007). Similarly, only four studies, one HPV (Conroy et al., 2009) and three HepB studies (Lee

et al., ; Middleman et al., 1999; O'Rourke et al., 2001), assessed associations between adolescent attitudes toward vaccination and actual vaccine uptake. Given that the three adolescent specific vaccines (HPV, MCV, and Tdap) are now licensed (Centers for Disease Control and Prevention, 2009c), it is important to conduct more studies assessing actual vaccination as an outcome variable.

Despite these limitations in the evidence base, some significant relationships have been identified between adolescent attitudes toward vaccination and vaccine acceptance and uptake. With respect to HPV vaccination, several attitudes emerged as significant predictors of vaccine acceptance or uptake across studies, including low knowledge (Chan et al., 2009; Forster et al., 2009; Marlow, Forster et al., 2009; Woodhall et al., 2007), normative beliefs (Chan et al., 2009; Conroy et al., 2009; Kahn et al., 2008), perceived risk of HPV (Chan et al., 2009; Di Giuseppe et al., 2008), perceived benefits of vaccination (Di Giuseppe et al., 2008; Marlow, Waller et al., 2009), and perceived barriers to vaccination (Kahn et al., 2008; Marlow, Waller et al., 2009). These findings, which are generally in line with the Health Belief Model and Theory of Reasoned Action, indicate that adolescent attitudes may in fact be salient factors in vaccine uptake. Based on the literature, future efforts geared towards increasing HPV vaccine uptake among adolescents may benefit from targeting adolescents' attitudes towards HPV vaccination. Specific areas to target include: increasing adolescents' knowledge about HPV vaccination, enhancing perceived social norms around HPV vaccination, underscoring risk of acquiring HPV, emphasizing benefits of HPV vaccination, and addressing barriers to HPV vaccination. Based on evidence from descriptive and qualitative studies, main barriers to tackle may include: fear of vaccination (including fear about pain, side effects,

and adverse events), concern about vaccine safety, vaccine cost, believing that the vaccine is not needed, and negative social norms / stigma. Key benefits to emphasize may include: protection against HPV and cervical cancer, recommendations by health care providers, and positive social norms.

Hepatitis B vaccination is now administered as a routine childhood vaccination, recommended primarily for children between 6 – 18 months of age, and considered a "catch-up" vaccination for adolescents (Centers for Disease Control and Prevention, 2009c). However, because HepB vaccination was initially targeted towards adolescents, research on adolescent attitudes toward HepB vaccination may be useful in identifying attitudes salient towards other vaccines, particularly for diseases which are sexually transmitted. Although few studies assessed attitude variables as predictors of HepB vaccine uptake, one study found significant associations with perceived risk of contracting HepB, feeling a prior vaccine protects against HepB, and concern that people know that participants are being vaccinated (O'Rourke et al., 2001). Also of note, history of STD emerged as a significant predictor of attitudes treated as outcome variables (vaccine acceptance, perceived importance of HepB immunization to health, and perceived likelihood of acquiring HepB) in multiple studies (Schmidt & Middleman, 2001; Slonim et al., 2005). Based on a qualitative study, common barriers to HepB vaccination were fear of needles and lack of knowledge, and suggestions to reduce barriers included education and having someone with HepB discuss the physical and mental manifestations and consequences of the disease (Slonim et al., 2005). Interventions geared toward increasing adolescent vaccination against other STIs may

benefit from addressing perceived risk, social norms, fear of needles, and lack of knowledge.

A handful of studies assessed adolescents' attitudes toward hypothetical STI vaccines (Jaspan et al., 2006; Webb et al., 1999; G. Zimet et al., 1999; G. D. Zimet, Blythe et al., 2000), including HIV/AIDS and other STI's such as gonorrhea and genital herpes (G. D. Zimet et al., 2005). Attitudes that were significantly associated HIV vaccine acceptability included: perceived susceptibility to HIV, perceived benefits of vaccination against HIV, fear of the vaccine, fear of needles, and not being in a high risk group. (G. Zimet et al., 1999). Only one study assessed attitudes as predictors of STI vaccine acceptability (perceived vulnerability to infection, anticipated anger associated with an STI, or anticipated anxiety associated with and STI), although none were significant (G. D. Zimet et al., 2005). The attitudes associated with HIV vaccine acceptance, particularly perceived risk of disease, perceived benefits of vaccination, and perceived barriers to vaccination (fear of the vaccine / needles) are consistent with attitudes significantly associated with HPV and HepB vaccine acceptance. There is mixed evidence regarding adolescents' opinions of the impact that receiving an HPV, HIV, or STI vaccine would have on sexual behaviors. This is an important area to study and requires more thorough research.

Despite the ACIP recommendations and sub-optimal adolescent coverage rates for MCV, Tdap, and influenza vaccinations, no published studies have assessed associations between adolescents' attitudes towards these vaccinations and vaccine uptake. It is unclear whether the same attitudes associated with vaccinations against STIs

would be significant predictors of these vaccines. Further research regarding adolescent's attitudes toward MCV, Tdap, and influenza vaccinations is highly warranted.

Limitations

This review is subject to several limitations. First, only full-length articles that were published in English between 1999 – 2009 were included. Thus, studies published in other languages, published prior to 1999, published only as abstracts, or not published may not be included. Second, many of the included studies assessed data from adolescents in the aggregate with data from young adults. Thus, it is difficult to disentangle the true relationships between attitudes toward vaccination and vaccine acceptance / uptake solely among adolescents under the age of 18. Finally, "attitudes" are a somewhat nebulous concept. We designed our search term to be very general so that it would capture as many relevant articles as possible. However, it is possible that studies assessing adolescents' attitudes toward vaccination using other terminology were not captured.

Conclusions

Overall, the evidence base regarding adolescent attitudes toward vaccinations is not very expansive. The majority of studies conducted to date have examined adolescent's attitudes toward vaccination against HPV and other STIs, are cross-sectional with moderately sized samples, and combine data from adolescents and young adults. In order to improve intervention programs to vaccination coverage, there is a need for additional large, longitudinal, adolescent-specific studies assessing adolescents' attitudes toward all recommended vaccinations, particularly MCV and influenza. Despite its limitations, the current evidence base does yield some consistent findings regarding the

relationship between adolescents' attitudes toward vaccination and vaccine acceptance / uptake. Specifically, studies have demonstrated perceived risk of disease, perceived benefits and barriers to vaccination, fear of shots / needles, and normative beliefs to be salient factors in adolescents' acceptance of HPV, HepB, and other hypothetical STI vaccines. As the need to increase adolescent vaccination coverage becomes more pressing, future interventions geared towards increasing vaccine uptake among adolescents may benefit from addressing adolescents' own attitudes toward vaccination, in addition to parental attitudes.

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Table 2.1. Basic information about studies included in the systematic review

Author, year	Country	Vaccine type	Study design	Data collection of attitudes	Age range of interest	Sex	Sample size of interest	Demographic Information	Data analysis	Theory
Brabin et al, 2009	England	HPV	Cross-sectional	Survey	12 - 13	F	553	-	A	-
Brown et al, 2009	Ireland	MenC, Polio, MMR, Tdap, Tb, HiB	Cross-sectional	Survey	15-17	M+F	784	-	A	-
Butler et al, 2005	US	Hepatitis B	Cross-sectional	Interviews	15 - 18	M+F	20	Hmong: 100	A	-
Caskey et al, 2009	US	HPV	Cross-sectional	Survey	13- 17	F	412	Adolescents: White: 61 Black: 13 Hispanic: 17 Other: 9	A	-
Chan et al, 2009	China (Hong Kong)	HPV	Cross-sectional	Survey	12, 19	F	250	-	A+YA	-
Conroy et al, 2009	US	HPV	Longitudinal	Survey	13 - 26	F	189	White: 14.7 Black: 70.4 Other: 5.9	A+YA	-
Di Giuseppe et al, 2008	Italy	HPV	Cross-sectional	Survey	14 - 24	F	1,328	-	A+YA	-
Glik et al, 2004	US	Immunizations in general	Longitudinal; Quasi-experimental	Survey	6th grade	M+F	929	White: 19.9 Black: 14.1 Hispanic: 49.5 API: 10.1 Other: 3.9	A	Health Belief Model, Social Learning Theory, Multiple Intelligences Theory
Hoglund et al, 2009	Sweden	HPV	Cross-sectional	Survey	16	M+F	572	-	A	-

Hoover et al, 2000	US	HPV	Cross-sectional	Survey	15 - 28	F	60	White: 96.7 Black 3.3	A+YA	-
Jaspan et al, 2006	South Africa	HIV	Cross-sectional	Survey	11, 19	M+F	510	Xhosa: 100	A+YA	-
Kahn et al, 2008	US	HPV	Cross-sectional	Survey	13 - 26	F	409	White:29 Black: 63 Other: 9	A+YA	Health Belief Model , Social Cognitive Theory, Theory of Planned Behavior
Kwan et al, 2008	China (Hong Kong)	HPV	Cross-sectional; Qualitative	Focus groups, Survey	13 - 20	F	64	Chinese: 100	A+YA	-
Lloyd et al, 2009	UK	HPV	Cross-sectional; Quasi-experimental	Survey	13 - 16	F	174	White: 79 API: 8 Other:13	A	Leventhal's Model of Lay Illness
Marlow et al, 2009	England	HPV	Cross-sectional	Survey	16 - 19	F	386	White: 59 Black 24.1 API: 12.6	A+YA	Risk Compensation Theory
Marlow et al, 2009(2)	England	HPV	Cross-sectional	Survey	16 - 19	F	328	Minority: 61%	A+YA	Health Belief Model
Middleman et al, 1999	US	Hepatitis B	Longitudinal	Survey	11, 24	M+F	943	White: 19.1 Black: 42.4 API: 1.2 Other: 14.0	A+YA	Health Belief Model, Health Communications Model
Moreira et al, 2006	Brazil	HPV	Cross-sectional	Survey	16 - 23	F	204	White: 2 Black: 25.5 Mixed: 72.5	A+YA	-
O'Rourke et al, 2001	US	Hepatitis B	Longitudinal	Interviews	10, 19	M+F	248	Spanish or bilingual: 56%	A	Health Belief Model
Schmidt et al, 2001	US	Hepatitis B	Cross-sectional	Survey	12, 19	M+F	769	White: 22 Black: 43 Hispanic: 20 API: 8 Other: 15	A+YA	Health Belief Model

Slonim et al, 2005	US	Hepatitis B	Cross-sectional	Interviews, Survey	13 - 21	M+F	Interviews: 96 Surveys: 17,063	Interviews: White: 46 Black: 47 Hispanic: 7 Surveys: White: 70 Black: 25 API: 1 Other: 3	A+YA	Health Belief Model, Social Cognitive Theory, Extended Parallel Process Model
Stringer et al, 2006	US	Hepatitis B	Longitudinal	Survey	>18	F	160	Pregnant:100 Black: 95 Other: 5	A	-
Webb et al, 1999	US	HIV	Cross-sectional	Interviews	13 - 18	M+F	140	Black: 83	A+YA	-
Weisberg et al, 2009	Australia	HPV	Cross-sectional	Survey	15 - 26	F	294	-	A+YA	-
Wong et al, 2008	Malaysia	HPV	Qualitative	Interviews	13 - 27	F	40	Malay: 42.5 Chinese: 32.5 Indian: 25	A+YA	-
Woodhell et al, 2007	Finland	HPV	Cross-sectional	Survey	14 - 15	M+F	379		A	-
Zimet et al, 1999	US	HIV	Cross-sectional	Survey	13 - 18	M+F	318	White: 27 Black: 72	A+YA	Health Belief Model
Zimet et al, 2000	US	HPV	Cross-sectional	Interviews	14 - 18	F	20	Adolescents: White: 75 Black: 5 Other: 20	A	-
Zimet et al, 2000(2)	US	HIV	Cross-sectional	Survey	13 - 21	M+F	661	White: 26 Black: 72	A+YA	-
Zimet et al, 2005	US	STI vaccines (gonorrhea, genital herpes, HIV)	Cross-sectional	Survey	11, 17	M+F	320	White: 59.7 Black: 36.9	A	Health Belief Model

Table 2.2. Adolescents' attitudes toward vaccination assessed as predictor variables

Author, year	Attitudes Assessed as Predictors	Validity / reliability assessed	Highest Level of Analysis	Outcome	Result
HPV					
Chan et al, 2009	Health beliefs (Perceived risk, perceived knowledge, interest in prevention)	$\alpha = .83$	B; PPMC	Vaccination intention	r = 0.45***
	Perceptions of who should receive the vaccine	$\alpha = .83$	B; PPMC	Vaccination intention	r = 0.40***
	Normative beliefs	$\alpha = .75$	B; PPMC	Vaccination intention	r = -0.38***
Conroy et al, 2009	Perceived barriers: knowledge-related		B; WRS	Receipt of vaccine	NS
	Perceived barriers: practical		B; WRS	Receipt of vaccine	NS
	Perceived barriers: safety-related		B; WRS	Receipt of vaccine	NS
	Perceived benefits: protection of self and partner		B; WRS	Receipt of vaccine	NS
	Perceived benefits: protection and safety		B; WRS	Receipt of vaccine	NS
	Fear of shots		B; WRS	Receipt of vaccine	NS
	Normative beliefs		B; WRS	Receipt of vaccine	OR = 2.21*
	Perceived severity of HPV-related disease		B; WRS	Receipt of vaccine	NS
	Self-efficacy to receive the vaccine		B; WRS	Receipt of vaccine	NS
	Intention to receive the vaccine		B; WRS	Receipt of vaccine	NS
Di Giuseppe et al, 2009	Perception of risk of contracting HPV infection		M; LogR	Willingness to receive an HPV vaccine	OR = 1.18***
	Perceived benefits of vaccination to prevent cervical cancer		M; LogR	Willingness to receive an HPV vaccine	OR = 1.33***
	Perception of risk of developing cervical cancer		M; LogR	Willingness to receive an HPV vaccine	OR = 1.09*
Kahn et al, 2008	Normative beliefs	$\alpha = .82$	M; LogR	Intention to receive an HPV vaccine	OR = 1.63*
				Belief in one's ability to receive an HPV vaccine	NS
	Barriers: vaccine safety	$\alpha = .82$	M; LogR	Intention to receive an HPV vaccine	OR = 0.69*

				Belief in one's ability to receive an HPV vaccine	NS
	Barriers: practical	α = .66	M; LogR	Intention to receive an HPV vaccine	NS
				Belief in one's ability to receive an HPV vaccine	OR = 0.37*
	Barriers: insufficient knowledge of HPV	α = .79	M; LogR	Belief in one's ability to receive an HPV vaccine	NS
	Benefits: health and safety	α = .82	M; LogR	Intention to receive an HPV vaccine	NS
				Belief in one's ability to receive an HPV vaccine	NS
	Benefits: protection of oneseld and one's partner	α = .65	M; LogR	Belief in one's ability to receive an HPV vaccine	NS
	Severity of HPV related disease	α = .75	M; LogR	Intention to receive an HPV vaccine	OR = 1.39*
				Belief in one's ability to receive an HPV vaccine	NS
	Severity of HPV infection	α = .75	M; LogR	Intention to receive an HPV vaccine	NS
				Belief in one's ability to receive an HPV vaccine	OR = 1.53*
	Susceptibility to HPV	α = .79	M; LogR	Intention to receive an HPV vaccine	NS
				Belief in one's ability to receive an HPV vaccine	NS
	Fear of shots generally	α = .79	M; LogR	Intention to receive an HPV vaccine	NS
				Belief in one's ability to receive an HPV vaccine	NS
	HPV-related stigma	α = .96	M; LogR	Intention to receive an HPV vaccine	NS
Marlow et al, 2009(2)	Perceived severity of HPV	α = .78	B; LogR	Intention to accept HPV vaccine	NS
	Perceived susceptibilty to HPV	α = .87	M; LogR	Intention to accept HPV vaccine	NS
	Perceived barriers: general barriers to vaccination	α = .55	M; LogR	Intention to accept HPV vaccine	OR = 0.72
	Perceived barriers: specific barriers to HPV vaccination	α = .79	M; LogR	Intention to accept HPV vaccine	OR = 0.69
	Perceived benefits: general benefits to vaccination	α = .57	M; LogR	Intention to get adolescent immunizations	OR = 1.24
	Perceived benefits: specific benefits to HPV vaccination	α = .81	M; LogR	Intention to accept HPV vaccine	OR = 1.79

Woodhall et al, 2009	Sexual initiation acceptable at an early age	B; LogR	Vaccine refusal	NS
	perceived susceptibilty to HPV	B; LogR	Vaccine refusal	NS
	Concern about safety of vaccines in general	B; LogR	Vaccine refusal	NS
	Believe STD vaccine leads to early initiation of sexual activity	M; LogR	Vaccine refusal	OR = 2.4*
Hepatitis B				
Middleman et al, 1999	Likelihood of acquiring Hep B	M; CRA	Decreased time to vaccination series completion	NS
	Ability to return for all 3 vaccines	M; CRA	Decreased time to vaccination series completion	NS
	Likelihood of completion of vaccine series	M; CRA	Decreased time to vaccination series completion	NS
O'Rourke et al, 2001	Perceived susceptibility: not protected by vaccine	B; CS	Began vaccination	p = 0.004**
	Perceived susceptibility: protected by previous vaccine	M; LogR	Vaccination #1	RR = 2.10
	Perceived susceptibility: worried about becoming infected	B; CS	Began vaccination	NS
	Perceived susceptibility: risk of becoming infected	M; LogR	Vaccination #1	RR = 2.20
	Perceived severity: take being sick seriously	B; CS	Began vaccination	NS
	Perceived severity: health problems do not go away by themselves	B; CS	Began vaccination	p = 0.033*
	Perceived severity: it would matter if I got HBV	B; CS	Began vaccination	NS
	Perceived severity: HBV is serious even if someone is not ill	B; CS	Began vaccination	NS
	Perceived benefits: I will not get HBV if I am vaccinated	B; CS	Began vaccination	NS
	Perceived benefits: benefits are more important than discomfort	B; CS	Began vaccination	NS
	Perceived barriers: HBV shots don't work	B; CS	Began vaccination	NS
	Perceived barriers: worried that people know I'm being immunized	M; LogR	Vaccination #2	RR = 3.8

	Perceived barriers: transportation to clinic		B; CS	Began vaccination	NS
	Perceived barriers: did not understand what clinic staff said		B; CS	Began vaccination	NS
	Perceived barriers: clinic staff did not explain things well		B; CS	Began vaccination	p = 0.014
	Self-efficacy to complete immunizations		B; CS	Began vaccination	NS
Stringer et al, 2006	Perceived pain associated with injection		M; LogR	Vaccine acceptance	NS
	At risk for Hepatitis B		M; LogR	Vaccine acceptance	NS
	Hepatitis B can cause death		M; LogR	Vaccine acceptance	NS
	Hepatitis B is spread by the Hepatitis B vaccine		M; LogR	Vaccine acceptance	NS
HIV					
Zimet et al, 1999	Perceived susceptibilty to HIV	$\alpha = .73$	M; LinR	Acceptability of HIV immunization among entire sample	$\beta = 0.19$**
				Acceptability of HIV immunization among sexually experienced adolescents	$\beta = 0.23$**
	Perceived severity of AIDS	$\alpha = .70$	M; LinR	Acceptability of HIV immunization among both samples	NS
	Perceived benefits of getting HIV vaccine	$\alpha = .62$	M; LinR	Acceptability of HIV immunization among entire sample	$\beta = .31$**
				Acceptability of HIV immunization among sexually experienced adolescents	$\beta = .32$**
	Perceived barriers: pragmatic obstacles	$\alpha = .70$	M; LinR	Acceptability of HIV immunization among both samples	NS
	Perceived barriers: non-membership in a high risk group	$\alpha = .72$	M; LinR	Acceptability of HIV immunization among entire sample	$\beta = 1.14$*
				Acceptability of HIV immunization among sexually experienced adolescents	NS
	Perceived barriers: fear of the vaccine	$\alpha = .70$	M; LinR	Acceptability of HIV immunization among entire sample	$\beta = -0.17$**
				Acceptability of HIV immunization among sexually experienced adolescents	NS

	Perceived barriers: fear of needles	α = .76	M; LinR	Acceptability of HIV immunization among entire sample	NS
				Acceptability of HIV immunization among sexually experienced adolescents	β = -0.22**
STI Vaccines					
Zimet et al, 2005	Perceived vulnerability to infection	α = .85	B; LinR	Vaccine acceptance	NS
	Anticipated anger associated with STI	α = .93	B; LinR	Vaccine acceptance	NS
	Anticipated anxiety associated with STI	α = .89	B; LinR	Vaccine acceptance	NS
Immunizations in general					
Glik et al, 2004	Fear of shots		M; GEE	Change in attitudes toward immunization from pre-test to post-test	β = -0.78**
	Fear of shots		M; GEE	Adolescent immunization uptake	OR = 0.634*
	Fear of shots		M; GEE	Talking to parents about immunizations	NS
	Fear of shots		M; GEE	Intention to get adolescent immunizations	NS
	Feelings towards doctors		M; GEE	Adolescent immunization uptake	NS
	Feelings towards doctors		M; GEE	Talking to parents about immunizations	OR = 0.584***
	Feelings towards doctors		M; GEE	Intention to get adolescent immunizations	NS
	Health concern		M; GEE	Adolescent immunization uptake	NS
	Health concern		M; GEE	Talking to parents about immunizations	OR = 1.53*
	Health concern		M; GEE	Intention to get adolescent immunizations	OR = 2.09**
	Health concern		M; GEE	Knowledge about immunizations	β = 1.05**
	Attitudes toward immunization at pre-test	α = .64	M; GEE	Change in attitudes toward immunization from pre-test to post-test	β = 0.46**
	Change in attitudes toward immunization from		M; GEE	Adolescent immunization uptake	NS

	pre-test to post-test			
	Change in attitudes toward immunization from pre-test to post-test	M; GEE	Talking to parents about immunizations	NS
	Change in attitudes toward immunization from pre-test to post-test	M; GEE	Intention to get adolescent immunizations	NS

KEY:
B = Bivariate, M = Multivariate
PPMC = Pearson product-moment correlation test
WRS = Wilcoxon rank-sum test
LogR = Logistic regression
CRA = Cox regression analysis
CS = Chi-square
LinR = Linear regression

Table 2.3. Adolescents' attitudes toward vaccinations attitudes assessed descriptively

Author, year	Attitudes Assessed	Analysis	Attitude components	Result
HPV				
Brabin et al, 2009	Girls' participation in vaccine decision making	Percentages	Girls shared in vaccine decision	77%
			Percent of girls whose parents refused the vaccine, but girls wanted it	42%
			Percent of girls vaccinated who did not want the vaccine	10%
			Percent of vaccinated girls who think girls should be able to make vaccine decisions without parental consent	70%
			Percent of unvaccinated girls who think girls should be able to make vaccine decisions without parental consent	41%
	Reasons for HPV vaccination	Percentages	Protection against cervical cancer	90.3%
			To avoid HPV infection	70%
	Social influences on views	Percentages	Parents	47%
			Friends	35%
			School nurses	35%
			Teachers	20%
	Consider HPV vaccine to be important	Percentages	Very important	54%
	Would recommend the vaccine to friends in the future		Percent of vaccinated girls who may not recommend the vaccine	39%
			Percent of unvaccinated girls may not recommend the vaccine	77%
	Fear of vaccination	Percentages	Heard rumors	49%
			Heard the injection was painful	24%
			Heard it caused significant side effects	9%
			Serious adverse events	8%
	Vaccine experience	Percentages	Felt ill after vaccination	20%
			Wished to discontinue the course	6%
	Sexual messages conveyed by HPV vaccination	Percentages	Wouldn't tell boyfriend they'd been vaccinated	24.8%
			Thought it was embarrassing because it was for an STI	21.4%
			Having the vaccine shows you are serious about your health	93.0%
			Vaccine reminds me of the possible risk of sexual contact	78.8%
			Might take more risks in the future because protected against HPV	13.6%

			Boyfriends expect me to take more risks because I am vaccinated	18.8%
Caskey et al, 2009	Barriers to HPV vaccination	Percentages	Not sexually active	47%
			Concerned about vaccine safety	26%
			Cost is too high	10%
			Unsure if vaccine works	16%
			Other	13%
			Doesn't think vaccine is needed	1%
			Vaccine not available	2%
	Facilitators to HPV vaccination	Percentages	Health provider recommended it	78%
			Parent recommended it	89%
			Health insurance covered entire cost	68%
			Had an abnormal pap smear in the past year	78%
			Had many close friends getting the vaccine	52%
Conroy et al, 2009	Reasons for vaccine refusal	Percentages	Concern about vaccine coverage	86.7%
	Reasons for being late to receive 2nd of 3rd dose	Percentages	Forgot to make an appointment	61.5%
			Forgot to return for an appointment thy made	38.5%
Forster et al, 2010	Intention to have the HPV vaccine among intenders	Qualitative; Coding themes	Beneficial to health	71.9%
			Perceived risk	13.0%
			Generally positive beliefs about vaccine being necessary or important	4.8%
	Intention to have the HPV vaccine among non-intenders	Qualitative; Coding themes	Perceived not to be at risk	18.8%
			Fear / anxiety	12.5%
			Social influence	12.5%
			Concerns about HPV vaccine	25%
			General vaccination beliefs (did not believe vaccines worked)	31.3%
	Intention to have the HPV vaccine among unsure participants	Qualitative; Coding themes	Beneficial to health	12.6%
			Need more information	42.5%
			Fear / anxiety	11.8%
			Other	12.6%

Hoglund et al, 2009	Comparison of HPV vaccine attitudes between boys and girls	Student's t-test	Own estimated risk of contracting STI	Girls higher p <.01**
			More unprotected sex if I was vaccinated	NS
			Less interested in using a condom if I was vaccinated	NS
			Other adolescenets would be less interested in using a condom if they were vaccinated	Girls higher p =.03
	Motivation to vaccinate against a specific STI	Percentages	Protection against an incurable disease	43%
			Avoiding the risk of becoming infertile	19%
			Protection against cancer	23%
Hoover et al, 2000	Rank of personal concern for potentially adverse outcomes of pregnancy	Rank	AIDS	#1
			Cervical cancer	#2
			Herpes	#3
			Genital warts	#4
			Pregnancy	#5
	Which type of HPV vaccine participants would prefer	Percentages	One that protects against 70% of cervical cancer and 100% of genital warts	83.3%
	When a woman should receive an HPV vaccine	Percentages	Before becoming sexually active	88.3%
			After becoming sexually active	5%
	Should men receive a vaccine against oncogenic HPV to protect their partners?	Percentages	Yes, strongly agreed	68.3%
			Yes, somewhat agreed	26.7%
			No, somewhat disagreed	3.3%
			No, strongly disagreed	1.7%
	Would pay for HPV vaccine if it was not covered by insurance	Percentages	Extremely likely	15%
			Somewhat likely	53.3%
			Somewhat unlikely	25%
			Extremely unlikely	6.7%
Kwan et al, 2008	Questions raised about HPV vaccination	Qualitative; Coding themes	Vaccine cost	
			Potential discomfort	
			Adverse effects (particularly on fertility and appearance)	
			Number of injections required	
			Duration of vaccine effectiveness	

	Vaccine refusal	Qualitative; Coding themes	Fear of pain Still too young No immediate perceived need No plan to have sex in the near future Uncertain duration of vaccine effectiveness	
	Perceived family reactions	Qualitative; Coding themes	Approval: supportive for "it is just protection" Disapproval: because of young age, thinking girls are too young for sex Concern about how family members would perceive girls if they wanted the HPV vaccine Fear family would think they were fooling around	
	Attitudes toward HPV vaccination and perceived support	T-test	More positive attitudes after focus group participation	p = 0.011
	Intention to be vaccinated	T-test	Higher intention after focus group participation	p = 0.013
	Willingness to conform to family's decisions	T-test	Higher willingness after focus group participation	p = 0.001
	Willingness to conform to peers	T-test	Higher willingness after focus group participation	p = 0.025
Moreira et al, 2006	Vaccine preference	Percentages	Protects against 70% of cervical cancer and 100% of genital warts Protects against 85% of cervical cancer exclusively Protects against 100% of genital warts exclusively	87% 10% 3%
Weisberg et al, 2009	Feel they have sufficient information to make a decision about HPV vaccination	Percentages	Yes	68.50 %
	Unlikely to complete course	Percentages	Yes	37.80 %
	Reasons for not having all 3 injections	List	Having a reaction to the vaccine Forgetting Not having time	
	Reasons for not having the vaccine	List	Insufficient knowledge Dislike of injections Worried about side effects	

			Didn't believe in vaccination	
			Pregnant	
			Family / friends discouraged	
			Not sexually active	
			Only one sexual partner	
			Doctor said they didn't need it	
			Bad study feedback	
	Importance of HPV vaccine for women	Percentages	Agree / strongly agree	78.20 %
	Importance of HPV vaccine for men	Percentages	Agree / strongly agree	27.80 %
	Preferred source of HPV vaccine	Percentages	FPNSW	24.50 %
			GP	20.70 %
			University or sexual health clinic	small #
Wong et al, 2008	HPV vaccine acceptability	Qualitative; Coding themes	Summary of key concepts in acceptance of HPV vaccine: Lack of knowledge about HPV / HPV vaccine	
			Vaccine not needed	
			Participanrs perceived themselves not to be at risk	
			Adverse effects	
			Promote promiscuity	
			Social stigma	
			Parental barrier	
			Halal	
			Cost	
			Physician recommendation	
			Mandatory vaccination	
	HPV vaccine acceptability	Percentages	Consider the vaccine acceptable for themselves	80%
Hepatitis B				
Butler et al, 2005	Shots can prevent disease	Percentages	Yes	70%
	Shots can be harmful	Percentages	Yes	50%
Slonim et al, 2005	Reasons someone would not get the first dose	List	Fear of needles	30%
			Vaccine safety	4%

			Side effects	3%
			Pain or side effects	10%
			Lack of knowledge	25%
			Low perceived susceptibility	14%
			Low perceived severity	4%
			Cost	15%
			Forgetting to come back	15%
			No time	15%
	What could be done to reduce barriers	List	Education	30%
			Reminder	14%
			Free vaccine	13%
			Stress need for all 3 shots	11%
			Have someone with Hepatitis B discuss physical and mental manifestations and consequences of the disease	30%
HIV				
Webb et al, 1999	Do you think adolescents would want to get a vaccine that works 90% of the time?	Percentages	Acceptable	89%
	Do you think adolescents would want to get a vaccine that works 50% of the time?	Percentages	Acceptable	28%
	Reasons 50% effective vaccine would be unacceptable	List	The probability of infection is still too high	
			Vaccine would be unnecessary, because it would not be an improvement over condom use	
	How would getting an AIDS vaccine (90% effective) influence adolescents' sexual behavior?	Percentages	Adolescents would increase HIV risk behaviors	77%
			Immunization would lead to a reduction in risk behaviors	14%
			No impact	9%
Zimet et al, 2000(2)	HIV vaccine acceptability	Ratings-based conjoint analysis	Assessed on 5 dimensions: cost, efficacy, mode of delivery, type, and parental permission required	
			Free, 90% efficacy, oral, killed, yes parental permission	#1
			Free, 90% efficacy, oral, killed, no parental permission	#2
			Free, 90% efficacy, 3 injections, synthetic, yes parental permission	#3

			$100, 50% efficacy, oral, synthetic, no parental permission	#16 (least)
	HIV vaccine acceptability	Choice-based conjoint analysis	Strongest influence on vaccine acceptability:	
			Vaccine efficacy (90% vs. 50%)	#1
			Type of vaccine (synthetic or killed vs. live)	#2
			Vaccine cost (free vs. cost)	#3
			Mode of delivery	#4
			Parental permission	#5
Infectious Disease				
Brown et al, 2009	Perceived severity of disease	Percentages	Believe the following diseases are very / fairly serious:	
			Meningitis	98%
			Polio	92%
			Rubella	84%
			Diptheria	71%
			Hib	70%
			Tetanus	62%
			Measles	60%
			Mumps	60%
			Whooping cough	49%
	Believe they are under-informed about vaccinations	Percentages	Not at all informed	32%
			Only a little informed	55%
	Believe vaccination should be covered by junior science syllabus	Percentages	Yes	67.9%
	Believe that diseases are potentially fatal	Percentages	Meningitis	92.1%
			Tuberculosis	73.6%
			Polio	60%
			Rubella	51%
			Measles	42%
			Diptheria	39%
			Tetanus	32%
			Whooping cough	24%
			Mumps	20%
	Would vaccinate own children against childhood diseases	Percentages	Yes	88.3%

Think vaccination should be compulsory	Percentages	Yes	42%
Think vaccines are riskier than the diseases against which they protect	Percentages	Yes	8%
Belief in vaccine safety	Percentages	Moderate / high risk:	
		BCG	11%
		MMR	18%
		Influenza	18%
		DTP	20%
		Tdap	21%
		IPV	23%
		MenC	24%
Think MMR can cause autism and Crohn's disease	Percentages	Yes: autism	22%
		Yes: Crohn's disease	8%
		Yes: both	4%
		No: Neither	12%
Think combination vaccines are a good idea	Percentages	Yes	43%
Consider their opinions to be influenced by others	Percentages	Parents	55.9%
		Media	32%
		Doctor	32%
		School	31.90 %
		Other	10.10 %

CHAPTER #3:
PSYCHOSOCIAL CORRELATES OF INTENTION TO RECEIVE AN INFLUENZA VACCINATION AMONG RURAL ADOLESCENTS

ABSTRACT

The CDC's Advisory Committee on Immunization Practices recently expanded annual influenza vaccination recommendations to include all children 6 months through 18 years of age. Adolescent attitudes toward influenza vaccination may play a key role in reaching this newly added age group. This study examined the association between attitudes toward influenza vaccination and intention to be vaccinated among rural adolescents. Data were collected from baseline surveys distributed to adolescents in September/October 2008, prior to the H1N1 influenza pandemic, in two counties participating in a school-based influenza vaccination intervention trial in rural Georgia (N=337). Survey items were based on constructs from the Health Belief Model and the Integrated Behavioral Model. Approximately one-third of participants (33.8%) intended to receive an influenza vaccination, 33.5% did not intend to be vaccinated, and 28.8 % were unsure. Controlling for background factors, intention to receive an influenza vaccination was associated with low perceived barriers (OR=0.77, p<.001), injunctive norms (OR=1.23, p=.002), and receipt of influenza vaccination in the past year (OR=6.21, p<.001). Findings suggest that perceived barriers and injunctive social norms may influence vaccination acceptance among rural adolescents. Future influenza vaccination efforts geared towards rural middle and high-school students may benefit from addressing adolescent attitudes toward influenza vaccination.

INTRODUCTION

Influenza consistently ranks among the top ten leading causes of death in the United States, with influenza-related illnesses and deaths occurring most frequently among elderly persons ≥ 65 years, people with medical complications, and infants under 2 years (Anderson & Smith, 2005; M. Heron, 2007; M. P. Heron & Smith, 2007; Kung, Hoyert, Xu, & Murphy, 2008). However, rates of influenza are highest among school-age children, who serve as the primary transmitters of influenza to persons at high risk for complications (Anthony E. Fiore et al., 2007; Fox, Cooney, Hall, & Foy, 1982; Fox, Hall, Cooney, & Foy, 1982; Foy, Cooney, & Allan, 1976; Frank et al., 1983; W. Paul Glezen, 1982; W. P. Glezen, 1982; Monto & Kioumehr, 1975). Influenza vaccination is the most effective method for preventing influenza infection, and vaccination of school-age children may indirectly protect populations vulnerable to influenza infection (Anthony E. Fiore et al., 2007; Glezen, 2006). In February 2008, the CDC's Advisory Committee on Immunization Practices (ACIP) recommended that annual influenza vaccination of children to include all children from 6 months through 18 years of age, expanding the previous recommendation of annual influenza vaccination for children aged 6 months to 4 years and older children with conditions that place them at increased risk for complications from influenza (A. E. Fiore et al., 2008).

Nearly all U.S. children attend school on a daily basis, with attendance rates ranging from 92.0% to 98.2% among students aged 10-18 years (US Census Bureau, 2008). Consequently, school-based vaccination programs may provide an efficient, effective strategy to immunize large numbers of school-age children and adolescents against influenza compared with other methods, such as individually-scheduled

physician visits (Luce et al., 2001; Reynolds et al., 1999; Vernon, Bryan, Hunt, Allensworth, & Bradley, 1997). School-based vaccination may be an especially important strategy among rural, low-income, minority populations. Rural areas have historically experienced higher poverty than urban or metro areas (USDA Economic Research Service, 2003), and lower influenza vaccination rates have been associated with living in a deprived area and minority status (Bryant, 2006; Coupland et al., 2007; O'Malley, 2006; Rangel et al., 2005; USDA Economic Research Service, 2003; Winston, 2006). African-Americans, in particular, consistently have lower influenza vaccination rates than other racial/ethnic groups (Bryant, 2006; Centers for Disease Control and Prevention, 2005; Collins, 1999; Figaro, 2005; Lashuay et al., 2000; O'Malley, 2006; Ostbye, 2003; Rangel et al., 2005; Winston, 2006). Although such disparities in influenza vaccination are clearly present in the elderly, it is unclear whether similar gaps persist among school-age children. There is evidence, however, clearly documenting disparities in other vaccinations among children. In 1999, The National Vaccine Advisory Committee identified poverty and its associated factors as the most "powerful and persistent" barriers to immunization among children ("Strategies to sustain success in childhood immunizations. The National Vaccine Advisory Committee," 1999). Further research has documented persistently low vaccination coverage among children living in poverty, and that children living near poverty have coverage levels similar to children living below poverty (Klevens & Luman, 2001). Despite a decline in rural childhood poverty during the 1990s, the rural child poverty rate remains higher than the urban rate (19 % versus 15 %) (USDA Economic Research Service, 2003). Furthermore, in non-metro areas, African-American and Hispanic

children are almost twice as likely to be poor as white children (USDA Economic Research Service, 2003). The sharp inequalities in vaccination coverage among rural, low-income, minority populations underscore the potential benefits of school-based influenza vaccination interventions.

While school-based programs may provide an excellent opportunity to vaccinate students who may not otherwise be immunized, such programs may face challenges in reaching adolescents. While younger children primarily depend on family members and schools for health decisions, adolescents are more likely to establish their own health-related attitudes and behaviors independently (Coates, Peterson, & Perry, 1982). Parental provision of informed consent may be a necessary, but insufficient step in ensuring that adolescents are vaccinated against influenza. Without direct parental supervision, the adolescent may opt out of vaccination in school-based programs as a result of their own attitudes towards vaccination. Thus, adolescent attitudes toward influenza vaccination may play a key role in immunization outcomes.

There is some debate in the field as to which, if any theory is most appropriate for designing, implementing, and evaluating studies regarding vaccination behaviors. Due to the Health Belief Model (HBM)'s original inception as an explanation for the failure of participation in tuberculosis screenings, it is still considered to be most appropriate for use with medical service-related behaviors, such as vaccinations, where illness avoidance and perceived threat are the most salient issues (Noar & Zimmerman, 2005; Rosenstock, 1974). However, additional research indicates that alternative theories, such as the Theory of Reasoned Action (TRA), which focuses on predictors of behavioral intention (Montano & Kasprzyk, 2008), and the Triandis Model (Montano,

1986) may be most appropriate for understanding influenza vaccination behavior (Montano, 1986). Based on evidence supporting the utility of multiple theories, our study incorporated constructs from two prominent behavior change theories: The HBM (Becker, 1974), and the Integrated Behavioral Model (IBM) (Montano & Kasprzyk, 2008), which incorporates constructs from both the TRA and the Triandis Model.

To date, research has shown that: 1) Influenza is a pressing health concern in the United States (Anderson & Smith, 2005; M. Heron, 2007; M. P. Heron & Smith, 2007; Kung et al., 2008); 2) Vaccinating school-age children against influenza may reduce the burden of influenza among children and high-risk populations (Anthony E. Fiore et al., 2007; Glezen, 2006); 3) Influenza vaccination may be especially important for low-income, rural, and minority populations (Bryant, 2006; Coupland et al., 2007; O'Malley, 2006; Rangel et al., 2005; USDA Economic Research Service, 2003; Winston, 2006); 4) Schools may be an effective location for vaccine delivery to children (Luce et al., 2001; Reynolds et al., 1999; Vernon et al., 1997); and 5) Attitudes and beliefs toward influenza vaccination, particularly attitudes emphasized by the Health Belief Model (HBM) (Becker, 1974) and Integrated Behavioral Model (IBM) (Montano & Kasprzyk, 2008), may influence vaccination behavior among adult populations (Montano, 1986).

However, there is a gap in the empirical literature with respect to adolescent attitudes toward influenza vaccination and the role that attitudes play in predicting vaccination behavior. This study sought to examine theory-based attitudes and beliefs toward influenza vaccination among a sample of low-income, rural adolescents to identify psychosocial factors associated with intention to receive an influenza vaccination.

METHODS

Study Sample

Study participants were drawn from schools participating in a non-randomized controlled trial of a school-based influenza vaccination intervention in the East Central Health District of Augusta, Georgia, including a multi-component school-based influenza vaccination intervention condition (County 1), and a standard of care condition (County 2). Data for the present study were derived from a baseline survey, completed prior to intervention implementation, among students in both County 1 and County 2. The baseline survey was completed by participants in September and October of 2008, prior to the H1N1 influenza pandemic. Participating counties were selected because they are relatively small (one middle- and high-school per county), rural, and have substantial minority populations. Eligibility criteria included: 1) being enrolled in middle or high-school in either County 1 or County 2; 2) providing written assent forms to participate in the study, and 3) providing parental written informed consent for the adolescent to participate in the study. This study was approved by the institutional review board at Emory University.

Data Collection and Survey Instrument

Data were collected via self-administered paper-and-pencil surveys distributed to adolescents attending middle and high-school in participating counties prior to implementing the intervention. Packets containing 1) a brief overview of the study, 2) a parental informed consent form, 3) a student assent form, and 4) an adolescent survey were mailed home to all enrolled students. Students were given three weeks to return the signed forms and the completed survey to their homeroom teachers. Ten-dollar Wal-mart

gift cards were provided as incentives to students who returned all signed forms and completed surveys. At each school site, an extra gift card was offered as an incentive for all students in the homeroom that achieved the largest response rate. The survey instrument was designed to investigate demographic, behavioral, and psychosocial factors associated with influenza vaccination. Based on previous research and recent theoretical development (Daley et al., 2007; Montano, 1986; Montano & Kasprzyk, 2008), psychosocial survey items were guided by the Health Belief Model (HBM) (Becker, 1974; Rosenstock, 1974) and the Integrated Behavioral Model (IBM) (Montano & Kasprzyk, 2008), which is based on the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975). Because no previous questionnaires have been developed to assess adolescent attitudes and beliefs toward influenza vaccination, questions were adapted from surveys with demonstrated reliability and validity among parents, including surveys by Daley et al. (Daley et al., 2007) and Poehling et al. (Hemingway & Poehling, 2004; Ma et al., 2006; Poehling et al., 2001).

Measures

Main outcome measure: The main outcome measure, intention to receive an influenza vaccination, was measured by asking: "Do you plan to get the flu vaccine next fall or winter?" This was a dichotomous variable (y/n).

Background factors: Participants were asked to report gender (dichotomous), race (categorical), age (continuous), middle or high-school (dichotomous), and vaccination history regarding receipt of an influenza vaccination in the past year (dichotomous).

Attitudes and beliefs toward influenza and influenza vaccination: The items comprising each psychosocial measure are detailed in Table I. All psychosocial

constructs were measured by questions based on five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). The range for each construct represents the addition of the responses to each item within that measure. For example, "perceived barriers" includes five questions, meaning responses could range from 5 (an answer of 1 to each question), to 25 (an answer of 5 to each question).

Psychosocial measures guided by the HBM included: 1) perceived severity of influenza infection (2 item scale, alpha = 0.80), 2) perceived susceptibility to influenza infection (1 item), 3) perceived barriers to influenza vaccination (5 item index, alpha = 0.58), 4) perceived benefits of influenza vaccination (4 item scale, alpha = 0.83), and 5) perceived self-efficacy to get vaccinated against influenza (2 item scale, alpha = 0.58). The perceived barriers variable was treated as an index, as opposed to a scale, because each item represented a different reason for not getting an influenza vaccination. Consequently, the reliability for perceived barriers was relatively low, as is typical for an index.

Psychosocial measures guided by the IBM included: 1) injunctive social norms for influenza vaccination (4 item scale, alpha = 0.89), 2) descriptive social norms for influenza vaccination (2 item scale, alpha = 0.74), and 3) perceived behavioral control (1 item).

Data Analysis

All analyses were conducted using SPSS version 15.0. Descriptive statistics were used to assess the distributions of background variables, psychosocial variables, and outcome variables among survey respondents. T-tests were used to compare mean scores for Likert items measuring psychosocial constructs across participants by intention to

receive an influenza vaccination. Questions assessing psychosocial constructs were combined into scales, and Cronbach's alphas were calculated for each scale to assess its internal consistency. Bivariate analyses were used to assess associations between background factors, psychosocial constructs, and the outcome variable. Only control variables (gender, race, age, and receipt of an influenza vaccination in the past year), and psychosocial variables that demonstrated significant bivariate associations at the $p = 0.10$ level, were included in multivariate logistic regression analyses. Age was used instead of middle or high-school level because it is a continuous variable, and therefore provides more detailed information. Controlling for background factors, Model 1 assessed the association between HBM-based psychosocial variables and intention to receive an influenza vaccination, and Model 2 assessed the association between IBM-based psychosocial variables and intention to receive an influenza vaccination. Model 3 built on the logistic regression equation in Models 1 and 2 by including both HBM and IBM-based variables.

RESULTS

Demographics and Characteristics Results

Out of 1199 eligible students, 337 participated in the study (28.1% response rate). In total, 45.7 % of respondents were from County 1 (n=154, 42.3% response rate) and 54.3% of respondents were from County 2 (n=183, 22.0% response rate). Respondents were mostly female (56.0%), black (75.1%), and in middle-school (56.9%). Mean age of respondents was 14, (SD=3). Comparisons with the full eligible population indicated that the study sample included a higher representation of female, black, and middle-school participants (respectively 47.9%, 68.0%, and 44.7% in the full eligible sample).

When asked "Do you plan to get the flu vaccine next fall or winter," 33.8% (n=114) of students responded "yes," 33.5% (n=113) responded "no," 28.8% (n=97) responded "don't know," and 3.9% (n=13) did not respond. Because students who responded "no" and "don't know" did not demonstrate a clear intention to receive an influenza vaccination, they were combined for analyses, totaling 62.3% (n=210) (Table 3.1). [Supplementary analyses indicated some differences between the students who responded "no" and "don't know" with respect to certain theoretical constructs. However, there were no substantive changes to the main results when the "don't know" group was excluded from analyses.] Compared to participants who did not plan to receive an influenza vaccination, participants who did intend to receive an influenza vaccine had lower mean scores on perceived barriers to influenza vaccination, and higher mean scores of perceived benefits, self-efficacy, injunctive social norms, and descriptive social norms supportive of influenza vaccination. The majority of participants who reported intention to receive an influenza vaccination also reported receiving an influenza vaccination in the previous year (50.9%), compared to only 7.7% of participants who did not plan to receive an influenza vaccination.

Bivariate and Multivariate Analyses

Bivariate and multivariate logistic regression analyses are presented in Table 3.2. In bivariate analyses, the only background factors significantly associated with intention to receive an influenza vaccination were female gender ($p = .02$) and receipt of an influenza vaccination in the past year ($p < .001$). HBM constructs associated with intention to receive an influenza vaccination were perceived susceptibility ($p = .002$), perceived benefits ($p < .001$), perceived barriers ($p < .001$), and self-efficacy ($p < .001$).

IBM constructs associated with intention to receive an influenza vaccination were injunctive social norms ($p < .001$) and descriptive social norms ($p < .001$). Intention to receive an influenza vaccination was not associated with race, age, middle or high-school level, perceived severity of influenza, or control beliefs.

In Model 1, the odds of reporting intention to receive an influenza vaccination were 1.28 times larger among adolescents reporting higher self-efficacy for getting an influenza vaccination ($p = .015$), and 8.40 times larger among adolescents who received an influenza vaccination in the past year ($p < .001$). Adolescents who reported more perceived barriers toward influenza vaccination were significantly less likely to report intention to receive an influenza vaccination ($p < .001$). Although perceived susceptibility to influenza, perceived benefits of influenza vaccination, and female gender were significantly associated with intention to receive an influenza vaccination in bivariate analyses, these associations were not significant when background factors and other HBM constructs were included in the model (Table 3.2).

In Model 2, the odds of reporting intention to receive an influenza vaccination were 1.27 times larger among adolescents reporting injunctive norms supportive of influenza vaccination ($p < .001$), and 7.13 times larger among students who received an influenza vaccination in the past year ($p < .001$). Although descriptive social norms and female gender were significantly associated with intention to receive an influenza vaccination in bivariate analyses, these associations were not significant when background factors and other IBM constructs were included in the model (Table 3.2).

Several variables that were significantly associated with intention to receive in influenza vaccination in Models 1 and 2 remained significant in Model 3, including

receipt of an influenza vaccination in the past year (OR = 6.21, $p < .001$), the HBM construct of perceived barriers to influenza vaccination (OR = 0.77, $p < .001$), and the IBM construct of injunctive social norms supportive of influenza vaccination (OR = 1.23, $p = .002$) (Table II). Although self-efficacy for getting an influenza vaccination was significant in the Model 1, this association was no longer statistically significant when controlling for background, HBM, and IBM variables (Table 3.2).

DISCUSSION

This study demonstrates an association between theory-driven measures of attitudes and beliefs toward influenza vaccination and intention to receive an influenza vaccination among a sample of primarily minority, rural adolescents. Findings from this study indicate that constructs from multiple theories, including the HBM and IBM (based on the TRA), may be useful in explaining intention to receive an influenza vaccination among rural adolescents.

In bivariate analyses, both background factors (female gender and receipt of an influenza vaccination in the past year), and key theoretical constructs from the HBM and IBM demonstrated significant associations with intention to receive an influenza vaccination. From the HBM, the constructs of perceived susceptibility to influenza, perceived benefits of influenza vaccination, perceived barriers to influenza vaccination, and self-efficacy for influenza vaccination demonstrated significant associations. From the IBM, injunctive and descriptive social norms emerged as significant variables associated with intention to receive an influenza vaccination.

In separate multivariate analyses, the HBM constructs of perceived barriers to influenza vaccination and self-efficacy for influenza vaccination (Model 1), and the IBM

construct of injunctive social norms supportive of influenza vaccination (Model 2) emerged as significant psychosocial correlates of intention to receive an influenza vaccination. Models 1 and 2 demonstrated that, controlling for background factors, constructs from both the HBM and the IBM were significantly associated with intention to receive an influenza vaccination. Model 3 illustrated that certain constructs from both the HBM (perceived barriers to influenza vaccination) and IBM (injunctive norms supportive of influenza vaccination) persisted as significant predictors of intention to receive an influenza vaccination while controlling for background factors and constructs from both theories. However, the HBM construct of self-efficacy for influenza vaccination was no longer significant when IBM variables were added in Model 3. Taken together, Models 1, 2, and 3 indicate that it may be important to incorporate constructs from multiple theories when addressing vaccination behaviors.

Although there is a dearth of research detailing adolescent attitudes toward influenza vaccination, these results are consistent with findings from previous studies that report associations between similar constructs and influenza vaccination uptake among non-adolescent populations such as elderly adults, health care workers, and parents of young children (Daley et al., 2007; Hofmann, Ferracin, Marsh, & Dumas, 2006; Nowalk et al., 2007; Ward & Draper, 2008). A review article by Ward et al. found that beliefs about vaccine safety, effectiveness, and side effects; perceived risks and consequences of contracting influenza; and perceived health status were key determinants of influenza vaccination among older adults (Ward & Draper, 2008). Further research suggests that access to care (Fiscella, 2002; Rangel et al., 2005), lack of provider recommendation (Winston, 2006), attitudes towards vaccination (Lindley, 2006; Winston, 2006), mistrust

of the vaccine, and believing that the vaccine causes influenza (Chen, Fox, Cantrell, Stockdale, & Kagawa-Singer, 2007) play a role in influenza vaccination outcomes among African-American adults. In a literature review of influenza vaccination among healthcare workers, Hofman et al. found that fear of adverse effects, the misconception that vaccine causes influenza, low perceived risk, inconvenient vaccination schedules, perception that influenza is not a serious disease, beliefs about vaccine inefficacy, and fear of injections were barriers to vaccine uptake (Hofmann et al., 2006). A study of parental attitudes toward child immunization found that anticipating immunization barriers and perceiving that influenza vaccination is the social norm may impact vaccination (Daley et al., 2007).

To our knowledge, this is the first study to demonstrate a significant association between attitudes toward influenza vaccination and intention to receive an influenza vaccination among an adolescent population. Whether rural adolescents' attitudes and beliefs toward influenza vaccination, including intention to receive an influenza vaccination, impact vaccine uptake remains to be seen. Because parental consent is a necessary factor in influenza vaccination for this population, the degree to which adolescent attitudes impact vaccine uptake may vary across families. Yet in general, compared to younger children, adolescents are more likely to take control of their own health-related attitudes and behaviors (Coates et al., 1982). Adolescent attitudes have been demonstrated to differ from parental attitudes with regard to several health behaviors, including vaccination (McGuire, Hannan, Neumark-Sztainer, Cossrow, & Story, 2002; Pakpreo, Ryan, Auinger, & Aten, 2004; Woodhall et al., 2007; Zimet, Mays, Sturm, & Ravert, 2002; G. D. P. Zimet et al., 2005). For example, Zimet et al. found that

parent-adolescent pairs were not likely to agree on who would be the primary decision-maker regarding adolescent STD vaccination. While 42% of parents reported they would be the primary decision-maker, only 12% of adolescents saw their parents in this role. On the contrary, 36% of adolescents reported that they would be the primary decision-maker, yet only 10% of parents saw their children in this role (G. D. P. Zimet et al., 2005). Other studies have shown that determinants of HPV vaccination acceptance differ among parents and adolescents (Woodhall et al., 2007), and that while adolescents may look to their parents for guidance concerning STD vaccination acceptance, their personal experiences may also be influential (G. D. Zimet et al., 2005). Attitudes regarding vaccines for sexually transmitted infections such as HPV may be very different than attitudes regarding vaccines for non-sexually transmitted infectious diseases such as influenza. However, the large majority of published research to date examining parental and adolescent attitudes toward vaccination focuses on HPV vaccination. More research on adolescent attitudes toward other vaccinations, including influenza vaccination, is warranted.

The findings of this study may be particularly useful for developing interventions seeking to increase the acceptance of influenza vaccination among adolescents. First, students with higher mean scores on the perceived barriers index were significantly less likely to plan on receiving an influenza vaccination. Interventions to increase influenza vaccination uptake among adolescent populations should identify and debunk key barriers relevant to the target adolescent population. Potential barriers of importance may include beliefs that the influenza vaccination causes people to get sick, does not prevent influenza, costs too much money, or is painful and uncomfortable. Second, injunctive

norms, or the perception that most people would approve of getting an influenza vaccine, was significantly associated with intention to receive an influenza vaccination. Based on this finding, interventions may benefit from emphasizing that doctors highly recommend getting an influenza vaccination. This finding also underscores the importance of intervening on multiple levels, including parents, providers, school administrators, peers, and teachers. Finally, adolescents who reported receiving an influenza vaccine in the past year are highly likely to plan on getting the vaccine in the next year. Thus, if interventions are successful in persuading adolescents to be vaccinated at least one time, adolescents may continue receiving an influenza vaccination in the future.

Limitations

This study has several limitations. First, this is a cross-sectional study. Thus, a causal link between attitudes toward vaccination and intention to receive an influenza vaccination cannot be established. Second, the outcome is intention to receive an influenza vaccination, not actual influenza vaccination. Although intention to receive an influenza vaccination is often highly correlated with the behavior itself, the correlation is imperfect. Self-reported intention to receive an influenza vaccination may also be prone to social desirability bias, where participants may indicate that they intend to receive an influenza vaccination because they believe that this will please the researchers. Third, the study population comprises predominantly African-American adolescents in a low-SES rural setting in a Southeastern state. Thus, the results of this study may not be generalizable to adolescents of other ethnicities or those residing in urban areas and other geographic locations. An additional limitation is that the survey did not collect information regarding whether respondents had a high-risk condition that would have

caused them to be recommended for annual vaccination prior to the expansion of the ACIP's recommendation to annually vaccinate all children and adolescents. Finally, the response rate was relatively low (28.1%), indicating the possibility of response bias among students who are more interested in influenza vaccination, compared to students who may not have a vested interest. However, research suggests that low response rates are a consistent challenge for school-based studies requiring active parental consent (Claudio & Stingone, 2008; Ji, Pokorny, & Jason, 2004; McMorris et al., 2004). Unfortunately, this may have challenging implications for obtaining parental consent for school-based medical interventions, such as vaccination. Also, the response rate varied from 22.0% in the standard of care county to 42.3% in the intervention county. This difference indicates a response bias among students in the intervention county, and is likely because the study team had increased contact with school staff, including homeroom teachers and administrators, in the intervention county. Thus, the staff in the intervention county more likely to remind students to return their consent forms and surveys.

CONCLUSIONS

The findings from this study, taken with the literature regarding a) attitudes toward influenza vaccination among non-adolescent age groups and b) uniqueness of adolescents with respect to vaccination decision making, highlight the importance of understanding the role that adolescent attitudes toward influenza vaccination play in impacting vaccine uptake. Findings from this study also underscore the importance of using constructs from multiple theories, including the HBM and the IBM, to inform studies investigating adolescent attitudes toward influenza vaccination. Future influenza

vaccination efforts geared towards rural middle and high-school students may benefit from addressing adolescents' attitudes toward influenza vaccination. The HBM construct of perceived barriers to influenza vaccination and the IBM construct of injunctive social norms supportive of influenza vaccination may be particularly important to address. However, as with developing any intervention, formative research should be conducted with potential study populations to ensure that these constructs are relevant. Future research is necessary to determine the relationship between intention to receive an influenza vaccination and vaccine uptake, and to explore which psychosocial factors are most salient to influenza vaccination among non-rural adolescent populations. Future intervention studies should also investigate whether targeting perceived barriers to influenza vaccination and injunctive social norms supportive of influenza vaccination impacts adolescents' intention to receive an influenza vaccination and influenza vaccine uptake.

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Table 3.1. HBM and IBM based psychosocial factors and intention to receive an influenza vaccination next year (N=324)

		Mean scores among respondents by intention to receive an influenza vaccination next year		
		Yes (n=114)	No/ Don't Know (n=210)	P-value
Psychosocial Variables	**Range**	**Mean (SD)**	**Mean (SD)**	
Perceived Severity of influenza (HBM)	**2-10**	**7.85 (1.73)**	**7.45 (1.98)**	**0.08**
The flu is a serious disease		4.13 (0.91)	3.94 (1.07)	0.12
The flu is a serious disease for teenagers		3.73 (0.98)	3.51 (1.08)	0.07
Perceived Susceptibility to influenza (HBM)	**1-5**	**2.43 (1.12)**	**2.85 (1.13)**	**0.002**
I am not very likely to get the flu				
Perceived Benefits to influenza vaccination (HBM)	**5-20**	**14.18 (3.4)**	**12.58 (3.74)**	**<0.001**
The flu vaccine will prevent me from getting sick with the flu		3.61 (1.00)	3.13 (1.06)	<0.001
If I get the flu vaccine, it will help protect my friends and family from getting the flu		3.24 (1.16)	2.89 (1.15)	0.009
The flu vaccine will prevent me from missing school because of the flu		3.68 (1.04)	3.26 (1.18)	0.002
If I get the flu vaccine, it will prevent my parent / guardian from missing work to take care of me		3.67 (1.08)	3.31 (1.22)	0.009
Perceived Barriers to influenza vaccination (HBM)	**5-25**	**12.93 (2.92)**	**15.01 (3.17)**	**<.001**
The flu vaccine will make me sick		2.54 (1.07)	3.02 (1.13)	<.001
The flu vaccine does not prevent the flu		2.57 (0.96)	3.05 (1.04)	<.001
Getting a flu vaccine costs too much money		2.18 (0.92)	2.67 (0.95)	<.001
Getting the flu vaccine is painful or uncomfortable		2.63 (1.11)	3.09 (1.04)	<.001
I would feel sore the day after a flu vaccine		3.06 (1.14)	3.23 (0.97)	0.18
Self-efficacy for influenza vaccination (HBM)	**2-10**	**7.61(1.75)**	**6.43 (1.99)**	**<.001**
I feel comfortable getting the flu vaccine		3.69 (1.14)	2.93 (1.21)	<.001
I would feel comfortable asking my parent / guardian to take me to get a flu vaccine		3.89 (1.01)	3.51 (1.14)	0.004
Perceived Behavioral Control (IBM)	**1-5**	**3.03 (1.24)**	**3.15 (1.25)**	**0.40**
I have control over whether or not I get a flu vaccine				
Social norms for influenza vaccination (injunctive) (IBM)	**4-20**	**15.69 (3.19)**	**11.99 (3.75)**	**<.001**

Most people important to me think I should get a flu vaccine		3.99 (0.97)	3.01 (1.12)	<.001
My doctor thinks I should get a flu vaccine		4.15 (0.94)	3.26 (1.10)	<.001
My parent / guardian thinks I should get a flu vaccine		4.12 (0.91)	2.98 (1.17)	<.001
My friends think I should get a flu vaccine		3.41 (0.99)	2.70 (1.04)	<.001
Social norms for influenza vaccination (descriptive) (IBM)	**2-10**	**7.07 (1.72)**	**5.86 (1.90)**	**<.001**
I know other people my age who got the flu vaccine		3.67 (0.99)	3.21 (1.19)	<.001
Most of my friends get the flu vaccine		3.40 (0.93)	2.65 (0.98)	<.001
Habit (IBM)	**0-1**	**50.88%**	**7.65%**	**<.001**
Did you get a flu vaccine last fall or winter?				

Table 3.2. Factors Associated with Intention to receive an Influenza Vaccination among Rural Adolescents (N=324)

Factor	Bivariate /Unadjusted OR (95%CI)	p-value	MODEL 1 (HBM) Multivariate /Adjusted OR (95%CI)	p-value	MODEL 2 (IBM) Multivariate /Adjusted OR (95%CI)	p-value	MODEL 3 (HBM + IBM) Multivariate /Adjusted OR (95%CI)	p-value
Gender								
Male	Reference	-	Reference	-	Reference	-	Reference	-
Female	1.73 (1.10, 2.74)	0.02	1.87 (0.96, 3.62)	0.06	1.69 (0.90, 3.14)	0.10	1.71 (0.85, 3.44)	0.13
Race								
White	Reference	-	Reference	-	Reference	-	Reference	-
Black	1.03 (0.25, 4.26)	0.97	1.02 (0.14, 7.28)	0.98	1.90 (0.31, 11.50)	0.47	1.65 (0.25, 11.04)	0.60
Other	1.62 (0.42, 6.27)	0.48	2.18 (0.32, 14.68)	0.42	2.93 (0.53, 16.05)	0.22	3.04 (0.49, 18.86)	0.22
Increasing age, in years	0.95 (0.87, 1.03)	0.17	1.00 (0.88, 1.13)	0.95	0.99 (0.89, 1.10)	0.82	1.02 (0.90, 1.15)	0.79
School Level								
Middle School	Reference	-	-	-	-	-	-	-
High School	1.35 (0.85, 2.15)	0.20	-	-	-	-	-	-
Receipt of influenza vaccination in the past year								
No	Reference	-	Reference	-	Reference	-	Reference	-
Yes	12.62 (6.68, 23.84)	<.001	8.40 (3.91, 18.02)	<.001	7.13 (3.48, 14.60)	<.001	6.21 (2.78, 13.90)	<.001
HBM Constructs								
Perceived Susceptibility	0.71 (0.58, 0.88)	0.002	0.80 (0.59, 1.08)	0.15	-	-	0.85 (0.61, 1.18)	0.33
Perceived Severity	1.12 (0.99, 1.28)	0.08	1.07 (0.88, 1.30)	0.52	-	-	1.00 (0.79, 1.27)	0.99
Perceived Benefits	1.14 (1.06, 1.22)	<.001	1.02 (0.92, 1.13)	0.71	-	-	0.97 (0.86, 1.09)	0.59
Perceived Barriers	0.80	<.001	0.78	<.001	-		0.77	<.001

	(0.73, 0.87)		(0.69, 0.87)				(0.68, 0.88)	
Self-efficacy	1.41	<.001	1.28	.015	-	-	1.14	0.27
	(1.23, 1.62)		(1.05, 1.58)				(0.90, 1.44)	
IBM Model Constructs								
Injunctive social norms	1.37	<.001	-	-	1.27	<.001	1.23	0.002
	(1.26, 1.49)				(1.15, 1.41)		(1.08, 1.40)	
Descriptive social norms	1.44	<.001	-	-	1.18	0.11	1.11	0.35
	(1.26, 1.66)				(0.97, 1.43)		(0.89, 1.39)	
Control Beliefs	0.92	0.40	-			-	-	
	(0.77, 1.11)							

CHAPTER #4:
ADOLESCENTS' ATTITUDES TOWARDS INFLUENZA VACCINATION AND VACCINE UPTAKE IN A SCHOOL-BASED INFLUENZA VACCINATION INTERVENTION: A MEDIATION ANALYSIS

ABSTRACT

Background: School-based vaccination programs may provide an effective strategy to immunize adolescents against influenza. This study examined whether adolescent attitudes toward influenza vaccination mediated the relationship between receipt of a school-based influenza vaccination intervention and vaccine uptake.

Methods: Participants were recruited from two counties participating in a school-based influenza vaccination intervention trial in rural Georgia (N=337). Data were collected from surveys distributed to adolescents at pre- and post-intervention time points and from documents indicating vaccine uptake. Guided by the Health Belief Model and the Integrated Behavioral Model, surveys assessed demographic, behavioral, and psychosocial variables. A mediation analysis was used to test whether changes in psychosocial variables from baseline to follow-up mediated the relationship between intervention condition and influenza vaccine uptake.

Results: Controlling for background variables, Step 1 of the mediation analysis revealed a significant relationship between study condition and vaccine uptake (OR=1.77, p=.038). Step 2 of the mediation analysis revealed a significant relationship between intervention condition and changes in psychosocial variables from baseline to follow-up. Steps 3 and 4 of the mediation analysis revealed that there was full mediation of the relationship between intervention condition and receipt of an influenza vaccination by intention to receive an influenza vaccination.

Conclusions: Findings suggest that the success of our school-based influenza vaccination intervention in increasing vaccine uptake may have been mediated adolescent's intention to receive an influenza vaccination. Future influenza vaccination efforts geared towards rural adolescents may benefit from addressing adolescent attitudes toward influenza vaccination, particularly increasing intention to receive a vaccine.

INTRODUCTION

Influenza is a significant source of morbidity and mortality in the United States, accounting for an average of 36,000 deaths and over 200,000 hospitalizations each year (Heron et al., 2009; Thompson et al., 2004; Thompson et al., 2003). Influenza-related illnesses and deaths occur most frequently among elderly persons $\geq$ 65 years, people with medical complications, and infants under 2 years (Barker, 1986; Barker & Mullooly, 1980; Monto & Kioumehr, 1975). Although school-age populations are not considered to be at high risk of influenza mortality, annual morbidity is strikingly high, with illness attack rates exceeding 10% in most years (Halloran & Longini, 2006). In addition, children and adolescents are the primary transmitters of influenza within communities; not only do they have the highest attack rates in annual epidemics (Glezen & Couch, 1978; Glezen, Greenberg, Atmar, Piedra, & Couch, 2000; Monto & Kioumehr, 1975), but infected youth also shed virus for longer periods than adults (Belshe, Maassab, & Mendelman, 2004).

Empirical evidence suggests that universal vaccination of school-age populations indirectly protects the elderly and other vulnerable community members by preventing viral transmission (Glezen, 2006). Furthermore, mathematical simulations of influenza transmission indicate that vaccinating just 20% of U.S. school children would reduce overall mortality in adults over 65 years of age more successfully than vaccinating 90% of the elderly (Halloran & Longini, 2006). Accordingly, in 2008, the CDC's Advisory Committee on Immunization Practices (ACIP) expanded the recommended ages for annual influenza vaccination to include all children and adolescents from 6 months through 18 years of age (Fiore et al., 2008).

School-based vaccination programs may provide an efficient, effective strategy to immunize school-age populations against influenza (Reynolds et al., 1999; Vernon, Bryan, Hunt, Allensworth, & Bradley, 1997). Because 95% of U.S. youth attend school on a daily basis (Vernon et al., 1997), school-based vaccination has the potential to be a more effective mechanism for vaccinating large numbers of children and adolescents against influenza than individually scheduled physician visits (Luce et al., 2001). Although many recent influenza vaccination campaigns have been carried out successfully in primarily white, middle-class, elementary school populations, efforts to enhance vaccination rates among African-American, low-income, adolescents have faced greater challenges (Carpenter et al., 2007).

School-based vaccination may be a particularly important strategy to reach rural, low-income, and minority youth. In 1999, The National Vaccine Advisory Committee identified poverty and its associated factors as the most "powerful and persistent" barriers to immunization among children ("Strategies to sustain success in childhood immunizations. The National Vaccine Advisory Committee," 1999). Despite a decline in rural childhood poverty during the 1990s, the rural child poverty rate remains higher than the urban rate (19 % versus 15 %) (USDA Economic Research Service, 2003). Furthermore, in non-metro areas, African-American and Hispanic youth are almost twice as likely to be poor as their White counterparts (USDA Economic Research Service, 2003).

School-based vaccination may also be an especially salient method for reaching adolescents. Research indicates that, unlike younger children, adolescents are more likely to establish their own health-related attitudes and behaviors independently of their

parents (Coates, Peterson, & Perry, 1982), and adolescent attitudes have been demonstrated to differ from parental attitudes with regard to several health behaviors, including vaccination (McGuire, Hannan, Neumark-Sztainer, Cossrow, & Story, 2002; Pakpreo, Ryan, Auinger, & Aten, 2004; Woodhall et al., 2007; Zimet, Mays, Sturm, & Ravert, 2002). Providing vaccination outside of medical settings where adolescents are unaccompanied by a parent could highlight discordant attitudes toward vaccination between parents and their children. Parental provision of informed consent may be a necessary, but not sufficient step in ensuring their child's vaccination. Without direct parental supervision, the child may opt out of vaccination. Consequently, our study sought to investigate the role of adolescent's attitudes toward influenza vaccination in determining immunization outcomes. This study determined whether adolescent attitudes toward influenza vaccination mediated the relationship between receipt of a school-based influenza vaccination intervention and vaccination uptake among rural adolescents.

METHODS

Participants

Study participants were drawn from schools participating in a three-year quasi-experimental controlled trial of a school-based influenza vaccination intervention in rural east Georgia, including a multi-component school-based influenza vaccination intervention condition (County 1), and a standard of care condition (County 2). The multi-component school-based influenza vaccination intervention included a *structural component* (school-based provision of influenza vaccination) and an *educational component* (a brochure targeted toward adolescents and parents, and a school skit /

presentation targeted toward adolescents) (Painter et al., 2010). Participating counties were selected because they were relatively small (one middle and high-school per county), rural, and had substantial minority populations. Data from the 2007-2008 academic year indicated that in County 1, 95% of students were African-American and 95% of students were eligible to receive free or reduced meals (Governor's Office of Student Achievement for the State of Georgia). County 2 data indicated 56% of students were African-American, and 68% were eligible to receive free or reduced meals (Governor's Office of Student Achievement for the State of Georgia). Eligibility criteria for participation in this study included: 1) being enrolled in middle or high-school in County 1 or County 2; 2) providing written assent to participate in the study, and 3) parental provision of written informed consent for their child to participate in the study. This study was approved by the Institutional Review Board of the researchers' university.

Data Collection and Survey Instrument

Data for the present study were derived from two sources: surveys administered to students in Counties 1 and 2, and documented receipt of an influenza vaccination in the school-based intervention county. Survey data were collected via self-administered paper-and-pencil surveys distributed to adolescents attending middle and high-school in participating counties at two time points: 1) baseline, prior to intervention implementation, and 2) follow-up, six months post-intervention. Prior to implementing the intervention, packets were mailed home to all enrolled students, containing: 1) a brief overview of the study, 2) a parental informed consent form, 3) a student assent form, and 4) an adolescent survey. Six months after the intervention, follow-up surveys were distributed via school homeroom to students who participated in the baseline survey. At

both time points, students were given three weeks to return the signed forms and the completed survey to their homeroom teachers. Ten-dollar Wal-mart gift cards were provided as incentives to students who returned all signed forms and completed surveys. At each school site, an extra gift card was offered as an incentive for all students in the homeroom that achieved the largest response rate (at baseline), or retention rate (at follow-up). The survey instrument was designed to assess demographic, behavioral, and psychosocial factors associated with influenza vaccination. Based on previous research and recent theoretical development (Daley et al., 2007; D. E. Montano, 1986; D.E. Montano & Kasprzyk, 2008), psychosocial survey items were guided by the Health Belief Model (HBM) (Becker, 1974) and the Integrated Behavioral Model (IBM) (D.E. Montano & Kasprzyk, 2008). Because no previous questionnaires have been developed to assess adolescent attitudes and beliefs toward influenza vaccination, questions were adapted from surveys with demonstrated reliability and validity among parents (Daley et al., 2007; Hemingway & Poehling, 2004; Ma et al., 2006; Poehling et al., 2001).

In the school-based intervention county, influenza vaccinations were provided to eligible students (with parental provision of written informed consent), via an on-site vaccine clinic. The school-based clinic was run by a team of professionals from the local health department and the researcher's university. Vaccine vouchers were collected from students who received the vaccine to document which students received an influenza vaccination. The primary vaccine used for the study was cold-adapted influenza vaccine,

trivalent (CAIV-T), delivered as a nasal mist spray. Trivalent inactivated vaccine (TIV), the flu shot, was available to students with contraindications to CAIV-T.[3]

Measures

Main outcome variable: The main outcome, receipt of an influenza vaccination, was assessed by documented receipt of vaccination in the intervention county and self-report data in the standard-of-care county. The self-report survey item asked: "Did you receive a flu vaccine last fall or winter?" There was a high correlation (.79) between self-report of influenza vaccination and documented of vaccine uptake.

Demographic variables: Participants were asked to report gender, race, age, and grade level.

Psychosocial mediator variables (Attitudes and beliefs toward influenza and influenza vaccination): The items comprising each psychosocial measure, scale ranges, and Cronbach's alphas are detailed in Table 4.1. Almost all psychosocial constructs were measured by questions based on five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). The range for each construct represents the addition of the responses to each item within that measure. For example, "perceived barriers" includes five questions, meaning responses could range from 5 (an answer of 1 to each question), to 25 (an answer of 5 to each question). Only two constructs, habit and intention, were measured as dichotomous variables. The change in attitudes and beliefs from baseline to follow-up was calculated by subtracting baseline scale scores for each psychosocial construct from follow-up scale score values.

[3] This study is currently funded by the Centers for Disease Control and Prevention (CDC). All aspects of data collection, including participant incentives and staff salaries, are funded by the CDC grant. MedImmune, Inc., manufacturer of CAIV-T, provided the vaccine for the study at no cost.

Psychosocial measures guided by the HBM included: 1) perceived severity of influenza infection, 2) perceived susceptibility to influenza infection, 3) perceived barriers to influenza vaccination, 4) perceived benefits of influenza vaccination, and 5) perceived self-efficacy to get vaccinated against influenza. The perceived barriers variable was treated as an index, as opposed to a scale, because each item represented a different reason for not getting an influenza vaccination. Consequently, the reliability for perceived barriers was relatively low, as is typical for an index.

Psychosocial measures guided by the IBM included: 1) injunctive social norms for influenza vaccination, 2) descriptive social norms for influenza vaccination, 3) perceived behavioral control, 4) habit (receipt of an influenza vaccine in the previous year), and 5) intention to receive an influenza vaccination.

Analyses

All data management and analyses were conducted using SPSS / PASW Statistics version 17. At baseline, univariate analyses were performed to assess differences in demographic variables and psychosocial mediators of influenza vaccination among adolescents in both study conditions. Differences between groups were assessed using t-tests for continuous variables or chi-square statistics for categorical variables. Next, bivariate analyses were conducted to assess associations between demographic variables, psychosocial variables, and the main outcome variable.

In multivariate analyses, a series of regression equations were used to test whether the change in psychosocial variables from baseline to follow-up mediated the relationship between study condition and receipt of an influenza vaccine among rural adolescents. In

accordance with the four-step mediation method delineated by Barron and Kenny (Baron & Kenny, 1986), the following steps were taken:

Step 1: A logistic regression equation was used to establish the relationship between study condition and receipt of influenza vaccination, controlling for demographic variables and baseline habit.

Step 2: To test for an overall difference in change in psychosocial variables from baseline to follow-up, a MANCOVA analysis was conducted with study condition as the primary independent variable; changes in psychosocial mediators as the dependent variables; and age, race, gender, and habit (receipt of an influenza in the past year reported at baseline) as control variables. Because results from the MANCOVA analysis indicated an overall significant difference in change in psychosocial variables, separate ANCOVA analyses were used to assess differences in mean scores for each psychosocial variable separately. Because intention to receive an influenza vaccination was a dichotomous variable, we used logistic regression, with change in intention to receive an influenza vaccination (positive change versus negative or no change) as the outcome variable and study condition as the main predictor variable, controlling for demographic variables and habit.

Step 3: This step assessed the relationship between changes in attitudes and beliefs toward influenza vaccination and receipt of influenza vaccination, controlling for study condition. Because multiple psychosocial variables were being tested as mediators simultaneously, correlations were conducted to check for multicollinearity (Kenny, Kashy, & Bolger, 1998). Due to the absence of multicollinearity, all demographic and psychosocial variables were included in the final model to test theoretically predicted mediation. Logistic regression analyses were conducted with changes in attitudes and

beliefs toward influenza vaccination as the main predictor variables; receipt of vaccination as the main outcome variable; and demographic variables and study condition as control variables.

Step 4: The effects in both Steps 3 and 4 were estimated in the same equation. The assessment of whether attitudes and beliefs toward influenza vaccination mediated the relationship between study condition and receipt of an influenza vaccine among rural adolescents was determined by comparing the equations above. A mediation effect was to be established if the relationship between study condition and receipt of influenza vaccination became non-significant when change in psychosocial variables were included in the model. The Sobel mediation test was used to confirm mediation (Baron & Kenny, 1986; Preacher & Hayes, 2004).

RESULTS

Of 337 students who completed the baseline survey, 298 (88.4%) completed the follow-up survey. The response rate was 84%, (129/154) in County 1, and 92% (169/183) in County 2. At baseline, several differences were noted between participants in each study condition. Participants in the intervention group were more likely to be older, black, have lower self-efficacy for influenza vaccination, and were less likely to report receiving an influenza vaccine in the past year (Table 4.2). No differences were observed for gender or other psychosocial variables.

Step 1 of the mediation analysis revealed a significant relationship between study condition and receipt of an influenza vaccination (Table 4.3). Controlling for demographic variables and baseline habit, the odds of receiving an influenza vaccination

were almost 1.8 times greater among students in County 1 (the intervention county) compared to students in County 2.

Step 2 of the mediation analysis revealed a significant relationship between study condition and changes in key psychosocial variables from baseline to follow-up (Table 4.4). Results from the MANCOVA indicated an overall significant difference among the mean scores for change in continuous psychosocial variables between the intervention group and the standard of care group (Wilks' lambda F = 2.31, p=.021). Given the overall significant MANCOVA, significant univariate differences were tested with ANCOVA analyses. Demographic variables (age, gender, race) and habit (report of receiving an influenza vaccination in the past year at baseline) were added as covariates. Results from the ANCOVAS indicated significant differences for change in perceived benefits to influenza vaccination (with a reduction of perceived benefits in the intervention group), and change in perceived benefits to influenza vaccination (also with a reduction of perceived benefits in the intervention group). Results from the logistic regression analysis indicated a significant increase in intentions to receive an influenza vaccination in the intervention group compared to the control group.

Step 3 of the mediation analysis revealed that, when controlling for demographic variables and baseline habit, change in intention to receive an influenza vaccination was significantly associated with receipt of an influenza vaccination (Table 4.3). The odds of receipt of an influenza vaccination were almost three times greater among participants who reported an increase in intention to receive an influenza vaccination (from "no" or "don't know" at baseline to "yes" at follow-up) compared to students who did not change their intention from baseline to follow-up or changed their intention in a

negative direction (from “yes” to “no” or “don’t know”). No other psychosocial variables demonstrated significant associations with receipt of in influenza vaccine.

Step 4 of the mediation analysis indicated that there was full mediation of the relationship between study condition and receipt of an influenza vaccination by intention to receive an influenza vaccination. Without including changes in psychosocial variables in the model, there was a significant association between intervention condition and receipt of an influenza vaccination. However, when changes in psychosocial variables were added to the model, the magnitude of the relationship between intervention condition and receipt of an influenza vaccination decreased and no longer was statistically significant. The association between study condition and receipt of an influenza vaccination was accounted for by the relationship between change in intention to receive an influenza vaccination and receipt of an influenza vaccination, indicating full (versus partial) mediation. Results from the Sobel test confirmed mediation, (Sobel test statistic=4.85, SE=1.25, $p<.001$).

DISCUSSION

The results indicate that our intervention was successful in decreasing perceived barriers toward influenza vaccination, increasing intention to receive an influenza vaccination, and most importantly, increasing influenza vaccine uptake among rural adolescents. Results also indicated that the pathway through which our intervention achieved success was mediated by our impact on adolescent’s intentions to receive an influenza vaccination. These findings may be particularly useful for future interventions seeking to increase the acceptance of influenza vaccination among rural adolescents.

Initial steps of the of the mediation analysis indicated that, after controlling for background variables, our intervention was significantly associated with receipt of an influenza vaccination (Step 1) and changes in certain psychosocial variables (Step 2). Specifically, our intervention was successful in decreasing perceived barriers toward influenza vaccination, including beliefs that the influenza vaccination makes people sick, does not prevent the flu, is painful or uncomfortable, and costs too much money. Results also indicated that our intervention was successful in increasing adolescent's intention to receive an influenza vaccination. Contrary to expectations, results also showed a decrease in perceived benefits of influenza vaccination among students in the intervention condition.

The successful aspects of our intervention's impact on attitudes may be particularly helpful for informing future interventions. First, research on the HBM has shown that, of all constructs, perceived barriers may be the most powerful predictor of health behaviors (Champion & Skinner, 2008). Furthermore, previous research has shown that adolescents with increased perceived barriers toward influenza vaccination were significantly less likely to plan on getting a vaccine, and suggested that interventions to increase influenza vaccination uptake among adolescent populations should discredit key barriers relevant to the target audience (Painter et al., 2009). Second, a common tenet of health behavior theory is that the most important determinant of a health behavior is intention to perform the behavior (Fishbein & Ajzen, 1975). Accordingly, the association between intention to receive an influenza vaccination and vaccine uptake has been previously demonstrated among adult populations (D. E. Montano, 1986). The finding that students in the intervention condition reported a

decrease in perceived benefits of influenza vaccination was surprising. However, this reduction in perceived benefits did not seem to impact our intervention's impact on influenza vaccine uptake in subsequent analyses.

Final steps of the mediation analysis indicated that, when psychosocial variables were added in the model, the initial relationship between our intervention and receipt of an influenza vaccination decreased and was no longer significant. Simultaneously, intention to receive an influenza vaccination became significant. Taken together, with validation from the Sobel test, these results indicate that the relationship between study condition and vaccine uptake was fully mediated by change in intention to receive an influenza vaccination. Put another way, the mechanism through which our intervention achieved success was by impacting adolescents' intentions to receive an influenza vaccination.

To our knowledge, this is the first study to investigate the mediating role of adolescent's attitudes toward influenza vaccination and vaccine uptake. Or findings support the assertion that at least one psychosocial variable, intention to receive an influenza vaccination, may be an important key to impacting vaccination behaviors. Unfortunately, the process through which our intervention impacted adolescent intention remains unclear. Our intervention included several components, including an educational component (a brochure geared toward both parents and adolescents and a school skit for adolescents), and a structural component (school-based provision of influenza vaccination). It is possible that our intervention impacted change in intention to receive an influenza vaccination by several mechanisms. First, our educational intervention materials may have impacted intention to receive an influenza vaccine directly or

indirectly, by reducing perceived barriers. It is also possible that our intervention successfully impacted parental attitudes toward influenza vaccination, which in turn impacted the adolescent's intention to receive a vaccine. Finally, it could be that, notwithstanding the educational materials, the simple presence of the school-based vaccine clinic could have impacted the adolescents' intention to receive an influenza vaccination.

Limitations

One key limitation is that responses to the survey were self-report, and therefore dependent upon the adolescents' recall. This issue may have affected measurement of influenza vaccination in the standard-of-care condition, where documented receipt of vaccination was not collected. However, in the intervention condition, there was a high correlation (.79) between self-report of influenza vaccination and documented of vaccine uptake. Second, because this is a relatively new area of research, existing validated scales measuring attitudes and beliefs toward influenza vaccination among adolescents have not been published. While scales developed for this study were based on prior research, they were not pilot tested among the target population. The Cronbach alphas (Nunnally, 1978) for each scale indicated that the measures overall were reliable. However, more work developing measures should be done. Finally, because the study was conducted with a specific sample of adolescents in rural Georgia, the results may not be generalizable to the broader context of all adolescents, particularly adolescents who do not live in rural areas or the South.

Conclusions

Our study demonstrated that a multi-component, school-based influenza vaccination intervention targeting both parents and adolescents enhanced certain adolescent attitudes toward influenza vaccination and increased vaccine uptake. The findings of this study provide some initial insights into the role that adolescents' attitudes play in vaccine uptake, and have potential implications for future intervention studies. Based on these results, it is reasonable to conclude that future school-based influenza vaccination efforts geared towards rural adolescents may benefit from addressing adolescent attitudes toward influenza vaccination, in addition to parental attitudes. Reducing adolescents' perceived barriers to influenza vaccination and increasing intention to receive a vaccination may be particularly important. However, the role that attitudes toward influenza vaccination play in determining vaccine uptake among non-rural adolescents may be different, and requires further study. Future research is necessary to explore the potential mediating role of intention to receive an influenza vaccination and vaccine uptake, and to determine which psychosocial factors are most salient to changing intentions.

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Table 4.1. Survey items and measurement characteristics for study variables[1]

Psychosocial Variables	Range	Alpha at Baseline	Alpha at follow-up
Perceived Severity of influenza (HBM)	2-10	0.80	0.74
The flu is a serious disease			
The flu is a serious disease for teenagers			
Perceived Susceptibility to influenza (HBM)	1-5	-	-
I am not very likely to get the flu			
Perceived Benefits to influenza vaccination (HBM)	5-20	0.83	0.79
The flu vaccine will prevent me from getting sick with the flu			
If I get the flu vaccine, it will help protect my friends and family from getting the flu			
The flu vaccine will prevent me from missing school			
If I get the flu vaccine, it will prevent my parent / guardian from missing work to take care of me			
Perceived Barriers to influenza vaccination (HBM)	5-25	0.58	0.66
The flu vaccine will make me sick			
The flu vaccine does not prevent the flu			
Getting a flu vaccine costs too much money			
Getting the flu vaccine is painful or uncomfortable			
I would feel sore the day after a flu vaccine			
Self-efficacy for influenza vaccination (HBM)	2-10	0.58	0.70
I feel comfortable getting the flu vaccine			
I would feel comfortable asking my parent / guardian to take me to get a flu vaccine			
Perceived Behavioral Control (IBM)	1-5		
I have control over whether or not I get a flu vaccine			
Social norms for influenza vaccination (injunctive) (IBM)	4-20	0.89	0.90
Most people important to me think I should get a flu vaccine			
My doctor thinks I should get a flu vaccine			
My parent / guardian thinks I should get a flu vaccine			
My friends think I should get a flu vaccine			
Social norms for influenza vaccination (descriptive) (IBM)	2-10	0.74	0.73
I know other people my age who got the flu vaccine			
Most of my friends get the flu vaccine			
Habit (IBM)	0-1	-	-
Did you get a flu vaccine last fall or winter?			
Intention (IBM)	0-1	-	-
Do you plan to get a flu vaccine next fall or winter?			

[1]HBM=Health Belief Model; IBM=Integrated Behavior Model

Table 4.2. Demographic information and distribution of psychosocial variables at baseline

Characteristics	Intervention (n = 129) N (%)	Standard of Care (n=169) N (%)	p-value
Age, mean (SD)	14.4 (2.6)	13.5 (2.9)	.007
Gender			.284
Male	65 (42)	84 (45)	
Female	89 (58)	99 (54)	
Race			<.001
White	8 (5)	64 (35)	
Black	145 (94)	108 (59)	
Hispanic	0 (0)	3 (2)	
Other	1 (.06)	8 (4)	
HBM variables			
Perceived susceptibility, mean (SD)	7.7 (1.9)	7.5 (1.9)	.205
Perceived severity, mean (SD)	2.7 (1.2)	2.7 (1.1)	.834
Perceived benefits, mean (SD)	13.3 (3.8)	13.1 (3.5)	.661
Perceived barriers, mean (SD)	14.7 (3.2)	14.0 (3.2)	.096
Self-efficacy, mean (SD)	6.6 (2.1)	7.0 (1.9)	.047
IBM variables			
Injunctive norms, mean (SD)	12.9 (4.2)	13.6 (3.7)	.077
Descriptive norms, mean (SD)	6.2 (2.0)	6.4 (1.8)	.271
Control beliefs, mean (SD)	3.2 (1.3)	3.0 (1.2)	.346
Intention			.485
Yes	50 (32)	64 (35)	
No / Don't know	94 (61)	116 (63)	
Habit			.041
Yes	26 (17)	48 (26)	
No / Don't know	119 (77)	132 (72)	

Table 4.3. Logistic regression analysis of the effects of the influenza vaccination intervention and psychosocial mediators on receipt of an influenza vaccination

Variable	Undjusted OR (CI)	p-value	Model 1 Adjusted OR (CI)	p-value	Model 2 Adjusted OR (CI)	p-value
Age	0.95 (0.88, 1.03)	0.252	0.96 (0.88, 1.05)	.352	0.98 (0.88, 1.09)	.715
Gender						
Male	Reference	-	Reference	-	Reference	-
Female	1.13 (0.71, 1.78)	0.608	1.17 (0.71, 1.95)	.537	0.90 (.470, 1.731)	.757
Race						
White	Reference	-	Reference	-	Reference	-
Black	2.17 (1.12, 4.13)	0.018	1.85 (0.91, 3.76)	.091	2.76 (1.11, 6.87)	.030
Habit	3.45 (1.98, 5.99)	<.001	3.85 (2.15, 6.89)	<.001	3.43 (1.60, 7.36)	.002
Intervention	1.78 (1.12, 2.84)	0.015	1.77 (1.03, 3.02)	.038	1.69 (0.82, 3.45)	.153
Psychosocial mediators						
Perceived Severity	1.01 (0.90, 1.13)	.880			0.97 (0.83, 1.14)	.714
Perceived Susceptibility	0.996 (0.83, 1.19)	.966			0.90 (0.72, 1.14)	.384
Perceived Benefits	1.06 (1.00, 1.13)	.038			1.02 (0.94, 1.12)	.606
Perceived Barriers	1.01 (.950, 1.07)	.779			1.05 (0.97, 1.13)	.240
Self-efficacy	1.14 (1.02, 1.28)	.025			1.13 (0.95, 1.34)	.183
Perceived Behavioral Control	.955 (0.82, 1.12)	.567			0.93 (0.75, 1.15)	.515
Injunctive social norms	1.06 (1.00, 1.13)	.032			1.01 (0.92, 1.12)	.806
Descriptive social norms	1.08 (0.98, 1.20)	.101			1.08 (0.92, 1.26)	.343
Intention	1.73 (1.09, 2.76)	.020			2.87 (1.23, 6.40)	.010

Table 4.4. Adjusted group means and ANCOVA statistics for change in psychosocial variables from baseline to follow-up, controlling for age, gender, race, and habit[1]

Change in Psychosocial Variables	Mean change in attitude scale scores from baseline to follow up			
	Intervention County (n=129) Mean (SD)	**Standard of Care County (n=169) Mean (SD)**	**F-statistic**	**P-value**
Perceived Severity of influenza (HBM)	-.069 (.21)	.150 (.18)	.581	.447
Perceived Susceptibility to influenza (HBM)	.018 (.13)	.085 (.11)	.137	.711
Perceived Benefits to influenza vaccination (HBM)	-.149 (.41)	1.00 (.33)	4.38	.037
Perceived Barriers to influenza vaccination (HBM)	-1.47 (.47)	-.024 (.37)	5.84	.016
Self-efficacy for influenza vaccination (HBM)	.090 (.22)	.125 (.18)	.012	.913
Perceived Behavioral Control (IBM)	.206 (.16)	.242 (.13)	.036	.850
Social norms for influenza vaccination (injunctive) (IBM)	-.283 (.43)	-.054 (.36)	.331	.566
Social norms for influenza vaccination (descriptive) (IBM)	.643 (.25)	.258(.20)	1.34	.247
	Percent increase from baseline to follow up		**OR**	**P-value**
Intention (IBM)	24.6%	13.3%	2.12	.018

[1]HBM= Health Belief Model; IBM=Integrated Behavior Model

CHAPTER 5:
SUMMARY AND CONCLUSIONS

In order to increase immunization rates, it is important to identify and address multiple barriers to vaccination, including adolescents' attitudes toward vaccination (National Vaccine Advisory Committee, 2008). Chapter #2 presented a systematic review of the literature to examine the extent to which adolescents' attitudes toward vaccinations have been examined, and identify relationships have been found between adolescent attitudes toward vaccination and vaccine acceptance and uptake.

Findings from the systematic review revealed that the evidence base regarding adolescent attitudes toward vaccinations is not very expansive. The majority of studies conducted to date have examined adolescent's attitudes toward vaccination against HPV and other STIs, are cross-sectional with moderately sized samples, and combine data from adolescents and young adults. In order to improve intervention programs to vaccination coverage, there is a need for additional large, longitudinal, adolescent-specific studies assessing adolescents' attitudes toward all recommended vaccinations, particularly MCV and influenza.

Despite its limitations, the review did yield some consistent findings regarding the relationship between adolescents' attitudes toward vaccination and vaccine acceptance / uptake. Specifically, studies have demonstrated perceived risk of disease, perceived benefits and barriers to vaccination, fear of shots / needles, and normative beliefs to be salient factors in adolescents' acceptance of HPV, HepB, and other hypothetical STI vaccines. As the need to increase adolescent vaccination coverage becomes more pressing, future interventions geared towards increasing uptake of STI vaccines among adolescents may benefit from addressing adolescents' own attitudes toward vaccination, in addition to parental attitudes.

Based on the Chapter #2 alone, it is unclear whether the same attitudes associated with vaccinations against HPV / STIs would be associated with vaccination against non-sexually transmitted diseases. Despite the ACIP recommendations and sub-optimal adolescent coverage rates for MCV, Tdap, and influenza vaccinations, no published studies have assessed associations between adolescents' attitudes towards these vaccinations and vaccine uptake. The review indicated that further research regarding adolescent's attitudes toward MCV, Tdap, and influenza vaccinations is highly warranted.

To fill this gap in the literature, Chapters #3 and #4 presented results from studies assessing attitudes toward influenza vaccination among rural adolescents. Chapter #3 presented results from a cross-sectional baseline survey of adolescents attending middle and high school in rural Georgia, recruited from two counties participating in an influenza vaccination intervention. Multivariate analyses illustrated that certain attitudes highlighted by both the HBM (perceived barriers to influenza vaccination) and IBM (injunctive norms supportive of influenza vaccination) were significant predictors of intention to receive an influenza vaccination while controlling for background factors and constructs from both theories. Thus, this study demonstrated an association between theory-driven measures of attitudes and beliefs toward influenza vaccination and intention to receive an influenza vaccination among a sample of primarily minority, rural adolescents. Findings from this study also indicated that constructs from multiple theories, including the HBM and IBM (based on the TRA), may be useful in explaining intention to receive an influenza vaccination among rural adolescents.

Building on findings from the systematic review (Chapter #2), Chapter #3 is the first study to demonstrate a significant association between attitudes toward influenza vaccination and

intention to receive an influenza vaccination among an adolescent population. Whether rural adolescents' attitudes and beliefs toward influenza vaccination, including intention to receive an influenza vaccination, impact vaccine uptake remains to be seen. Because parental consent is a necessary factor in influenza vaccination for this population, the degree to which adolescent attitudes impact vaccine uptake may vary across families. Nonetheless, the findings of Chapter #3 may be useful for developing interventions to increase the acceptance of influenza vaccination among adolescents.

Building on findings from Chapter #3, Chapter #4 presented a longitudinal mediation analysis that assessed the impact of changes in adolescents' attitudes toward vaccination on vaccine uptake. While Chapter #3 indicated that adolescents' attitudes toward influenza vaccination were associated with intention to receive a vaccine, this study was cross-sectional study, and therefore could not establish a causal link between adolescents' attitudes toward vaccination and vaccine uptake. In contrast, by analyzing data collected at two time points, Chapter #3 examined the impact of an educational intervention on attitudes toward influenza vaccination and vaccine uptake.

Study findings indicated that a school-based vaccination intervention was successful in decreasing perceived barriers toward influenza vaccination, increasing intention to receive an influenza vaccination, and most importantly, increasing influenza vaccine uptake among rural adolescents. Results also indicated that the pathway through which the intervention achieved success was mediated by its impact on adolescent's intentions to receive an influenza vaccination. These findings may be particularly useful for future interventions seeking to increase the acceptance of influenza vaccination among rural adolescents.

Again, drawing on evidence from Chapter #2, this was the first study to investigate the mediating role of adolescent's attitudes toward influenza vaccination and vaccine uptake. The findings support the assertion that at least one psychosocial variable, intention to receive an influenza vaccination, may be an important key to impacting vaccination behaviors. Unfortunately, the process through which our intervention impacted adolescent intention remains unclear. However, based on findings from Chapter #3, it is reasonable to hypothesize that our intervention impacted psychosocial factors associated with intention to receive a vaccination, such as social norms and perceived barriers to vaccination. By reducing barriers to vaccination and increasing normative beliefs, our intervention could have increased intention to receive a vaccination, and therefore increased vaccine uptake.

Overall, findings from Chapters #2 - 4, taken with the literature regarding a) attitudes toward influenza vaccination among non-adolescent age groups and b) uniqueness of adolescents with respect to vaccination decision making, highlight the importance of understanding the role that adolescent attitudes toward influenza vaccination play in impacting vaccine uptake. Findings from Chapter #2 indicate that adolescents' attitudes toward vaccination may be salient in determining uptake of vaccines against HPV, HepB, and HIV, while findings from Chapters #3 and #4 indicate that adolescents' attitudes may also be salient in determining uptake of vaccines against influenza. Findings from Chapters #3 and #4 also underscore the importance of using constructs from multiple theories, including the HBM and the IBM, to inform studies investigating adolescent attitudes toward influenza vaccination.

Future efforts geared towards increasing vaccination coverage among middle and high-school students may benefit from addressing adolescents' attitudes toward vaccination. The

HBM construct of perceived barriers to influenza vaccination and the IBM constructs of injunctive social norms supportive of influenza vaccination and intention to receive a vaccine may be particularly important to address. However, as with developing any intervention, formative research should be conducted with potential study populations to ensure that these attitudes are relevant. Future research is also needed to conduct more large-scale, longitudinal studies assessing the relationship between adolescents' attitudes toward vaccination and vaccine uptake for all recommended adolescent vaccinations.

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