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Validation of the vaccine conspiracy beliefs scale

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ABSTRACT

Background: Parents' vaccine attitudes influence their decision regarding child vaccination. To date, no study has evaluated the impact of vaccine conspiracy beliefs on human papillomavirus vaccine acceptance. The authors assessed the validity of a Vaccine Conspiracy Beliefs Scale (VCBS) and determined whether this scale was associated with parents' willingness to vaccinate their son with the HPV vaccine.

Methods: Canadian parents completed a 24-min online survey in 2014. Measures included socio-demographic variables, HPV knowledge, health care provider recommendation, Conspiracy Mentality Questionnaire (CMQ), the seven-item VCBS, and parents' willingness to vaccinate their son at two price points.

Results: A total of 1427 Canadian parents completed the survey in English (61.2%) or French (38.8%). A Factor Analysis revealed the VCBS is one-dimensional and has high internal consistency (α=0.937). The construct validity of the VCBS was supported by a moderate relationship with the CMQ (r=0.44, $p < 0.001$). Hierarchical regression analyses found the VCBS is negatively related to parents' willingness to vaccinate their son with the HPV vaccine at both price points ('free' or '$300') after controlling for gender, age, household income, education level, HPV knowledge, and health care provider recommendation.

Conclusions: The VCBS is a brief, valid scale that will be useful in further elucidating the correlates of vaccine hesitancy. Future research could use the VCBS to evaluate the impact of vaccine conspiracies beliefs on vaccine uptake and how concerns about vaccination may be challenged and reversed.

1. Introduction

Fear and mistrust in vaccines have existed since inoculation was introduced [1–3]. Currently, conspiracy beliefs about vaccines are widely endorsed [4–10]. For example, the belief that vaccines can cause autism has no basis in empirical evidence [11]; yet, a nationally representative survey of 1351 Americans found that 56% of those surveyed reported that they 'agree' or 'neither agree nor disagree' that 'doctors and the government still want to vaccinate children even though they know these vaccines cause autism and other psychological disorders' [12].

Recent research has indicated that belief in conspiracies can impact individual health decisions [13,14]. In various areas of medical research, conspiracy beliefs have been associated with behavioural outcomes such as decreased HIV treatment adherence, decreased condom use, and increased use of alternative medicines [12,15]. Specific to vaccination conspiracies, a study of 89 British parents found that belief in vaccine conspiracy theories was significantly associated with the likelihood that parents would not vaccinate a fictitious infant [16]. Despite the concern that conspiracy beliefs may be central to the anti-vaccination movement and recent outbreaks of infections diseases, there has been a scarcity of research examining vaccine conspiracies [17].

A standardized, validated measurement tool would help advance our understanding of the impact of vaccine conspiracy beliefs on vaccine hesitancy and uptake rates. Measures do exist that examine general (non-vaccine) conspiracy beliefs [10,13,14,18,19], and other (not conspiracy specific) vaccine attitudes [20–25]. However, to the authors' knowledge, no validated scale exists that explicitly evaluates vaccine conspiracy beliefs even though vaccine conspiracy beliefs are likely to influence vaccine intentions beyond other known predictive factors such as socio-demographic, vaccine knowledge, and health care provider's recommendation [26–28]. The purpose of this study is therefore to develop and validate the Vaccine Conspiracy Beliefs Scale (VCBS) by investigating the scale's structure and internal consistency, construct validity, and criterion validity (i.e. whether the VCBS is associated with parents' willingness to vaccinate their child). Examining conspiracy beliefs with regard to the HPV vaccine is

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particularly useful as uptake rates for the HPV vaccine are not reaching desired rates [29–31], are lower than other recommended vaccines [32,33], and content analyses of websites and qualitative research indicates that conspiracy beliefs are an important contributor to the decision to vaccinate one's child with the HPV vaccine [5,7,34–36].

2. Methods

2.1. Study design

Data collected in this study was part of a larger two-wave longitudinal examination of Canadian parents HPV vaccine decision-making for their sons. This study reports upon additional items that were included in the questionnaire at the second time point to evaluate vaccine conspiracy beliefs.

The online survey was offered in English and French (i.e. Canada's official languages). A specialized translation firm translated the survey into French, and bilingual healthcare professionals also reviewed the translation results. Each survey was personalized so that parents responded to questions that specifically included their son's name. Data collection was conducted between October and November 2014. The survey took approximately 24 minutes to complete and was designed so that there would be no missing data, as participants were required to answer all questions on a page before continuing. After the survey was complete, participants were thanked and debriefed.

A detailed description of the study design is reported elsewhere [37]. The Institutional Review Board at the Jewish General Hospital (Montreal, Canada) approved the study.

2.2. Participants

Participants were recruited by email invitations from Leger Marketing, a polling and market research firm with a panel of 400,000 Canadians across 10 provinces. Eligibility criteria for this study included being a parent of a 9–16 year old boy, residence in a Canadian province, fluency in English or French, Internet access, and participation in the first of this two-wave longitudinal study. Participants were compensated $3.00 for their participation.

2.3. Survey measures

All participants completed initial socio-demographic items including parental gender (binary), level of education (binary), age, and household income.

2.3.1. HPV knowledge

Waller et al.'s 16-item General HPV Knowledge scale was used (α=0.849) [38]. Participants responded whether they believed items were 'true', 'false', or 'don't know'. Sample items include 'men cannot get HPV' (false) or 'HPV can cause genital warts' (true). The combination number of correct items was calculated to compute a total HPV knowledge score.

2.3.2. Health care provider (HCP) recommendation

Parents were asked "have you ever talked with a doctor/health care provider about the HPV vaccine for < son's name > ?'. Parents' responses were recoded to identify a positive recommendation (i.e. 'yes, and he/she recommended that < son's name > get the HPV vaccine') versus other responses.

2.3.3. General conspiracy beliefs

General conspiracy beliefs were assessed using the Conspiracy Mentality Questionnaire (CMQ), a 5-item measure designed to assess an individual's tendency to engage in general (i.e. not vaccine specific) conspiracy ideation (α=0.84) [14]. Participants rated how true they thought a given item was on an 11-point scale that ranges from 'certainly not' (0%) to 'certain' (100%). A sample item includes, 'I think that many very important things happen in the world, which the public is never informed about'. This questionnaire was chosen because compared to other measures of general conspiracy beliefs, it has been validated in a large cross-cultural sample, and was found to be stable across time [14].

2.3.4. Vaccine conspiracy beliefs scale

A scan of the literature revealed one study that included items that assessed vaccine-specific conspiracy belief. Ten items were used by Jolley and Douglas to examine the efficacy of a conspiracy theory manipulation task [16]. To develop the VCBS, we retained six of ten items from Jolley and Douglas [16] that specifically referred to a conspiracy (i.e. a deception or collusion rather than a fear or general attitude). Lastly, one additional item (i.e. "the government is trying to cover up the link between vaccines and autism") was added in this study given this is a commonly held conspiracy belief (see Oliver et al. [12]). Participants indicated how much they agree or disagree with a given statement on a 7-point scale that ranges from 'strongly disagree' (1) to 'strongly agree' (7). The reading age of the VCBS is a Grade 9 level [39]. An average score was calculated. A copy of the scale is available (see Supplementary material).

2.3.5. Willingness to vaccinate

Two items were used to investigate parents' willingness to vaccinate their sons as a function of cost (i.e. the study's outcome variables). Parents were asked to 'please indicate how willing you would be to get all the HPV vaccine doses for < son's name > if vaccinating < son's name > against HPV would...' (1) '...be free? ' or (2) '...cost $300? '. These items were measured on a 5-point Likert scale from 'extremely unwilling' (1) to 'extremely willing' (5). These cost outcomes (i.e. 'free' and '$300′) were chosen because in Canada the vaccine is either provided for free (i.e. depending on the child's age, gender, and province) in school-based programs, or the vaccine costs parents approximately $300 (CAD).

2.4. Statistical analysis

Using G*Power software (version 3.1), a sample size of 1099 would be sufficient to detect a small effect (f^2=0.02) using multiple regression on 7 independent variables with α=0.05 and β=0.05.

To examine the scale's structure and internal consistency, a Factor Analysis was conducted and Cronbach's alpha was examined. The descriptive statistics, item-total correlation coefficients, and each item's loading onto Factor 1 are reported. The percentage of total variance of each component and the eigenvalues are also reported.

Construct validity was evaluated by examining the (convergent and discriminant) relationship between the VCBS and CMQ.

To determine the criterion (i.e. concurrent) validity of the VCBS, Pearson correlations between each predictor (i.e. gender, age, level of education, household income, HPV knowledge, HCP recommendation, and vaccine conspiracy beliefs) and outcome variables (i.e. willingness to vaccinate one's son as a function of cost) were evaluated. In order to examine the unique contribution of the VCBS (within the context of the other variables in the model) to predict parents' willingness to vaccinate their son, two separate linear hierarchical regression analyses [40] were conducted (at each price point: '$0′ and '$300′). All tolerance coefficients in the regression results were greater than .83, indicating no issues of multicollinearity. All statistical analyses were conducted using SPSS Version 22 for Mac OS X (IBM Corp., 2013).

3. Results

3.1. Sample characteristics

A total of 1608 parents responded to an online questionnaire.

Overall, 181 (11.3%) participants were excluded from the final sample due to detection of these participants as "careless" respondents.[1] The final sample consisted of 1427 (967 women and 460 men) parents between the ages of 26 and 69 (M=44.77, SD=6.66) (Table 1). The majority of respondents were White (89.7%), married (62.6%), working full-time (66.1%), and had a college or university education (78.8%). Parents' average score on the 16 HPV knowledge items was 63% correct (M=10.06, SD=3.78).

3.2. Structure and internal consistency of the VCBS

Table 2 presents the means and standard deviations, skewness (Range=0.08 to 0.72), and kurtosis (Range=−0.11 to −0.68) for the VCBS.[2] Cronbach's alpha was 0.937 and item-total correlation coefficients ranged between 0.77 and 0.82, indicating good internal consistency.

The Factor Analysis yielded a one-component solution with an eigenvalue of 5.10. The first component accounted for 68.37% of the total variance, suggesting that the VCBS is one-dimensional. The loadings of the pattern matrix are reported in Table 2. The other components had eigenvalues smaller than 0.5 and each accounted for less than 7% of the total variance. The seven items of the VCBS were therefore averaged to create a 1-item measure.

3.3. Construct validity of the VCBS

Correlations amongst the variables are presented in Table 3. The construct validity of the VCBS was supported by a significant correlation with the CMQ (r=0.44, $p < 0.001$), but sufficient dissimilarity (1-r^2=0.806) between these measures.

3.4. Criterion validity of the VCBS

Parents' willingness to vaccinate was higher when the vaccine was 'free' (M=3.78, SD=1.30) compared to when the vaccine was '$300′ ($M$=1.85, SD=1.09). The Pearson correlations between the predictor variables and the dependent variable are presented in Table 3.

Two separate linear HRAs examined the unique contribution of the VCBS to parents' willingness to vaccinate their son with the HPV vaccine at two different price points ($0, $300) (see Tables 4 and 5). In each regression, parents' gender, age, income, education level (coded as having a high-school education or a college/university education), HPV knowledge, and HCP recommendation were entered in the first step, and the VCBS was entered in the second step.[3]

Table 4 shows the results of the HRA when the vaccine was 'free' ($0). The variables entered in the first step contributed weakly to the prediction of willingness to vaccinate (2%) (Table 4). The VCBS was entered in the second step of the analysis and accounted for the majority of the variance of parents' willingness to vaccinate their son with the HPV vaccine (31% total variation accounted for) (Table 4). Examination of the standardized beta weights from the regression equation indicated that income (β=0.09, $p < 0.01$), parental age (β=0.06, $p < 0.05$), HCP Recommendation (β=0.10, $p < 0.01$), and the VCBS (β=−0.56, $p < 0.001$) contributed significantly unique variance.

Table 5 shows the results of the HRA when the vaccine cost was '$300′. At this elevated price point, three variables entered in the first step (i.e. income, age, and HCP recommendation) contributed to the prediction of willingness to vaccinate, explaining 9% of the variance. The VCBS, entered in the second step of the analysis, contributed 3% additional variance of parents' willingness to vaccinate their son with HPV vaccine. Examination of the standardized beta weights from the regression equation indicated that income (β=0.19, $p < 0.001$), parental age (β=0.15, $p < 0.001$), HCP recommendation (β=0.14, $p < 0.001$), and the VCBS (β=−0.18, $p < 0.001$) contributed significantly unique variance (Table 5).

Table 1
Sample demographics.

	n	%
Gender		
Male	460	32.2
Female	967	67.8
Province		
Alberta	144	10.1
British Columbia	130	9.1
Manitoba	53	3.7
New Brunswick	36	2.5
Newfoundland and Labrador	20	1.4
Nova Scotia	50	3.5
Ontario	400	28.0
Prince Edward Island	7	0.5
Quebec	566	39.7
Saskatchewan	21	1.5
Marital Status		
Single	107	7.5
Married	893	62.6
Common law relationship	280	19.6
Separated but still legally married	48	3.4
Divorced	86	6.0
Widowed	8	0.6
Other	3	0.2
I prefer not to answer	2	0.1
Household Income (CAD)		
$19,999 or less	44	3.1
$20,000–39,999	129	9.0
$40,000–59,999	187	13.1
$60,000–79,999	221	15.5
$80–99,999	237	16.6
$100,000 or more	459	32.2
I prefer not to answer	150	10.5
Highest Level of Education Completed	**n**	**%**
Elementary or High School	301	21.1
College or University	1125	78.8
I prefer not to answer	1	0.1
Language of Questionnaire		
English	873	61.2
French	554	38.8
Employment		
Working full time	943	66.1
Working part-time	215	15.1
Not working	151	10.6
Retired	32	2.2
Other	81	5.7
I prefer not to answer	5	0.3

N=1427.

4. Discussion

The present study was the first to assess the validity of a scale to measure vaccine conspiracy beliefs and determine whether such beliefs are associated with parents' willingness to vaccinate their child with the HPV vaccine. The results established that the VCBS is one-dimensional and has high internal consistency (α=0.937).

This examination revealed that the VCBS had significant negative

[1] The techniques used to identify careless responders included variance, bogus items, psychometric antonyms, and psychometric synonyms [41].

[2] The VCBS means significantly differed between those who answered the survey in English (n=873) and French (n=554). As large sample sizes are more easily able to detect small differences we examined the effect size, which was small (Cohen's d=0.203; Hedges' g=0.199). Analyses were run by language subgroup and the results were similar. A combined analysis is therefore presented.

[3] Analyses were run both including and excluding the CMQ variable as a predictor. When CMQ was included, VCBS remained a significant and important predictor of willingness to vaccinate.

Table 2
Measures of central tendency and dispersion for vaccine conspiracy beliefs scale items.

Item	*M*	*SD*	Item-Total Correlation	Skewness	Kurtosis	Factor 1
1. Vaccine safety data is often fabricated.	3.42	1.52	0.80	0.32	−0.37	0.86
2. Immunizing children is harmful and this fact is covered up.	2.77	1.56	0.79	0.72	−0.11	0.85
3. Pharmaceutical companies cover up the dangers of vaccines.	3.86	1.63	0.79	0.08	−0.68	0.85
4. People are deceived about vaccine efficacy.	3.59	1.54	0.79	0.17	−0.49	0.85
5. Vaccine efficacy data is often fabricated.	3.45	1.48	0.82	0.27	−0.25	0.87
6. People are deceived about vaccine safety.	3.69	1.52	0.80	0.08	−0.48	0.86
7. The government is trying to cover up the link between vaccines and autism.	3.16	1.68	0.77	0.37	−0.56	0.84

M=mean, SD=standard deviation.

Table 3
Correlations between variables.

	Gender	Income	Education	Age	HPV Knowledge	HCP Recommendation	CMQ	VCBS	HPV Vaccine for Son =$0	HPV Vaccine for Son =$300
Gender	X									
Income	−0.24***	X								
Education	−0.13***	0.28***	X							
Age	−0.29***	0.17***	0.08**	X						
HPV Knowledge	0.17***	0.04	0.08**	−0.11***	X					
HCP Recommendation	0.02	−0.01	0.00	−0.00	0.12***	X				
CMQ	0.03	−0.18***	−0.13***	−0.06*	−0.06*	−0.02	X			
VCBS	0.02	−0.23***	−0.09**	−0.04	−0.11***	−0.10***	0.44***	X		
HPV Vaccine for Son=$0	−0.02	0.10**	0.03*	0.05	0.03	0.10***	−0.17***	−0.55***	X	
HPV Vaccine for Son=$300	−0.11***	0.22***	0.05	0.19***	−0.01	0.13***	−0.13***	−0.23***	0.26***	X

HPV=human papillomavirus, HCP=health care provider, CMQ=Conspiracy Mentality Questionnaire, VCBS=Vaccine Conspiracy Beliefs Scale.
* significant at $p < 0.05$.
** significant at $p < 0.01$.
*** significant at $p < 0.001$.

Table 4
Hierarchical regression analysis when the HPV vaccine is free.

	Beta	R^2	F
Dependent=Willingness to vaccinate son when vaccine is $0			
Step 1			
Gender (1=m, 2=f)	0.01		
Income	0.09**		
Level of Education	0.00		
Age	0.06*		
HPV Knowledge	0.00		
HCP Recommendation	0.10**	0.02	4.52 (6,1234)***
Step 2			
VCBS	−0.56***	0.31	79.92 (7,1233)***

N=1427.
HPV= human papillomavirus, HCP=health care provider, VCBS=Vaccine Conspiracy Beliefs Scale, Beta=regression coefficient beta, R^2=R squared, F=*F* test in SPSS.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$

Table 5
Hierarchical regression analysis when the HPV vaccine costs $300.

	Beta	R^2	F
Dependent=Willingness to vaccinate son when vaccine is $300			
Step 1			
Gender (1=m, 2=f)	−0.03		
Income	0.19***		
Level of Education	−0.01		
Age	0.15***		
HPV Knowledge	−0.01		
HCP Recommendation	0.14***	0.09	20.65 (6,1234)***
Step 2			
VCBS	−0.18***	0.12	24.58 (7,1233)***

N=1427;
HPV=human papillomavirus, HCP=health care provider, VCBS=Vaccine Conspiracy Beliefs Scale, m=male, f=female, Beta=regression coefficient beta, R^2=R squared, F=*F* test in SPSS.
*** $p < 0.001$.

relationships with parents' income, education, HPV knowledge, and HCP recommendation (Table 3). Contrary to some initial research [32,35], belief in vaccine conspiracies did not differ by gender in this study. As expected, there was substantial overlap between those who believe in vaccine-specific conspiracies with those who believe in general conspiracies. Indeed, research has shown that belief in one conspiracy theory is the most important predictor of belief in another conspiracy theory [10,18], even when such theories are conflicting [42]. Though the VCBS and CMQ overlap, there also appears to be sufficient dissimilarity between these measures, substantiating the usefulness of the vaccine-specific measure of conspiracy beliefs.

It is also important for any new measurement to demonstrate a relationship with an expected outcome (i.e. criterion validity). Analyses revealed that the VCBS is significantly negatively correlated with parents' willingness to vaccinate their child when the vaccine was 'free' and '$300′. Interestingly, the relationship between parent's vaccine conspiracy beliefs and willingness to vaccinate their children was stronger when the vaccine was free. This might suggest that the recommendation for a vaccine that costs '$300′ may create less suspicion among parents compared to a free vaccine, or that other factors (such as income) account for a greater variation in parents' willingness to vaccinate their child when the vaccine costs '$300′. It is also plausible that the scores on the VCBS had a stronger relationship

with parents' willingness when the vaccine was free because adding an element of cost may complicate the question (by introducing an additional motivation). Nevertheless, these results demonstrate that vaccine conspiracy beliefs have a stronger (unique) relationship to parents' willingness to vaccinate their child when the vaccine is offered for 'free'. It would be helpful for future research to further investigate the relationship between vaccine cost and parents' vaccine conspiracy beliefs. This has particular repercussions for discussions surrounding the HPV vaccine, a vaccine that is either free or costs approximately $300 (CAN) depending on the child's gender and province.

In the Hierarchical Regression Analyses, income, parental age, HCP recommendation, and vaccine conspiracy beliefs emerged as significant predictors of parents' willingness to vaccinate their child. Not surprisingly, when vaccination cost '$300′, greater parental income was significantly associated with greater willingness to vaccinate one's child (see Table 3 and Table 5). However, it is interesting that there was still a significant (albeit weaker) positive relationship between parental income and willingness when the vaccine was 'free' (see Table 3 and Table 4), indicating that wealthier parents were still more likely to vaccinate their child when the issue of cost was completely eliminated.

4.1. Study limitations

There are some notable limitations in this study. Firstly, using preselected items to develop this scale may have increased the likelihood of producing a one-dimensional scale. Secondly, the VCBS contains seven items. Although few items will be practical in the replication and administration of this scale, evaluating additional vaccine conspiracy beliefs would ascertain whether other beliefs drive another underlying construct. For example, it may have been helpful to also include items that ask about other prominent conspiracies including: that the purpose of vaccination is for population control or to cause deliberate harm (including genocides), vaccine information is withheld from the medical community, doctors support of vaccination is motivated by profit, or that the dangers of vaccines are purposefully downplayed [34]. Moreover, the VCBS does not have reverse coded items, which may increase the potential for acquiescent and extreme response bias.

While the sampling procedure aimed to recruit a nationally representative sample, on the whole, the sample was slightly more White (89.7%) and educated (78.8% college/university degree) than parents of 9–16 year old sons in the Canadian population at large (72.2% and 66.9% respectively) [43]. Given the relationship between VCBS and education, beliefs in vaccine conspiracy may be more prevalent in the general population than was found in this sample.

4.2. Future research directions

In terms of further validation, it is important to evaluate the test-retest reliability of the VCBS and assess whether vaccine conspiracy beliefs change over time. It would also be helpful to examine the VCBS in other contexts, including for other vaccines, parents of girls, other (non-parent) samples, and in other countries, so to confirm the generalizability of this scale. In so doing, it may be appropriate to include other items in the VCBS to measure vaccine conspiracies that are commonly believed in other regions of the world [4,6,8,9].

The above findings do not suggest that vaccine conspiracy beliefs are the only important factor in parents' willingness to vaccinate their children. The relationship between the VCBS and parents willingness had a medium effect size when the vaccine was 'free' (r^2=0.30), and a small effect size when the vaccine cost '$300′ ($r^2$=0.05). Other correlates including influence of partner or peers and other attitudes should be evaluated in future studies. Future research should also be directed at understanding the socio-demographical and psychological correlates of vaccine conspiracy beliefs [10,18,44]. Lastly, experimental research could use the VCBS to better understand how vaccine conspiracy beliefs may be challenged and reversed [16,45].

5. Conclusions

Vaccination is an incredibly effective public health tool, yet increasing numbers of parents are choosing not to vaccinate their children [1,46]. As beliefs in vaccine conspiracies are widespread and present an important opportunity in understanding vaccine refusal [4,16], the validity of the VCBS was assessed through examining its structure and internal consistency, construct validity, and criterion validity. The VCBS will facilitate future research that seeks to understand vaccine hesitancy and address the barriers to vaccination in a range of vaccines.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pvr.2016.09.001.

References

[1] G.A. Poland, R.M. Jacobson, The age-old struggle against the antivaccinationists, N. Engl. J. Med. 364 (2011) 97–99.
[2] P.Offit, Deadly Choices: How The Anti-Vaccine Movement Threatens Us All New York (NY): Basic Books, 2011.
[3] J. Leask, Should we do battle with antivaccination activists?, Public Health Res. Pract. 25 (2015) e2521515.
[4] D. Cobos Munoz, L. Monzon Llamas, X. Bosch-Capblanch, Exposing concerns about vaccination in low- and middle-income countries: a systematic review, Int. J. Public Health 60 (2015) 767–780.
[5] C. Craciun, A. Baban, "Who will take the blame?": understanding the reasons why Romanian mothers decline HPV vaccination for their daughters, Vaccine 30 (2012) 6789–6793.
[6] J.O. Olufowote, Local resistance to the global eradication of polio: newspaper coverage of the 2003–2004 vaccination stoppage in northern Nigeria, Health Commun. 26 (2011) 743–753.
[7] M.A. Penta, A. Băban, Dangerous agent or saviour? HPV vaccine representations on online discussion forums in Romania, Int. J. Behav. Med. 21 (2014) 20–28.
[8] S. Chaturvedi, R. Dasgupta, V. Adhish, K.K. Ganguly, S. Rai, L. Sushant, et al., Deconstructing social resistance to pulse polio campaign in two North Indian districts, Indian Pediatr. 46 (2009) 963–974.
[9] L. Fourn, S. Haddad, P. Fournier, R. Gansey, Determinants of parents' reticence toward vaccination in urban areas in Benin (West Africa), BMC Int. Health Hum. Rights 9 (Suppl. 1) (2009) S14.
[10] V. Swami, R. Coles, S. Stieger, J. Pietschnig, A. Furnham, S. Rehim, et al., Conspiracist ideation in Britain and Austria: evidence of a monological belief system and associations between individual psychological differences and real-world and fictitious conspiracy theories, Br. J. Psychol. 102 (2011) 443–463.
[11] L.E. Taylor, A.L. Swerdfeger, G.D. Eslick, Vaccines are not associated with autism: an evidence-based meta-analysis of case-control and cohort studies, Vaccine 32 (2014) 3623–3629.
[12] J.E. Oliver, T. Wood, Medical conspiracy theories and health behaviors in the United States, JAMA Intern. Med. 174 (2014) 817–818.
[13] R. Brotherton, C.C. French, A.D. Pickering, Measuring belief in conspiracy theories: the generic conspiracist beliefs scale, Front. Psychol. 4 (2013) 279.
[14] M. Bruder, P. Haffke, N. Neave, N. Nouripanah, R. Imhoff, Measuring individual differences in generic beliefs in conspiracy theories across cultures: conspiracy mentality questionnaire, Front. Psychol. 4 (2013) 225.
[15] G.B. Gaston, B. Alleyne-Green, The impact of African Americans' beliefs about HIV medical care on treatment adherence: a systematic review and recommendations for interventions, AIDS Behav. 17 (2013) 31–40.
[16] D. Jolley, K.M. Douglas, The effects of anti-vaccine conspiracy theories on vaccination intentions, PLoS One 9 (2014) e89177.
[17] D. Jolley, K.M. Douglas, The social consequences of conspiracism: exposure to conspiracy theories decreases intentions to engage in politics and to reduce one's carbon footprint, Br. J. Psychol. 105 (2014) 35–56.
[18] V. Swami, T. Chamorro-Premuzic, A. Furnham, Unanswered questions: a preliminary investigation of personality and individual difference predictorsof 9/11 conspiracist beliefs, Appl. Cogn. Psychol. 24 (2010) 749–761.
[19] V. Swami, Social psychological origins of conspiracy theories: the case of the jewish conspiracy theory in malaysia, Front. Psychol. 3 (2012) 280.
[20] M.B. Gilkey, B.E. Magnus, P.L. Reiter, A.L. McRee, A.F. Dempsey, N.T. Brewer, The Vaccination Confidence Scale: a brief measure of parents' vaccination beliefs,

Vaccine 32 (2014) 6259–6265.
[21] M.B. Gilkey, P.L. Reiter, B.E. Magnus, A.L. McRee, A.F. Dempsey, N.T. Brewer, Validation of the vaccination confidence scale: a brief measure to identify parents at risk for refusing adolescent vaccines, Acad. Pediatr. (2015).
[22] D.J. Opel, R. Mangione-Smith, J.A. Taylor, C. Korfiatis, C. Wiese, S. Catz, et al., Development of a survey to identify vaccine-hesitant parents: the parent attitudes about childhood vaccines survey, Hum. Vaccin. 7 (2011) 419–425.
[23] H.J. Larson, C. Jarrett, W.S. Schulz, M. Chaudhuri, Y. Zhou, E. Dube, et al., Measuring vaccine hesitancy: the development of a survey tool, Vaccine 33 (2015) 4165–4175.
[24] Z. Horne, D. Powell, J.E. Hummel, K.J. Holyoak, Countering antivaccination attitudes, Proc. Natl. Acad. Sci. USA 112 (2015) 10321–10324.
[25] S. Perez, G.K. Shapiro, O. Tatar, K. Joyal-Desmarais, Z. Rosberger, Development and validation of the Human Papillomavirus attitudes and beliefs scale in a national canadian sample, Sex. Transm. Dis. (2016) 43.
[26] A. Zingg, M. Siegrist, Measuring people's knowledge about vaccination: developing a one-dimensional scale, Vaccine 30 (2012) 3771–3777.
[27] A. Krawczyk, B. Knauper, V. Gilca, E. Dube, S. Perez, K. Joyal-Desmarais, et al., Parents' decision-making about the human papillomavirus vaccine for their daughters: i. Quantitative results, Hum. Vaccines Immunother. 11 (2015) 322–329.
[28] K. Trim, N. Nagji, L. Elit, K. Roy, Parental knowledge, attitudes, and behaviours towards human papillomavirus vaccination for their children: a systematic review from 2001 to 2011, Obstet. Gynecol. Int. 2012 (2012) 921236.
[29] S. Reagan-Steiner, D. Yankey, J. Jeyarajah, L.D. Elam-Evans, J.A. Singleton, C.R. Curtis, et al., National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 Years — United States, 2014, Morb. Mortal. Wkly. Rep. 64 (2015) 784–792.
[30] S.J. Hanley, E. Yoshioka, Y. Ito, R. Kishi, HPV vaccination crisis in Japan, Lancet 385 (2015) 2571.
[31] N.L. Gilbert, H. Gilmour, E. Dubé, S.E. Wilson, J. Laroche, Estimates and determinants of HPV non-vaccination and vaccine refusal in girls 12 to 14 years of age in Canada: results from the Childhood National Immunization Coverage Survey, 2013, Hum. Vaccines Immunother. (2016).
[32] G.L. Freed, S.J. Clark, A.T. Butchart, D.C. Singer, M.M. Davis, Parental vaccine safety concerns in 2009, Pediatrics 125 (2010) 654–659.
[33] Public Health Agency of Canada. Update On Human Papillomavirus (HPV) Vaccines. In: Public Health Agency of Canada, editor. Canada Communicable Disease Report, 2012.
[34] A. Kata, A postmodern Pandora's box: anti-vaccination misinformation on the Internet, Vaccine 28 (2010) 1709–1716.
[35] R. Briones, X. Nan, K. Madden, L. Waks, When vaccines go viral: an analysis of HPV vaccine coverage on YouTube, Health Commun. 27 (2012) 478–485.
[36] K. Madden, X. Nan, R. Briones, L. Waks, Sorting through search results: a content analysis of HPV vaccine information online, Vaccine 30 (2012) 3741–3746.
[37] S. Perez, O. Tatar, G.K. Shapiro, E. Dubé, G. Ogilvie, J. Guichon, V. Gilca, Z. Rosberger. Psychosocial determinants of parental human papillomavirus (HPV) vaccine decision-making for sons: Methodological challenges and initial results of a pan-Canadian longitudinal study, BMC Public Health, Accepted for publication
[38] J. Waller, R. Ostini, L.A. Marlow, K. McCaffery, G. Zimet, Validation of a measure of knowledge about human papillomavirus (HPV) using item response theory and classical test theory, Prev. Med. 56 (2013) 35–40.
[39] Readability Score. Measure Text Readability.
[40] G.A. Mishra, S.A. Pimple, S.S. Shastri, Prevention of cervix cancer in India, Oncology 91 (Suppl. 1) (2016) S1–S7.
[41] A.W. Meade, S.B. Craig, Identifying careless responses in survey data, Psychol. Methods 17 (2012) 437–455.
[42] M.J. Wood, K.M. Douglas, R.M. Sutton, Dead and alive: beliefs in contradictory conspiracy theories. social psychological and personality, Science 3 (2012) 767–773.
[43] Statistics Canada. 2011 National Household Survey, Custom request (BO-0526). 2011.
[44] A. Furnham, Commercial conspiracy theories: a pilot study, Front. Psychol. 4 (2013) 379.
[45] B. Nyhan, J. Reifler, Does correcting myths about the flu vaccine work? An experimental evaluation of the effects of corrective information, Vaccine 33 (2015) 459–464.
[46] J.P. Guidry, K. Carlyle, M. Messner, Y. Jin, On pins and needles: how vaccines are portrayed on Pinterest, Vaccine 33 (2015) 5051–5056.