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Influenza Knowledge, Attitude, and Behavior Survey for Grade School Students: Design and Novel Assessment Methodology

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Abstract

Background—Despite the fact infectious diseases can spread readily in grade schools, few studies have explored prevention in this setting. Additionally, we lack valid tools for students to self-report knowledge, attitudes, and behaviors. As part of an ongoing study of a curriculum intervention to promote healthy behaviors, we developed and evaluated age-appropriate surveys to determine students' understanding of influenza prevention.

Methods—Surveys were adapted from adolescent and adult influenza surveys and administered to students in grades 2–5 (ages 7–11) at two Rochester public schools. We assessed student understanding by analyzing percent repeatability of 20 survey questions and compared percent “Don't Know” (DK) responses across grades, gender, and race. Questions thought to be ambiguous after early survey administration were investigated in student focus groups, modified as appropriate, and reassessed.

Results—The response rate across all surveys was > 87%. Survey questions were well understood; 17 of 20 questions demonstrated strong pre/post repeatability (> 70%). Only 1 question showed an increase in DK response for higher grades ($p < .0001$). Statistical analysis and qualitative feedback led to modification of 3 survey questions and improved measures of understanding in the final survey administration.

Conclusions—Grade-school students' knowledge, attitudes and behavior toward influenza prevention can be assessed using surveys. Quantitative and qualitative analysis may be used to assess participant understanding and refine survey development for pediatric survey instruments. These methods may be used to assess the repeatability and validity of surveys to assess the impact of health education interventions in young children.

Keywords

Community health education; child health behavior; survey design; influenza

Background

Children are often underrepresented in influenza prevention interventions despite their critical role in spreading the disease (1, 2). Furthermore, the greatest opportunity for enhancing lifelong knowledge, attitudes and behaviors regarding influenza prevention may lie in interventions targeting young children (3). Grade schools, due to their critical role in influenza spread and early childhood education represent an ideal setting to investigate this hypothesis (4, 5). School-based educational interventions have historically involved externally administered, investigator-initiated efforts and have had limited evidence of success (6). Surprisingly, few tools have been developed to assess young children's knowledge, beliefs, and behavior toward health promotion, especially given the diverse topics that could be studied (e.g. healthy eating, exercise, addiction) (7–9). Published outcome measures for influenza education intervention assessments have been restricted to parent, teacher, and investigator observations and exclude student self-reports (10).

Integrated Science Education Outreach (InSciEd Out) is a unique education intervention promoting science inquiry in K-8 public schools in Rochester, Minnesota through strong teacher/scientist partnerships. Early results have demonstrated significant gains in student engagement and science proficiency over the last 4 years (11). We are currently expanding these early efforts to test the effects of increased science proficiency on student health behaviors. Our hypothesis proposes that directly embedding disease prevention strategies within grade school students' curriculum will significantly improve health behavior decision-making and ultimately, individual and community health. We call this intervention "Prescription Education." In the spring of 2013, 3rd and 4th grade classrooms in partnering public schools in Rochester implemented a novel curriculum relating to infectious disease prevention, specifically communicating the importance of influenza vaccination, hand hygiene, and cough etiquette. In addition to traditional educational metrics, outcomes included a variety of qualitative and quantitative measures. As there was no age-appropriate survey to assess student's knowledge, attitudes and self-reported behaviors, we developed and evaluated a survey designed to evaluate these parameters. In this paper, we present the methodology we used to develop and assess the repeatability and validity of a student survey instrument, as well as administration procedures designed to increase response rates.

Methods

Survey Design

Survey response categories were created based on previously published adolescent and parental influenza surveys and grounded in both the Health Belief Model (HBM) and Integrated Behavioral Model (IBM) (7, 12–16). Topic domains were further chosen through a qualitative, iterative process among the study team. A priori domains included measured knowledge about "the flu" and "the flu shot/mist," attitudes towards risk, susceptibility,

prevention motivators, and self-report of preventative behavior adherence. Influenza prevention themes included hand-washing technique, covering of cough and sneezes, vaccination, and proximity to other individuals. As we were unable to find a survey for grade school students including these topics, individual questions were created to encompass each domain and were unified by theme. Questions were piloted in qualitative interviews conducted among 2nd–5th grade students, parents, and teachers prior to survey administration to further gauge the age-appropriateness of the questions and ambiguity of responses. The initial survey consisted of 20 content items comprised of a mix of response types, including “yes, no, or maybe” and 5-point Likert scales. Three additional demographic items were included (grade, gender, and race). The Mayo Clinic Survey Research Center, a resource for clinicians to ensure maximum survey repeatability, validity, and relevancy, was consulted throughout the survey design process. The overall grade level readability was 3.4 according to the Flesch-Kincaid test (17, 18).

Study Design

The study included elementary students at two partner schools in Rochester, MN chosen based upon a willingness of school leadership to participate in the InSciEd Out education program and in consideration of demographic similarities and school size. School 1 was designated as an intervention school, with 3rd and 4th grade classes receiving the intervention curriculum, and 2nd and 5th grade classrooms acting as an intra-school control (~45 students per grade/year). School 2 was recruited to serve as an independent control, with all 2nd–5th graders receiving Rochester Public School standard curriculum (~80 students per grade/year).

Within the intervention school, 3rd and 4th grade students received 4–6 weeks of InSciEd Out curriculum in 2 successive school years. Surveys were given to all 2nd–5th grade students at both schools at multiple time points in the study. This study was approved by the Mayo Clinic Pediatric and Adolescent Research Committee, the Office of Community Engaged Research, and Institutional Review Board with a waiver of specific informed consent in accordance with 45CFR46.116.

Subjects/Recruitment

Eligibility criteria included enrollment of all students in 2nd–5th grades, between 7 and 11 years of age, at both partner schools. We informed parents of the study through a combination of presentations at school “meet the teacher” nights, parent teacher association (PTA) meetings, classroom visits, and letters home to parents. The goal of our communication was to: 1) Inform of the study and its requirements; 2) Provide them with an opportunity to decline participation. Historically, school-based studies requiring active written consent have led to non-representative sampling of the students enrolled (19–21). However, studies enlisting a waiver of informed consent have been shown to greatly increase child participation while overwhelmingly maintaining parental support. In these studies, follow-up of parental reasoning for non-response indicated overall indifference rather than concern for risk (22, 23). Letters were sent home through the school office informing parents that their child was to participate in an in-class survey as part of the ongoing partnership with the Mayo Clinic. Parents were to contact the school or the study

team only if they preferred that their child not participate. The remaining deficit in response rate was due to students missing school on the designated survey day and choosing not to complete it on their own. Written assent was documented for all participating students.

Administration

Surveys were administered immediately prior to, and after, curriculum implementation in the spring of 2013 (Year 1 Pre/Post Survey) and again in fall of 2013 (Year 2 Survey) via school iPads or desktop computers. The team utilized an online survey tool called REDCap (24), a secure, web-based application for building and managing online surveys and databases. At the beginning of class, all students were given a unique user ID and password to login to the database. All students, except those whose parents declined, were directed to the survey assent page, and only students providing assent could access the survey. Surveys took approximately 10–20 minutes to complete, with higher grade levels requiring less time.

Statistical Analysis

Survey repeatability was evaluated using the percentage of agreement across the first two survey administrations in the control school. For the repeatability analysis, all questions were dichotomized prior to analysis as a favorable (“correct”) or an unfavorable (“incorrect”) response. Within all applicable questions, the “I don’t know” response was coded separately from other response options. For simplicity, we refer to these collectively as the “don’t know” (DK) response. DK responses were compared by grade the Cochran-Armitage trend test. Questions for which responses demonstrated both a statistically significant difference and an increase in DK responses by grade were considered to have difficult to understand or ambiguous wording, because older children should demonstrate greater understanding for questions when worded appropriately. We performed a similar analysis comparing DK responses by gender and race using chi-square tests (or Fisher’s exact tests as appropriate) to explore potential confounding. P-values less than 0.05 were considered statistically significant. All analyses were performed using SAS version 9 (Cary, NC).

Evaluation of Student Understanding

During survey administration, qualitative descriptions provided by study personnel in response to student requests for additional explanation or clarification were recorded in writing. This descriptive analysis was combined with our statistical analysis to identify confusing questions. Questions meeting at least 1 of the 3 following criteria were identified as candidates for change: 1) Poor pre/post repeatability (<70%); 2) Significant increase in DK response for higher grades; and 3) Qualitative descriptions of question misunderstanding gathered during survey administration.

To further assess potentially flawed questions among our candidate list, focus groups were conducted among 3rd and 4th grade students from School 1. Twelve students participated in three focus groups in the summer of 2013, between Year 1 and Year 2 of the intervention. Students were asked to directly comment on potentially difficult or ambiguous wording of questions and asked to articulate their understanding with modified wording. Questions were

updated following student feedback, these changes were included in the Year 2 Survey, and our comparisons of DK responses by grade were repeated for the revised survey.

Results

Survey Design

The survey underwent several modifications before it was first administered to students in January 2013. Following the baseline interviews of students, parents, and teachers in 2012, the total number of questions was reduced from 30 to 20 due to reduced student attention toward the end of the survey. Likewise, true/false knowledge questions were changed to a yes/no/I don't know format to simplify understanding. Five-point Likert scales assessing student attitudes were used with modified language because students were able to articulate differences between each response category. Attitude questions were changed from a response range of "strongly disagree" through "strongly agree," to "disagree a lot" through "agree a lot." The terminology and application of the words "disagree" and "agree" were well understood by all ages.

Response Rate

A total of 1066 surveys from 565 unique students were administered across both School 1 and School 2 (Year 1 Pre n = 450, Year 1 Post n = 234, Year 2 n = 382). Less than 1% of households (n = 5) between the 2 schools declined student participation. The overall response rate was 88.4% and did not differ between schools (School 1 87.1%, School 2 89.7%) across all three surveys. Response rates for individual survey administrations did not differ (Year 1 Pre Survey 89.3%, Year 1 Post Survey 89.7%, Year 2 Survey 87.2%).

Question Repeatability

Question repeatability was estimated using Year 1 Pre/Post responses within the control school (School 2). Repeatability of the dichotomized survey questions, as shown through % agreement, was generally high across all question domains and response options (Table 1). Of 20 questions, 17 met the criteria for strong pre/post repeatability (>70%), with 14 demonstrating 75% repeatability. Only 2 questions demonstrated inadequate repeatability. These were, "I am uncomfortable or shy going to clean my hands if I cough or sneeze in class" (59% agreement) and, "If I have the flu but don't touch healthy people, I can be around them without making them sick" (64% agreement).

In our analysis of DK response across grades, 4 of 15 questions that included a DK response option had statistically significant trends by grade (Table 1). However, only 1 of these 4 showed an increase in DK response in advancing grades. The question, "The flu shot/mist can keep people from getting sick" showed a consistent increase in DK response from 25% to 51% between 2nd and 5th grades ($p < .0001$; Table 1). Other questions displaying a decrease in DK proportions were thought to demonstrate an improved understanding consistent with normal cognitive development. For example, in the question, "If I have the flu but don't touch healthy people, I can be around them with making them sick," there was a clear decrease in "don't know" responses between 2nd and 5th grade, from 36% to 16% ($p < .0001$; Table 1).

The percentage of DK responses was also compared by gender and race. Although no overall differences in DK response were observed by gender, two questions approached significance. First, in the question “The flu can be spread through coughs, sneezes, and/or dirty hands,” boys had a DK response of 10%, while girls had a DK response of 5% ($p = .055$). Also, in the question “If I have the flu but don’t touch healthy people, I can still bearound them without making them sick,” boys and girls had a DK response of 21% and 29%, respectively ($p = .05$).

Two questions showed significant differences in DK response percentages in our analysis by race, specifically comparing white and non-white students. Again in the question “If I have the flu but don’t touch healthy people...” non-white student had an overall DK response rate of 27%, as compared to 18% in white students. Additionally, in the question assessing vaccination status, “Did you get or are you planning to get the flu shot/mist this year,” 25% of non-white students listed a DK response as compared to 15% of white students.

Question Modification

Five questions were chosen to be further investigated in our student focus groups due to poor repeatability, increasing DK response by grade, and/or negative classroom feedback (Table 2). Of these, 3 questions were selected for revision and 1 new question was determined necessary to improve clarity of related questions (Table 3). The new question sought to clarify the percent of students who use their arm versus their hands to cover their cough or sneeze. Questions explored in focus groups but remaining unmodified were shown to be well understood by students regarding the intent of the question, despite meeting criteria for potential ambiguity.

Following modification, we again compared overall DK response tendencies by grade and across years (Table 3). The greatest effect was seen in changing the question, “The flu shot/ mist can keep people from getting *sick*,” to, “The flu shot/mist can keep people from getting the *flu*.” Here, overall DK responses dropped from 37% to 8% among those who took the survey in all 3 offerings. Similar trends were noted within the 3rd and 4th grade cohorts (Table 3). Other modified questions demonstrated an overall decrease in DK response, but the changes were not statistically significant. Overall, changes in DK response were not observed in the unmodified questions.

Discussion

In this study we have, to our knowledge, created the first health knowledge, attitude, and behavior survey relating to influenza prevention among grade school children (Final survey shown in Appendix). We employed rigorous quantitative and qualitative methods to revise the survey in order to ascertain student understanding of questions and ensure response options were appropriate for students’ reading level and understanding. Our original survey was well understood by most students, as reflected by high pre/post agreement in 17 of 20 questions (Table 1).

We continued to investigate question ambiguity using overall DK response rates and qualitative classroom feedback. Our methodology for identifying candidate questions for

change resulted in further qualitative assessment of 5 questions. These questions were assessed among student focus groups with 3rd and 4th grade students (Table 2). This process led to the revision of 3 questions, the addition of 1 new question, and the elimination of a negative trend in question understanding, as reflected by DK response, across grades (Table 3). Differences in DK response rates by race and gender were observed and may reflect important differences in influenza knowledge, attitudes, and behavior.

In addition to our findings relating to the survey instrument itself, our survey process also demonstrates that high response rates (>87%) within student populations are possible through an integrated study design. This includes coordinating with school communication methods to reach all parents as well as employing a waiver of informed consent procedure to include more students. We suggest that survey design can be used across remaining grades K-12 education. Furthermore, we recommend our method of administration and consent may be a model for other school-based investigations to achieve strong, reproducible response rates and inclusive results.

Strengths of this study include the high response rate and the use of both qualitative and quantitative methods to identify and evaluate ambiguous questions. A limitation is that we focus on representative indicators of question ambiguity, such as percent repeatability and DK response trends, and have no direct questions within the survey to test ambiguity. In addition, repeatability data was not available following survey modification, so changes to repeatability were not assessed.

This work also presents a methodology for identification and correction of question ambiguity for surveys designed for grade-school children as well as survey administration methods resulting in high response rates. The survey is designed to capture students' knowledge, attitudes, and behavior across topics such as influenza vaccination, hand hygiene, non-pharmaceutical interventions, and social interactions. Further work is required to assess the coverage of domain topics to represent student influenza knowledge, attitudes, and behavior.

Conclusion

We developed a novel survey to assess knowledge, attitudes and behaviors related to influenza prevention in grade-school children. The survey was well understood in general, and we demonstrate reduction in question ambiguity upon modification. This strategy can be used to assess other health-related behavior, but for descriptive purposes and to assess the impact of health promotion interventions.

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Table 1

Survey Repeatability and Trends in Percent DK Response Across Grades

Domain	Question	Pre/Post Percent Agreement	2 nd (N=104)	3 rd (N=117)	4 th (N=120)	5 th (N=109)	Overall (N=450)	P-value for trend	Trend by Grade
Knowledge about the flu									
	1. The flu can be spread through coughs, sneezes, or dirty hands	91%	12%	4%	12%	4%	8%	0.19	No trend
	2. The flu can be spread by people who don't feel sick	68%	32%	41%	33%	40%	37%	0.42	No trend
	3. Healthy people can die from the flu	80%	32%	37%	43%	40%	38%	0.16	No trend
Knowledge/attitudes about flu vaccine									
	4. The flu shot/mist can keep people from getting sick	76%	25%	34%	41%	51%	38%	<0.0001	Strong Increase
	5. The flu shot/mist can give people the flu	77%	24%	27%	34%	28%	29%	0.28	No trend
	6. Getting the flu shot/mist is a good idea	87%	11%	6%	8%	9%	8%	0.85	No trend
Risk/Susceptibility									
	7. I am likely to get the flu	82%	30%	50%	47%	44%	43%	0.08	No trend
	8. The flu could make me really sick	84%	18%	14%	6%	9%	12%	0.01	Slight Decrease
Vaccine Adherence									
	9. Did you get or are you planning to get the flu shot/mist this year?	87%	22%	25%	21%	11%	20%	0.03	Slight Decrease
	10. I would be able to get the flu shot/mist if I wanted to	74%	33%	27%	25%	26%	27%	0.22	No trend
NPI's									
	11. Cleaning my hands after I cough or sneeze will keep others from getting sick	82%	4%	4%	1%	3%	3%	0.33	No trend
	12. Covering my cough and sneeze will keep others from getting sick	78%	8%	4%	7%	3%	5%	0.19	No trend
	13. I am uncomfortable or shy going to clean my hands if I cough or sneeze in class	59%	26%	25%	17%	20%	22%	0.14	No trend
Social Interaction									

Domain Question	Pre/Post Percent Agreement	Don't know response by grade (%)					Overall (N=450)	P-value for trend	Trend by Grade
		2 nd (N=104)	3 rd (N=117)	4 th (N=120)	5 th (N=109)	25%			
14. If I have the flu but don't touch healthy people, I can be around them without making them sick	64%	36%	32%	17%	16%	25%	<0.0001	Strong Decrease	
15. Staying home when I am sick will keep others from getting sick	79%	7%	7%	4%	2%	5%	0.06	No trend	
Self Reported Behavior Frequency*									
16. How often do you get the flu shot/mist?	81%	--	--	--	--	--	--	--	--
17. After you go to the bathroom, how often do you wash your hands?	86%	--	--	--	--	--	--	--	--
18. When you cough or sneeze on your hands, how often do you cover your mouth or nose?	81%	--	--	--	--	--	--	--	--
19. If you cough or sneeze on your hands, how often do you clean them after?	69%	--	--	--	--	--	--	--	--
20. When you are feeling sick how often do you come to school anyways?	70%	--	--	--	--	--	--	--	--

DK – Don't Know

*. Survey questions regarding frequency of behavior among students did not include a DK response option. Pre/post % agreement (repeatability) values abstracted from Year 1 Pre and Year 1 Post Surveys in the control school alone. P values calculated comparing DK trend across grade via Cochran-Armitage trend test using data from the Year 1 Pre Survey only at both schools.

Table 2

Evaluation of Question Ambiguity Through In-Class Feedback and Student Focus Groups

Ambiguous Questions	Classroom Feedback	Focus Group Feedback (n= 12)
The flu shot/mist can keep people from getting sick	Students often asked for help in completing this survey response. They demonstrated understanding that it could prevent the flu but not other illnesses. "Do you mean it can keep you from getting all kinds of sick...because it can't do that."	<i>Students responded that the flu shot/mist doesn't guarantee you from getting different kinds of sick but displayed understanding that it could potentially prevent the flu.</i> "It might keep you from getting sick, but it's not 100%."
Healthy people can die from the flu	Students appeared to have trouble reconciling a "healthy" individual having the flu. "This doesn't make sense to me. If they have the flu, then they are not healthy."	Students thought healthy could simply mean, "not sick with the flu," or any sort of cold virus. Or it could refer to a person's overall state of health considering age, immune system strength, chronic illnesses, risk factors like obesity and smoking, etc. <i>Students that interpreted health to mean either of these definitions still felt a healthy person could not die from the flu after these clarifications were made.</i>
The flu shot/mist can make people sick with the flu	Older students showing greater understanding of the mechanism of influenza vaccination had more difficulty with this question. <i>Students pointed out that the flu shot/mist actually works by making people "sick" with a small dose of the virus.</i>	"That it kind of depends. Well, what the flu vaccine is designed to do is to tell your immune system that there is a flu...that it tricks your immune system into thinking that you're infected with the flu virus."
I am likely to get the flu	A variety of reasons contributed to confusion with this question, such as, uncertainty for those who had gotten flu shot of how to answer, difficulty in predicting what would happen to them, understanding flu shot isn't perfect.	<i>One student said she does not tend to get sick, which allowed her to answer, "No," to the question, but she added that she would definitely still need to get the flu vaccine.</i>
I am uncomfortable or shy going to clean my hands if I cough or sneeze in class	<i>Students didn't know how to answer if they used their arm/elbow to cover cough or sneeze.</i>	The question was well understood in student focus groups, but students indicated they would say, "No," if they used arm/elbow to cover cough.

Table 3

Modified Questions Demonstrate Improvement in DK Response Trends

Question Modifications		DK Response Pre/Post Changes (n =108)					
		3 rd Grade Cohort (N=48)			4 th Grade Cohort (N=60)		
Year 1 Pre/Post Wording	Year 2 Wording	Year 1 Pre	Year 1 Post	Year 2	Year 1 Pre	Year 1 Post	Year 2
The flu shot/mist can keep people from getting <u>sick</u>	The flu shot/mist can keep people from getting the <u>flu</u>	35%	40%	6%	38%	27%	10%
The flu shot/mist <u>can give</u> people the flu	The flu shot/mist can <u>make people sick</u> with the flu	29%	31%	27%	32%	28%	20%
Healthy people can die from the flu	Healthy people <u>who get</u> the flu can die from it	27%	31%	27%	38%	43%	28%
	<u>New Question:</u> When you cough or sneeze, how often do you use your arm to cover?*	--	--	--	--	--	--

* Question did not include DK response option

DK response trends listed before and after survey modification. For each listed cohort, survey changes were made between the Year 1 Post Survey and Year 2 Survey. The 3rd grade cohort took the survey as 4th graders in Year 2. The 4th grade cohort took the survey as 5th graders in Year 2.