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The vaccine hesitancy scale: Psychometric properties and validation

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ABSTRACT

Introduction: The SAGE Working Group on Vaccine Hesitancy developed a vaccine hesitancy measure, the Vaccine Hesitancy Scale (VHS). This scale has the potential to aid in the advancement of research and immunization policy but has not yet been psychometrically evaluated.
Methods: Using a cross-sectional design, we collected self-reported survey data from a large national sample of Canadian parents from August to September 2016. An online questionnaire was completed in English or French. We used exploratory and confirmatory factor analysis to identify latent constructs underlying parents' responses to 10 VHS items (response scale 1–5, with higher scores indicating greater hesitancy). In addition to the VHS, measures included socio-demographics items, vaccine attitudes, parents' human papillomavirus (HPV) vaccine decision-making stage, and vaccine refusal.
Results: A total of 3779 Canadian parents completed the survey in English (74.1%) or French (25.9%). Exploratory and confirmatory factor analysis revealed a two-factor structure best explained the data, consisting of 'lack of confidence' ($M = 1.98$, $SD = 0.72$) and 'risks' ($M = 3.07$, $SD = 0.95$). Significant Pearson correlations were found between the scales and related vaccine attitudes. ANOVA analyses found significant differences in the VHS sub-scales by parents' vaccine decision-making stages ($p < .001$). Independent samples *t*-tests found that the VHS sub-scales were associated with HPV vaccine refusal and refusing another vaccine ($p < .001$). Socio-demographic differences in the VHS were found; however, effect sizes were small ($\eta^2 < 0.02$).
Conclusions: The VHS was found to have two factors that have construct and criterion validity in identifying vaccine hesitant parents. A limitation of the VHS was few items that loaded on the 'risks' component and a lack of positively and negatively worded items for both components. Based on these results, we suggest modifying the wording of some items and adding items on risk perceptions.
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1. Introduction

Since inoculation was first introduced in Europe in the 18th century to prevent smallpox there have been people who have been hesitant about receiving vaccinations [1–4]. The term 'vaccine hesitancy' refers to the delay in acceptance or refusal of vaccination despite the availability of services [5]. The factors contributing to vaccine hesitancy likely varies depending on the specific vaccine, individual and social influences, and one's environment [6–8]. Vaccine hesitancy has been described as an attitude (concerns or doubts) as well as a behaviour [9]. Vaccine hesitancy has been used to refer to a heterogeneous group representing divergent attitudes including issues of confidence (e.g. not trusting in vaccines or health care providers), complacency (e.g. not perceiving a need for vaccination or not valuing vaccination), and convenience (e.g. access) [6,10,11]. Vaccine hesitancy is complex and multilayered as "individuals may refuse some vaccines, but agree to others, delay vaccination or accept vaccination although doubtful about doing so" (p. 6649) [5]. Peretti-Watel et al. (2015) have criticized the ambiguity of the available definitions for vaccine hesitancy, and has theorized vaccine hesitancy as a decision-making process that depends on one's level of commitment to health (or risk) culture as well as one's confidence in health authorities and mainstream medicine [12].

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There is concern that public confidence in vaccines is decreasing and anti-vaccine movements are becoming stronger [4,9,10,13–16]. For example, a recent study of Canadian vaccine experts and front-line providers showed that they considered vaccine hesitancy to be a significant problem that is contributing to sub-optimal vaccination coverage [9]. Recent outbreaks of largely eradicated diseases such as measles, mumps, and diphtheria have been attributed to vaccine hesitancy [2,3,14,17]. This reduces herd immunity, making individuals who are not yet vaccinated and those with compromised immune systems vulnerable to infection [18].

The development and standardization of a measure of vaccine hesitancy is crucial in order to improve the measurement, evaluation, and ability to compare across jurisdiction and over time. Some measures have begun examining vaccination issues related to vaccine hesitancy. These include (1) the eight-item Vaccine Confidence Scale that has three factors [19,20]; (2) the 18-item Parental Attitudes about Childhood Vaccines that was developed using qualitative methodology [21] and found to have two [7] or three [22] factors upon further validation; (3) the one-dimensional, 7-item Vaccine Conspiracy Belief Scale [23]; (4) the one-dimensional, nine-item Knowledge of Vaccination Scale [24]; (5) the four-factor, 12-item Vaccination Attitudes Examination Scale [25]; and (6) the five-item Vaccine Attitude Scale [26]. Furthermore, there are additional measures that examine general attitudes related to specific vaccines such as Measles, Mumps, and Rubella (MMR) [27], human papillomavirus (HPV) [28–31], or human immunodeficiency virus (HIV) [32]. Though related to vaccine hesitancy, these measures are more general than vaccine hesitancy (e.g. as theorized by Peretti-Watel and colleagues) [12].

In 2015, Larson and colleagues from the SAGE Working Group on Vaccine Hesitancy sought to standardize the measurement of vaccine hesitancy [33]. This research group developed a measure to quantify vaccine hesitancy by conducting a systematic review of existent research, examining questions used by the WHO-UNICEF Joint Reporting Form, and through expert consultation [33]. Although Larson et al. (2015) constructed the scale and encouraged the future validation of this measure, to our knowledge, this measure has not yet been psychometrically validated.

A standardized, validated measurement tool of vaccine hesitancy beliefs would aid in the advancement of research and immunization policy. This tool has the potential to be used widely to understand the correlates of vaccine hesitancy, the association of vaccine hesitancy with vaccine coverage, compare vaccine hesitancy between countries, and evaluate changes in vaccine hesitancy over time. The objective of this paper is to therefore test the psychometric properties of Larson et al.'s (2015) scale questions. Accordingly, this study examines the scale's structure and internal consistency, construct validity, criterion validity, and socio-demographic differences in parents' vaccine hesitancy.

2. Methods

2.1. Participants and study design

We used a cross-sectional design to collect self-reported survey data through an online questionnaire from a national sample of Canadian parents. Data collection was facilitated by Canada's largest market research and polling firm, Leger—The Research Intelligence Group. The online survey was offered in English and French (i.e. Canada's two official languages). Data presented in this study were collected in the first of a two-wave study undertaken in August to September 2016. Parents and/or guardians (hereafter referred to as parents) of a 9- to 16-year-old child were eligible to participate. To recruit participants, Leger sent email invitations and survey links to panellists; a maximum of three reminder emails were sent. A detailed explanation of the survey methodology is presented elsewhere [34].

2.2. Scale description

We validated a vaccine hesitancy measure developed by the SAGE Working Group on Vaccine Hesitancy, which has not been psychometrically evaluated (see Larson et al., 2015) [33]. The Working Group developed survey items based on: (1) conducting a systematic review of peer reviewed and grey literature of existing vaccine hesitancy surveys; (2) completing expert consultations (within the SAGE Working Group on Vaccine Hesitancy and with SAGE members); and, (3) examining vaccine hesitancy questions on immunization that are completed annually by national immunization program managers [33]. The Working Group developed three groups of survey questions: core closed questions, Likert-type scale questions, and open-ended questions. This study sought to validate the 10 VHS Likert-type scale questions because Likert scales are more feasible for health providers and researchers to administer, quantify and evaluate nuance. Accordingly, the open-ended vaccine hesitancy questions and core closed questions of vaccine hesitancy at the community level are not included in this study's validation.

In this study, we used the 10 items of the Vaccine Hesitancy Scale (VHS) that are measured on a five-point Likert-type rating scale ranging from 'strongly disagree' to 'strongly agree' (Supplemental File, Section 1, Tables A1 and A2). No changes were made to the wording of the 10 VHS items. We administered questions in a random order to ameliorate any order effect. We reversed seven items in the scoring of the scale so that higher scores indicated more hesitancy on all items.

2.3. Measures

All participants completed socio-demographics items. The 10 VHS items on a five-point Likert-type rating scale (as described above) were included. The survey assessed additional vaccine attitudes (measured on seven-point Likert-type rating scales ranging from '1-strongly disagree' to '7-strongly agree'). To validate the VHS, the following four vaccine attitude scales were used: (a) *Vaccine-related conspiracy beliefs* were measured using a seven-item psychometrically developed scale, the Vaccine Conspiracy Belief Scale (VCBS; Cronbach's $\alpha = 0.94$) [23]; (b) *Harms of HPV vaccination* were measured using six items that comprise a sub-scale of the HPV Attitudes and Beliefs Scale (HABS; Cronbach's $\alpha = 0.90$ and 0.91; sample item: 'I feel that the HPV vaccine may lead to long-term health problems') [31]; (c) *Benefits of HPV vaccination* were measured using 10 items that comprise a sub-scale of the HABS (Cronbach's $\alpha = 0.95$ and 0.95; sample item: 'I feel that the HPV vaccine works well') [31]; (d) *Trust* was measured using four items constructed for this questionnaire (sample item: 'I trust the information I receive about vaccines').

The *Precaution Adoption Process Model (PAPM),* a stage-based theoretical model, was used to assess parents' HPV vaccine decision-making stage [35]. The PAPM elucidates all the stages involved in adopting health-protective behaviours (e.g. vaccination), and is helpful in highlighting qualitative differences among people in different stages. Parents were asked: 'which of the following best described your thoughts about the HPV vaccine for [CHILD] before today?' Six response options were provided to classify parents according to distinct categorical stages of HPV vaccine decision-making: (1) unaware, (2) unengaged, (3) undecided, (4) decided not to vaccinate, (5) decided to vaccinate, and (6) vaccinated.

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