Vaccine 30 (2012) 1149–1153

Contents lists available at SciVerse ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Homeschooling parents' practices and beliefs about childhood immunizations

Elizabeth L. Thorpe[a,b,*], Richard K. Zimmerman[c,d], Jonathan D. Steinhart[d,e], Kathleen N. Lewis[f], Marian G. Michaels[b,g]

[a] Department of General Pediatrics, Division of Pediatric Emergency Medicine, Pittsburgh, PA, United States
[b] Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States
[c] Department of Family Medicine and Clinical Epidemiology, Pittsburgh, PA, United States
[d] University of Pittsburgh, Pittsburgh, PA, United States
[e] Department of Statistics, University of Pittsburgh, Pittsburgh, PA, United States
[f] Department of Humanities and Human Sciences, Psychology Program, Point Park University, Pittsburgh, PA, United States
[g] Department of General Pediatrics, Division of Infectious Diseases, Pittsburgh, PA, United States

ARTICLE INFO

Article history:
Received 26 August 2011
Received in revised form
29 November 2011
Accepted 2 December 2011
Available online 14 December 2011

Keywords:
Homeschooling
Immunizations
Beliefs
Vaccinations

ABSTRACT

Objective: Concern over the rise of vaccine preventable diseases (VPD) coupled with the increasing popularity of homeschooling makes understanding the attitudes and behaviors of homeschoolers regarding immunizations a critical area of investigation. This study was a pilot to investigate the immunization attitudes of homeschooling parents and the vaccination status of their children.
Methods: In the spring of 2010, online surveys were sent to a convenience sample of 707 homeschooling parents in Western Pennsylvania with children ages 0–18 years of age. Information was collected on demographic characteristics, vaccination status of children, and attitudes toward vaccination.
Results: Surveys were returned by 18 percent of respondents, representing 396 homeschooled children. Demographic characteristics mirrored national homeschooling trends. The majority (95%) surveyed felt that education about vaccines was important. Thirty-eight percent of families had fully vaccinated children while 56% reported partial vaccination and 6% said children had received no vaccines. Respondents who fully vaccinated their children were more likely to agree that vaccinating according to the American Academy of Pediatrics was a good idea (OR: 4.8 [95% CI: 2.0–11.7]) and were more likely to comply with the recommendations of their health care provider (OR: 8.3 [95% CI: 3.6–19.1]). Respondents who vaccinated their children were more likely to believe that vaccines are safe (OR: 7.6 [95% CI: 1.0–56.2]). Beliefs about autism, thimerosal and learning disabilities did not vary significantly with vaccination status in regression analysis.
Conclusions: While specific factors influencing vaccination practices were not identified, this study demonstrated that recommendations of physicians and the AAP do not significantly influence homeschooling vaccination practices in the pilot population. Given the results of this pilot study, more research is called for, particularly a larger study with public school controls.

1. Introduction

For many years, vaccinations have been required for entrance into public schools and have contributed to the overwhelming success of the US immunization program [1,2]. In the last decade there has been an increase in the number of parents in some states claiming non-medical exemptions for childhood vaccinations [3]. Unvaccinated children are at the greatest risk from contracting vaccine-preventable diseases (VPD) and transmitting diseases to susceptible persons. For example, children in the United States with non-medical exemptions between 1985 and 1992 were 35 times more likely to contract measles than vaccinated children [4]. In 2006, Omer et al. demonstrated that the incidence of pertussis was higher in states that offered personal belief exemptions from vaccinations [5].

In the last decade, the number of children being electively homeschooled has increased dramatically. The National Center for Education Statistics reported in 2003 that approximately 1.1 million students in the US were homeschooled, an increase of 29% in 5 years [6]. The National Center for Home Education suggests that the number of homeschooled children in 2008 was close to 2 million [7]. Very little has been published on the vaccination status of homeschooled children. While some authors assert that

* Corresponding author at: Division of Pediatric Emergency Medicine, Children's Hospital of Pittsburgh of UPMC, 4401 Penn Avenue, AOB 2nd Floor Suite 2400, Pittsburgh, PA 15224, United States. Tel.: +1 412 692 7692/615 403 7561; fax: +1 412 692 7464.
E-mail address: Elizabeth.thorpe@chp.edu (E.L. Thorpe).

0264-410X/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.vaccine.2011.12.019

homeschoolers are an under-immunized population, supporting clinical studies or population data are lacking [8,9]. Furthermore, homeschoolers are subject to the same state-level immunization laws as public or private school children [10]. In Pennsylvania, homeschooling families are supposed to either show immunization records or provide a letter documenting a medical or religious exemption [11].

The only report on homeschool immunizations with numerical data comes from a Center for Disease Control and Prevention (CDC) report of measles outbreaks in Washington and Illinois in which some of the individuals affected, including one of the index cases, were homeschooled and unvaccinated [12]. While the National Center for Education Statistics conducts regular surveillance on education, including homeschoolers, there are no published studies to date on homeschoolers attitudes and beliefs about vaccination.

Concern over the rise of VPD coupled with the increasing popularity of homeschooling makes understanding the attitudes and behaviors of homeschoolers regarding immunizations a critical area of investigation. Accordingly, this pilot study was designed to survey parents of homeschooled children about their immunization beliefs and the vaccination status of their children.

2. Methods

2.1. Subjects

Subjects were parents of homeschooled children ages 0–18 years in and around Pittsburgh, PA. Homeschool groups were identified from Internet web listings. In total, ten groups were identified that listed the email or contact information for a group leader. Group leaders were initially contacted with two questions: (1) What do you think is the best way to reach the homeschooling community to conduct a survey and (2) Would your group be willing to participate in a survey? Two groups were found to be subsets of a larger group and were not contacted separately. Of the remaining eight groups, five agreed to participate in the survey. Email was identified as the most efficient way of contact since the advent of cyberschools and online curriculums for most groups limited in-person meetings and the majority of communication was now performed on-line through collectives and blogs. No national homeschool registry was available. Accordingly, an online survey tool was developed and distributed by the group leaders to the collectives. In order to protect the privacy of the homeschoolers, the group leaders maintained control over the collectives and individual emails were not shared with the investigators. Therefore it was not possible to know the true number of individuals who received a survey and the denominator of surveyed families could not be determined. Thus, the current study is based upon a convenience sample necessitated by the difficulties inherent in contacting homeschooling families in a systematic manner.

2.2. Survey development

The survey was developed using the Triandis Model of the Theory of Reasoned Action [13,14]. The theory includes facilitating conditions, behavioral habits, social influences and attitudes regarding the action and its consequences. The Triandis Model has been used to predict a variety of behaviors including influenza immunization receipt [14,15] sexual behaviors [16], mammography screening [17] and medical resident lecture attendance [18]. When used to predict immunization behavior, the Triandis Model has been shown to be internally consistent and externally valid [19]. The survey contained 45 questions including multiple choice items and Likert-scale items. The survey also contained multiple choice demographic questions. The survey was created using the online program SurveyMonkey (www.surveymonkey.com).

2.3. Data collection

Surveys were distributed to respondents by group leaders in May 2010. An Internet link to the survey (SurveyMonkey) was sent to the group leader who forwarded the link to the group. Group leaders reported the number of individuals on a collective. The number of individuals on any one group collective ranged from 16 to 293. The sum of the emails on all of the collectives totaled 707. Collectives were managed by the group leader and therefore if individuals were members of more than one group, they would have received multiple emails and been counted more than one time in the denominator. Group leaders were asked to send one reminder approximately two months after the original email. The survey was closed in November 2010. No individual names or emails were associated with surveys and respondents were never contacted directly by the investigators. No incentives were offered for completion of the survey. The study was approved by the Institutional Review Board of the University of Pittsburgh.

2.4. Statistics

Raw survey data were imported into R 2.12.0 (R Foundation for Statistical Computing, Vienna, Austria) for coding and manipulation, and then exported into SAS 9.2 (SAS Institute, Cary, NC) for analysis.

Clopper–Pearson binomial confidence intervals of proportions were prepared for every survey question for each vaccination status (fully immunized, partially immunized and unimmunized), to estimate and compare response probabilities conditional on vaccination status. Similarly, binomial confidence intervals were calculated to estimate the conditional probabilities of each vaccination status given a particular response to each of the items.

Subsequently six stepwise linear regressions were performed which modeled the log odds of full vaccination of all children as a function of each of these item groups: reasons for homeschooling, Triandis-social, Triandis-attitudes, Triandis-intents, Triandis-consequences, and demographics. When one or more terms in a group were found to be significant, the model was refitted using only the significant terms, in order to make use of all available data. We also used contrasts to estimate the mean probabilities of full vaccination at each level of response under the resulting models.

Finally, Fisher's exact tests were used to look for associations between strength of agreement with American Academy of Pediatrics (AAP) recommendations, and age, income, and education.

3. Results

3.1. Study sample

Of the 707 addresses contacted, 124 parents responded to the survey for an 18% response rate, representing at least 396 homeschooled children. Not all individuals answered every question. Only 111 responses were in the statistical analysis as 13 individuals did not mark the vaccination status of their children. Demographic characteristics of the respondents are shown in Table 1. All surveys responses represent self-reported vaccination status.

Most of the survey respondents were female (97%) and most belonged to a family where one parent worked full time and the other stayed home (75%). Over two-thirds of the respondents had completed a four year college program and almost 20% had

Table 1
Demographic characteristics of homeschooling parents surveyed in the spring of 2010.

Characteristics	Percent (%)
Parent education	
High school	9
Community college	12
Four-year college	57
Graduate degree	22
Parent age	
≤30	5
31–40	35
≥41	60
Income	
≤$50,000	21
$50,001–$100,000	56
≥$100,001	23
Number of children per family	
One	5
Two	25
Three	31
Four	20
Five or more	19
Employment status (FT = full time PT = part time, NW = not working)	
Two parents, both working FT	3
Two parents, one FT, one PT	16
Two parents, one FT, one NW	74
Single parent	7

completed a graduate degree. The average number of children per family was 3.2 and the mean yearly income was approximately $75,000.

3.2. Reasons for homeschooling

Most parents reported that they chose homeschooling to increase family time and parental influence in the child's life and to decrease peer pressure and other negative influences (Fig. 1). Only five parents (4%) included a desire not to vaccinate children as a reason for homeschooling.

3.3. Vaccination status

Thirty-eight percent of families reported having their children fully vaccinated while 56% reported partial vaccination and 6% (seven families) said their children had received no vaccines. Regression analysis showed that fewer children per family increased the probability of being fully vaccinated (OR: 0.58 [95% CI: 0.40–0.84]).

3.4. Social factors

The only social factor identified that influenced vaccination status was the opinion of a spouse. Full vaccination was associated with spouses who feel that children should be vaccinated (OR: 5.8 [95% CI: 2.6–12.7]). Religion was not found to play a role in vaccination status; however a heterogeneous religious sample was not obtained (67% Protestant/Christian, 15% Catholic, 9% Atheist/Agnostic, 0% Jewish, 0% Muslim, 0% Buddhist and 9% other).

3.5. Facilitating conditions

Families did not report difficulty with conditions that would facilitate vaccination. Most reported living close to their children's health care provider and experienced no difficulty with transportation.

3.6. Attitudes toward vaccination

Parental attitudes and beliefs about childhood vaccination were summarized by Triandis category in Table 2. The majority (95%) of the parents taking the survey felt that education about vaccines was important. 75% of parents felt that VPD can cause serious illness and 64% believed that vaccines were good at preventing VPD. Respondents who fully vaccinated their children were more likely to believe that vaccines were good at preventing VPD (OR: 8.4 [CI: 1.7–39]).

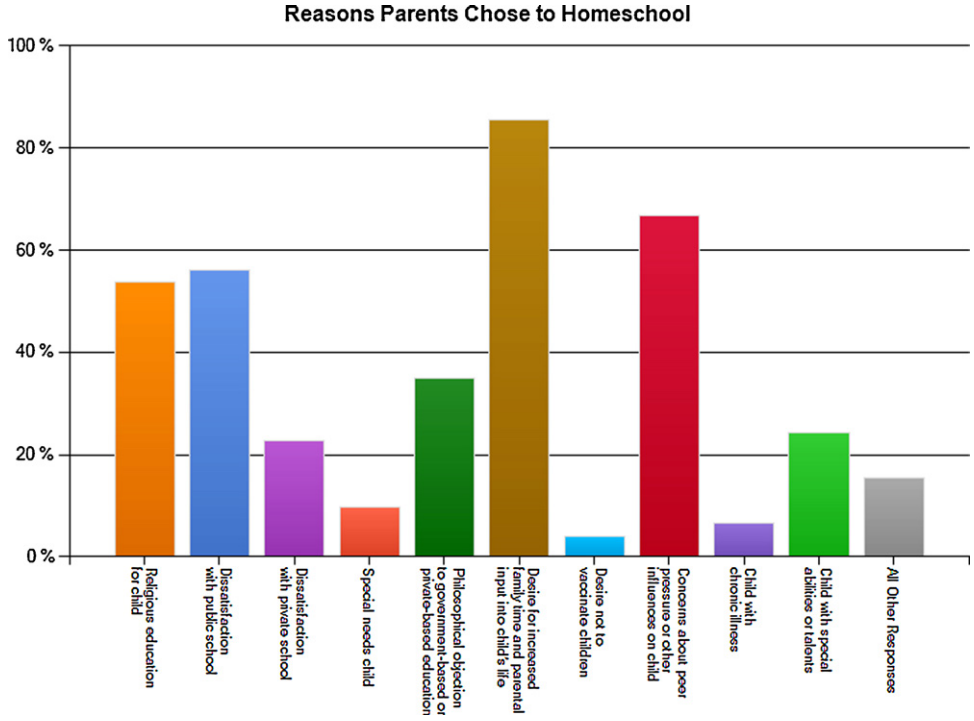

Fig. 1. Percentage of respondents who selected various reasons for homeschooling. Respondents could choose more than one option.

Table 2
Parental attitudes and beliefs about childhood vaccination summarized by Triandis category ($n = 111$).

	Agree	Disagree	NR
Attitudes			
Vaccinating is a good idea	64%	29%	7%
Vaccinating according to the AAP guidelines is a good idea	33%	60%	7%
Spacing out vaccines is a good idea	75%	20%	5%
Education about vaccines is important	95%	0%	5%
Vaccines only necessary if traveling outside USA	14%	78%	8%
Vaccines are generally safe	60%	33%	7%
Perceived consequences			
Vaccines have dangerous side effects	48%	43%	9%
Vaccines are good at preventing disease	64%	35%	1%
Some vaccines cause autism	49%	41%	10%
Some vaccines cause learning disabilities	50%	41%	9%
Thimersol, in some influenza vaccines, is harmful	68%	21%	11%
Social influences			
Friends think I should vaccinate my children	40%	41%	19%
Friends think the risks of vaccination outweigh the benefits	48%	35%	17%
Health care provider thinks children should be vaccinated	92%	4%	4%
Religious community thinks children should be vaccinated	41%	14%	45%
Intention – more likely to give vaccine if. . .			
All my questions are answered	77%	17%	6%
Other children I know have received the vaccine	34%	52%	14%
Recommended by my health care provider	33%	55%	12%
A vaccine that I also received as a child	46%	44%	10%

Survey choices were strongly agree, agree, disagree and strongly disagree. For this table, strongly agree and agree and strongly disagree and disagree were combined, respectively into agree and disagree. Percentages do not add up to 100% as some respondents did not answer every question. NR: non-response.

While 92% reported that their health care provider believed children should be vaccinated, only 33% were more likely to give a vaccine if recommended by their doctor and only 33% felt that vaccinating according to the AAP guidelines was a good idea. Respondents who fully vaccinated their children were more likely to agree that vaccinating according to the AAP was a good idea (OR: 4.8 [95% CI: 2.0–11.7]) and were more likely to comply with the recommendations of their health care provider (OR: 8.3 [95% CI: 3.6–19.1]). We hypothesized that a younger generation might be more likely to follow guidance from sources other than the AAP. Therefore Fisher's exact tests were performed to look for associations between agreement that "AAP recommendations are good" and several demographic variables: family income over/under $75 K ($p$-value 0.68), age over/under 35 years (p-value 0.33), and college degree/none (p-value 0.15). At alpha = 0.05, none of these were significantly associated with positive attitude toward AAP recommendations.

While only thirty-nine percent commented upon having safety concerns about vaccines in general, a larger number of the total parents surveyed responded to specific examples. Approximately half (48%) of the total parents surveyed felt that vaccines have dangerous side effects while concerns about autism and learning disabilities were noted by 49% and 50%, respectively. Eighty percent of those surveyed believed that thimerosal, as used in some influenza vaccines, is a harmful compound. Of those who strongly disagreed with the statement "I think that vaccines can cause learning disabilities", none had children who were unvaccinated and the majority had fully vaccinated children compared to partially vaccinated (90.0% and 10.0% [95% CI's: 55.4–99.7 and 0.3–44.5]). Of those who strongly agreed with the learning disabilities statement, none had fully vaccinated children and more children were partially vaccinated than unvaccinated (91.7% and 8.3% [95% CI: 61.5–99.8 and 0.2–38.5]). Similar but less dichotomous patterns were seen in sub-analysis of the autism question. Despite most respondents believing that thimerosal is harmful, the majority of those who either strongly agreed or agreed with the statement had fully or partially vaccinated children.

Logistic regression analysis (Table 3) shows that the more strongly parents agreed that vaccinations were safe, the more likely they were to fully vaccinate (estimated OR: 7.6 [95% CI: 1.0–56.2]) – (e.g., compare the modeled mean of 1.1% for those who strongly disagree with that of 83.3% for those who strongly agree). Vaccination status did not vary significantly with beliefs about autism, thimerosal and learning disabilities in regression analyses.

4. Discussion

To our knowledge this the first survey to attempt to examine the patterns of behavior and beliefs of the homeschooling community regarding vaccination. Given the rise in the past five years in the number of children participating in the homeschool movement [6] the vaccination beliefs and practices of this community are of increasing concern to medical practitioners.

Approximately half of the respondents in this pilot study commented upon having safety concerns about vaccines. The percentage of parents concerned about vaccine safety in this study is comparable to national trends. In a 2008 national representative

Table 3
Regression analysis.

Parameter	Estimate	Standard error	Estimated odds ratio	95% Confidence interval (odds ratio)		p-Value
Regression 1: demographics						
Intercept	1.19	0.60	NA	NA	NA	0.047
Number of children	−0.54	0.19	0.58	0.41	0.84	0.004
Regression 2: beliefs						
Intercept	−9.80	2.98	NA	NA	NA	0.001
Accept AAP recommendations	1.58	0.45	4.85	2.01	11.69	<0.001
Vaccinations are safe	2.03	1.02	7.60	1.03	56.22	0.047
Regression 3: consequences						
Intercept	−4.46	2.98	NA	NA	NA	0.134
Vaccines have side effects	−0.86	0.44	0.42	0.18	1.01	0.054
Vaccines prevent disease	2.14	0.79	8.46	1.79	39.96	0.007
Regression 4: social						
Intercept	−5.70	1.27	NA	NA	NA	<0.001
Spouse thinks children should be vaccinated	1.76	0.40	5.82	2.66	12.74	<0.001
Regression 5: intent						
Intercept	−5.56	1.07	NA	NA	NA	<0.001
More likely to vaccinate if PCP recommends	2.13	0.42	8.39	3.67	19.16	<0.001

A logistic regression model was developed to determine the impact of the following variables on the likelihood of having a fully vaccinated homeschooled child.

sample of parents with children < 17 years of age, Freed and colleagues found that more than half of the respondents expressed concerns regarding serious adverse effects [20]. The 2008 Freed study did not subdivide families by type of education and the number of homeschooling families included in the study is not known. The only other study that includes homeschoolers is that by Kennedy and Gust from the 2003 Health Styles survey data. Compared to private and public school parents, homeschool parents were less likely to believe that vaccines are safe, and were more concerned that vaccines are given to prevent illnesses that children are unlikely to get [21]. However the number of homeschooling parents in the survey was only 27 (3%) of the total 936 in the survey. The homeschoolers in the current study were shown to have concerns about vaccines safety at rates similar to those of the general population as reflected in Freed's study.

While homeschoolers agreed with the general population regarding concerns about vaccine safety, a striking difference between this study and the Freed study was the response to doctor recommended immunization; 88% of families surveyed by Freed agreed or strongly agreed with the statement "Generally I do what my doctor recommends about vaccines for my children". In the current study approximately one third agreed with the statements: "I am more likely to give my child a vaccine if it is recommended by my health care provider" and "I think vaccinating children according to the schedule recommended by the American Academy of Pediatrics is a good idea". In addition, only 64% agreed that vaccinations were good at preventing VPD. In the Freed study, 90% agreed with the statement, "getting vaccines is a good way to protect my children from disease".

Only 38% of families stated that their children had received all the recommended vaccines. While a small minority had not vaccinated their children at all, 56% chose to only partially vaccinate their children. This study was not designed to address which vaccines were accepted or refused by families. Accordingly, it is very possible that one specific vaccine such as human papilloma virus vaccine refusal could skew results.

The demographic data of our sample were comparable to nationwide trends in homeschooling families. According to a nationwide cross-sectional descriptive study by Ray [22] when compared to the general population, homeschoolers have parents with more formal education (over 60% of parents with a college degree or higher), belong to larger families (68% with three or more children), and predominately have married couple families (97%). The national median income for homeschooling families was $75,000, which was similar to all married couple families nationwide.

The major limitation in our study was the necessary use of a convenience sample. It is not possible to determine the denominator of surveyed families due to the difficulties involved in gaining access to the homeschool population. In fact, the denominator may be inflated as we were not permitted to access the emails or names of the individual parents. We do not know if any emails were inactive or if emails were being sent more than one time to the same family. Accordingly the 18% response rate may be overly conservative. We did attempt to ask if we could visit the families in person or send the emails by the investigators. However, due to the concern by the leaders of the groups that this would be viewed as intrusive to families and violate their privacy, we did not do this. Additionally, the groups who agreed to participate in the study were predominantly located north of the city of Pittsburgh. There was not a mechanism for capturing any homeschooling family who was not part of a social-networking group for homeschoolers.

5. Conclusion

This pilot study is the first to date to directly investigate the vaccination beliefs and practices of homeschooling families. Further study is needed on a larger population of homeschooling families with non homeschool controls to verify results. In addition, further evaluation to determine if specific vaccines are more problematic for parents of homeschooled children and to better understand the factors or people influencing their decisions to vaccinate. Finally, strategies to educate parents of homeschooled children about the benefits of immunization need to be developed.

Conflicts of interest

Dr. Zimmerman has research funding and consultancy with Medimmune Inc., and research funding from Merck Inc., and Sanofi Pasteur. Dr. Michaels has received research funding from Roche Pharmaceuticals, Sanofi Pasteur, Glaxo Smith Kline and Merck Inc.

References

[1] Orenstein WA, Hinman AR. The immunization system in the United States – the role of school immunization laws. Vaccine 1999;(Suppl. 3):S19–24.
[2] Centers for disease control and prevention. Impact of vaccines universally recommended for children – United States, 1900–1998. JAMA 1999;281: 1482–3.
[3] Salmon DA, Siegel AW. The administration of religious and philosophical exemptions for vaccination requirements: legal review and lessons learned from conscientious objectors from conscription. Public Health Rep 2001;116:289–95.
[4] Salmon DA, Haber M, Gangarosa EJ, Phillips L, Smith NJ, Chen RT. Health consequences of religious and philosophical exemptions from immunization laws: individual and societal risks of measles. JAMA 1999;282:47–53.
[5] Omer SB, Pan WK, Halsey NA, Stokley S, Moulton LH, Navar AM, et al. Nonmedical exemptions to school immunization requirements: secular trends and association of state policies with pertussis incidence. JAMA 2006:1757–63.
[6] See http://nces.ed.gov/pubs2006/homeschool/ [accessed 20.10.11 at 2 pm].
[7] Ray BD. http://www.nheri.org/Research-Facts-on-Homeschooling.html [accessed 20.10.11 at 2 pm].
[8] Khalili D, Caplan A. Off the grid: vaccinations among homeschooled children. J Law Med Ethics 2007;471–477.
[9] Choi BK, Manning ML. The immunization status of home-schooled children in America. J Pediatr Health Care 2009;(April):1–6, online issue only.
[10] http://www.pahomeschoolers.com/info.html and http://www.portal.state.pa.us/portal/server.pt [both accessed 24.09.11 at 3 pm].
[11] http://www.pacode.com/secure/data/028/chapter23/s23.84.html [accessed 24.09.11 at 2 pm].
[12] MMWR 2008;57(January–July (33)):893–6, update: measles US.
[13] Montano DE, Kasprzyk D. The theory of reasoned action and the theory of planned behavior. In: Glanz K, Lewis FM, Rimer BK, editors. Health Behavior and Health Education: Theory, Research and Practice. 3rd ed. San Francisco: Jossey-Bass Publishers; 1997. p. 85–112.
[14] Nowalk MP, Zimmerman RK, Shen S, Jewell IK, Raymund M. Barriers to pneumococcal and influenza vaccination in older community-dwelling adults (2000–2001). JAGS 2004;52:25–30.
[15] Nowalk MP, Zimmerman RK, Lin CJ, Ko FS, Raymund M, Hoberman A, et al. Parental perspectives on influenza immunization of children aged 6–23 months. Am J Prev Med 2005;29(3):210–4.
[16] Reece M, Milhausen RR, Perera B. A theory based approach to understanding sexual behavior at Mardi Gras. J Sex Res 2006 May;43:97–106.
[17] Brown RL, Baumann LJ, Helberg CP, Han Y, Fontana SA, Love RR. The simultaneous analysis of patient, physician and group practice influences on annual mammography performance. Soc Sci Med 1996;43(3):315–24.
[18] Boots RJ, Treloar C. Prediction of intern attendance at a seminar-based training programme: a behavioral intention model. Med Educ 2000;34:512–8.
[19] Montano DE. Predicting and understanding influenza vaccination behavior. Alternatives to the health belief model. Med Care 1986;24:438–53.
[20] Freed JL, Clark SJ, Butchart AT. Parental vaccine safety concerns in 2009. Pediatrics 2010;(May):654–9.
[21] Kennedy AM, Gust DA. Parental vaccines beliefs and child's school type. Health Serv Appl 2005;75(7):276–80.
[22] Ray BD. Academic achievement and demographic traits of homeschool students: a nation wide study. Acad Leadersh J 2010;8(1). Online at www.academicleadership.org [accessed 20.10.11 at 2 pm].