Ann Ist Super Sanità 2021 | Vol. 57, No. 2: 167-173
DOI: 10.4415/ANN_21_02_09

Health Belief Model efficacy in explaining and predicting intention or uptake pertussis vaccination during pregnancy

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Abstract

Introduction. Pertussis is a highly contagious respiratory disease and vaccination of pregnant women seems to be the most effective strategy to prevent pertussis in infants. The aim of this study is to assess the acceptance by women of pertussis vaccination during pregnancy based on Health Belief Model (HBM) constructs.

Methods. A multicentre observational study was carried out with a convenience sample of 300 respondents.

Results. Most women were worried to contract or to transmit pertussis during the first months of the infant's life and perceived pertussis contracted in the first months of life as very serious. Parity appears to be a factor predicting this health behaviour, as nulliparous women tend to get more vaccinated or have a higher intention to get vaccinated (ORa 2.8 CI 95% 1.5-5.2 p<0.01).

Discussion and conclusions. HBM is an effective tool for identifying facilitators and barriers to health behaviours. Strategies to promote vaccination during pregnancy are needed, including educational interventions and communication campaigns.

Key words

- health belief model
- vaccination
- pregnancy
- health promotion

INTRODUCTION

Pertussis is a highly contagious respiratory disease caused, in most cases, by the Gram-negative coccobacillus Bordetella pertussis. Symptoms develop after an incubation period of approximately 7-10 days (range 5-28 days), with mild, moderate or severe symptoms [1] and the pathology persists from 6 to 12 weeks, or longer.

According to the latest WHO updates, there were 132,754 cases of pertussis in 2019, despite an 85% three doses vaccination coverage against diphtheria-tetanus-pertussis (DTP) [2]. In Italy, there is a decreasing trend of pertussis mainly due to the increase in vaccination coverage [3, 4]. The incidence ranges from 0.88 to 0.85 (2013-2015) and the decrease was observed also for 0-5 years children [4].

Pertussis in newborns and infants can be associated with an increased risk of morbidity and mortality, with a clinical manifestation that may differ based on age, immunization status and presence or absence of antibodies transmitted through placenta [1, 5-7]. This risk is higher in the first 6 months of life [8].

Several studies have shown that the source of infections for infants is usually a family member, in most cases the mother [9, 10]. Based on these observations, the cocooning approach involves the use of Tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine (Tdap) for parents and people who come into close contact with infants to reduce the risk of pertussis transmission [10, 11]. Vaccination of pregnant women, however, seems to be the most effective and cost-effective strategy to prevent pertussis in infants who are too young to be vaccinated [12]. Tdap vaccination has not been associated with an increased risk of adverse outcomes for the mother or foetus, with the exception of a small increased risk of chorioamnionitis [13, 14]. Women should be vaccinated between 28 and 32 weeks of pregnancy, or, otherwise, during the postpartum [15].

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The Italian Ministry of Health in the "National Vaccinal Prevention Plan" (2017) and in a policy document, recommends the vaccine against diphtheria, tetanus and pertussis to all pregnant women, even if the woman has already been vaccinated or has performed ten-year boosters or has had pertussis [15, 16]. According to data from the Italian National Institute of Health, child vaccination coverage in Italy is on average 94.99% [17].

The choice of pregnant women to get vaccinated against pertussis is influenced by knowledge. The level of information is often low and increases with higher levels of education. Favourable attitudes also demonstrated to be associated with vaccination choice [18]. The main barriers include concerns on the vaccine safety, the belief that it is not necessary or effective, the fact of not being recommended by the healthcare professional (HCP), access problems, costs and conflicting advice [19]. Different conceptual frameworks have been proposed in order to predict health choices and behaviours, such as the Health Belief Model (HBM).

The HBM is a theoretical model that aims to investigate what factors influence the health choices and behaviours of an individual and the access to healthcare services [20]. The six constructs of HBM are: *risk susceptibility, risk severity, benefits to action, barriers to action, cues to action and self-efficacy* [21, 22]. The effectiveness of the HBM has been widely demonstrated as it has been used in different areas [23-25], also effective in assessing the vaccination degree of acceptance during pregnancy [26-28].

In Italy, despite the existence of a national surveillance system on other population groups [17], there is still no available data on pertussis vaccination in pregnant women. To our knowledge, there is no Italian study on HBM effectiveness investigating the factors that influence the choice to vaccinate against pertussis during pregnancy. Therefore, the aim of this study is to assess the factors that influence the acceptance by Italian women of pertussis vaccination during pregnancy based on HBM constructs and the characteristics associated with non-vaccination.

METHODS

Design

A multicentre observational study was carried out.

Participants and setting

Two days a week, all women at 2nd and 3rd trimesters of pregnancy attending the maternal clinic outpatient of two Italian hospitals were invited to participate to the study. The exclusion criteria was not being able to read and understand the Italian language. From October 2019 to January 2020 a convenience sample of 300 respondents was achieved. None refused to answer the questionnaire. One hundred and fifty women were recruited from an accredited Italian private facility, while the other 150 women were recruited from an Italian public facility. All participants gave their oral informed consent, following the explanation of the study's purpose and methods. A self-administered, anonymous questionnaire was provided to women at two different centres simultaneously, and full availability was guaranteed for any procedural clarifications during compilation.

Study instrument

The questionnaire, including validated items on the effectiveness of the HBM in predicting the levels of acceptance of pertussis vaccination during pregnancy [29], was divided into two sections. The first provided 6 socio-demographic items and 2 related to the intention to get vaccinated. The second section included the six HBM constructs using a 5-point Likert scale, ranging from "1-Completely agree" to "5-Completely disagree" (Cronbach's alpha=0.76).

Authorization and privacy

The Head of Health Department of both hospitals agreed for the administration of the anonymous questionnaire. The responders were informed and agreed to the use of anonymous data in accordance with Italian and European Data Protection legislation.

Data analysis

Descriptive and inferential analyses were performed. Frequency and percentage of demographic were determined and a bivariate analysis allowed to assess the presence of statistically significant associations. Logistic regression was performed to identify predictors of vaccination or the intention to be vaccinated against pertussis. Odds ratio (OR) and 95% confidence intervals (CI) were calculated. Statistical measurements were conducted using Epi InfoTM v. 7.0 (CDC). By convention, the significance level was set at 0.05 ($p<0.05$).

RESULTS

Demographic characteristics

The average age of the sample was 33.3 years (SD±6), 83.3% were Italian and 53.3% were married. About parity, 50% of women were nulliparous, the other 50% said they had 1 (37%) or 2 or more children (13%). Of 300 women, 48.3% were vaccinated or planned to get vaccinated against pertussis during the current pregnancy *(Table 1)*.

HBM and pertussis vaccine

The frequency of the HBM model dimensions is shown in *Figure 1*.

With regard to *risk susceptibility*, 57% of women declared that they were worried to contract pertussis during the first months of the infant's life with 23% unsure about this risk. The concern to transmit pertussis in the first months of the infant's life was expressed by 64% of women, while 76% were worried that someone else could transmit to both mother and baby. Furthermore, 80% perceived pertussis contracted in the first months of life as very serious (*risk severity*). In relation to the perceived *benefits*, 75% of the women agreed that vaccination against pertussis in pregnancy could reduce the mother's risk of contagion, with 23% of women unsure. In addition, 70% agreed that vaccination protects the baby's health in the first months of life, 25% were unsure. As for the perceived *barriers*, despite 54% disagreeing, there were 33% of women unsure whether the

Table 1
Women's socio-demographic characteristics and frequencies of pertussis vaccination or intention to get vaccinated

Data of participants	n (%)
Mean age in years	33.3 (SD±6)
Nationality	
Italian	250 (83.3)
Foreigner	50 (16.7)
Marital status	
Married	160 (53.3)
Unmarried	133 (44.3)
Separate/Divorced	7 (2.4)
Educational level	
University degree	143 (47.7)
Secondary school	132 (44)
Lower secondary	20 (6.7)
Primary school	5 (1.6)
Occupation situation	
Employed	201 (67)
Housewife	35 (11.7)
Unemployed	33 (11)
Student	4 (1.3)
Other	27 (9)
Parity	
Nulliparous	250 (50)
1 or ≥2	250 (50)
Pertussis vaccination or intention to get vaccinated	
No	155 (51.7)
Yes	145 (48.3)

vaccine could transmit pertussis. The perception of the vaccine as unsafe for the health of the foetus during pregnancy also had 33% of women unsure and 53% disagree. The fear of injections did not represent a serious barrier to vaccine (63% disagreement), compared to the lack of adequate information on vaccinations (55% agreement). This is confirmed by the fact that 74% of women agrees on the importance of the role of professional recommendations about vaccination. Only 15% reported that friends and family discouraged them to get vaccinated during pregnancy and 55% affirmed they trust the guidelines with 32% unsure. With regard to self-efficacy, 57% thought they had received all the information needed to decide whether to get vaccinated or not, 20% were unsure and 23% disagreed.

Most HBM constructs were associated with intent or getting vaccinated during pregnancy *(Figure 2)*, confirming its role in explaining or predicting health behaviours and choices.

Only the fear of injections and the role of friends and family did not affect the vaccination choice. A high educational level has been significantly associated with not being worried to transmit pertussis to infant in the first months of life (ORa 0.2 CI 95% 0.05-0.7 p<0.01) and with the perception of not having received all information needed to decide whether to get vaccinated or not (ORa 0.4 CI 95% 0.1-0.9 p<0.05). Being employed was significantly associated with the fact that injections do not represent an obstacle to vaccination (ORa 2.3 CI 95% 1.3-3.9 p<0.01), with not being worried to lack of knowledge on vaccinations during pregnancy (ORa 1.9 CI 95% 1-3.8 p<0.05) and with not having been discouraged by friends and family to get the vaccination (ORa 2.1 CI 95% 1.2-3.6 p<0.01). Having one or more children was associated with the concern of transmitting pertussis to infant during the first months of life (ORa 1.8 CI 95% 1.1-2.9 p<0.01). The Italian nationality was negatively associated with this construct (ORa 0.3 CI 95% 0.1-0.7 p<0.01) and showed a significant association also with not being afraid of injections (ORa 3 CI 95% 1.6-5.8 p<0.01), with not being discouraged by friends and family to vaccinate during pregnancy (ORa 2.9 CI 95% 1.6-5.5 p<0.01) and with the perception of not having received all information needed to decide

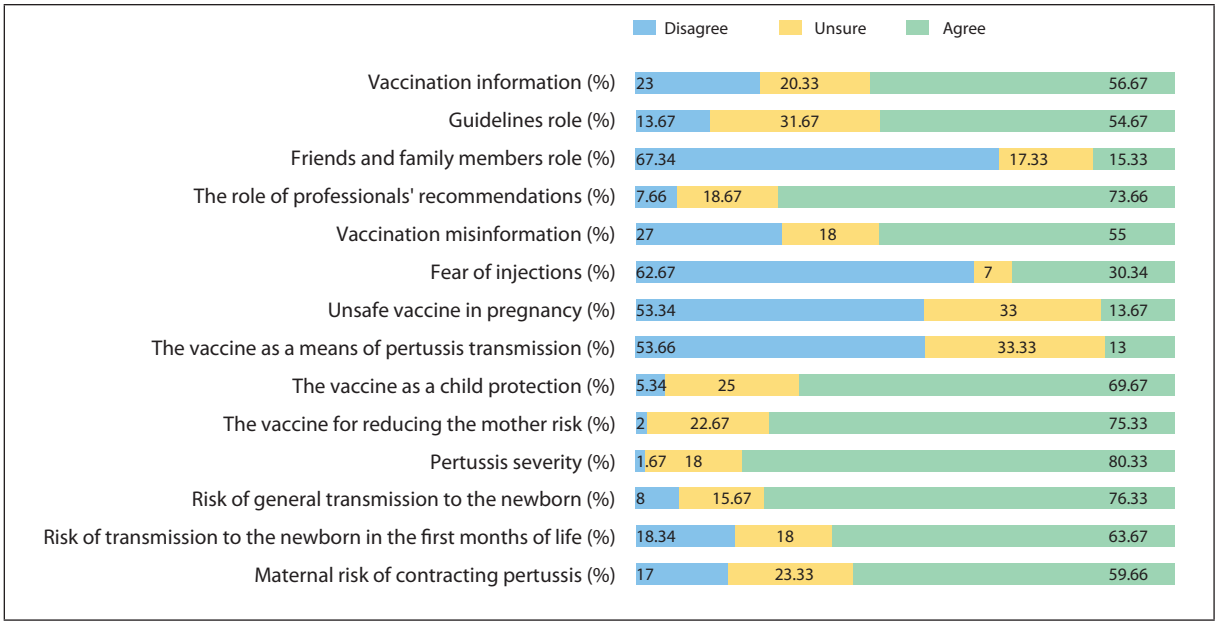

Figure 1
Frequency of the HBM model dimensions (n=300).

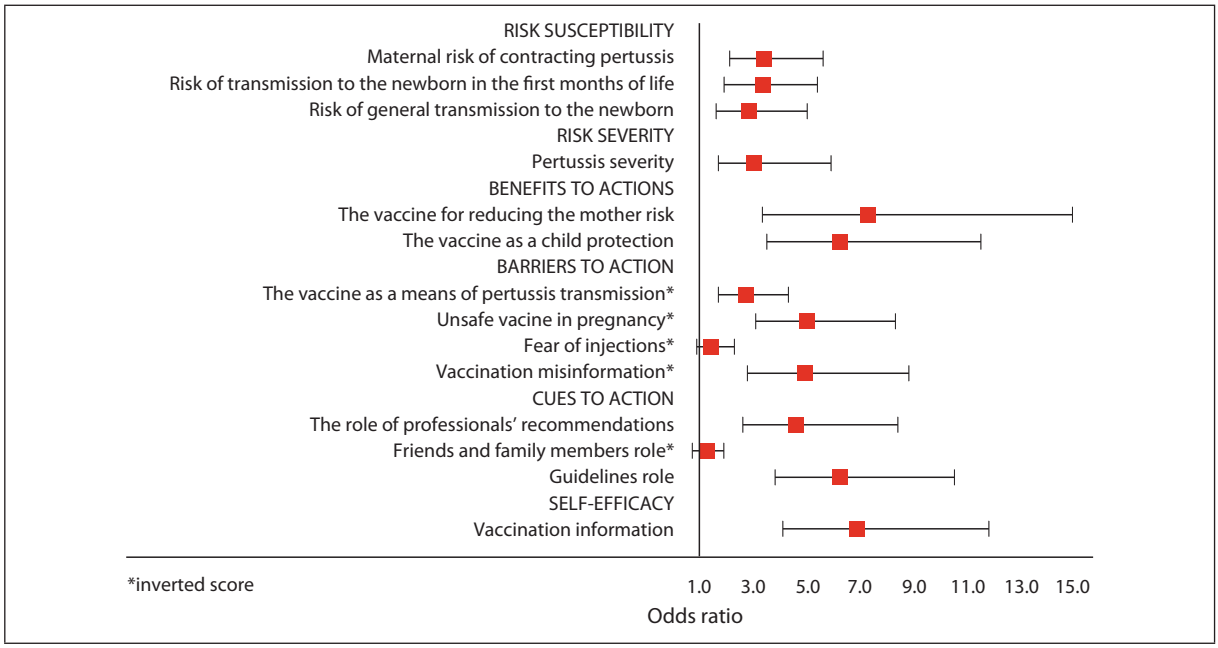

Figure 2
Frequency of the HBM model dimensions (n=300).

whether to get vaccinated or not (ORa 0.4 CI 95% 0.2-0.8 p<0.01). Fear of injections represented a barrier in women aged less than or equal to 31 years (ORa 0.4 CI 95% 0.3-0.7 p<0.01) *(Table 2)*.

The logistic regression model showed factors associated with intent or vaccination against pertussis during pregnancy *(Table 3)*.

Parity appears to be a factor predicting this health behaviour, as nulliparous women tend to get more vaccinated or have a higher intention to get vaccinated against pertussis (ORa 2.8 CI 95% 1.5-5.2 p<0.01). The other associated factors are healthcare related: receiving the recommendation to vaccinate from a health professional (General Practitioner, gynaecologist, midwife) (ORa 2.8 CI 95% 1.4-5.7 p<0.01), trust in guidelines recommending vaccination during pregnancy (ORa 3.5 CI 95% 1.9-6.4 p<0.01), and the perception of having received all the information needed to take an informed choice (ORa 5.8 CI 95% 3.1-10.7 p<0.01).

Table 2
HBM and social-demographic characteristics

	I am worried that I will transmit pertussis to my baby during his/her first months of life (risk susceptibility)	I'm afraid of injections (barriers to action)*	I'm worried there may be things I don't know about vaccinations in pregnancy (barriers to action)*	Friends or family members have discouraged me from getting vaccinated during pregnancy (cues to action)*	I believe I have received all the information needed to decide whether to get vaccinated (self-efficacy)
Educational level					
High	61.5%	–	–	–	54.9%
Low	88%				76%
Occupation situation	–	67.5%	29.8%	71.5%	–
Employed		47.2%	18%	80.7%	
Unemployed					
Parity					
1 or ≥2	70.7%	–	–	–	–
Nulliparous	56.7%				
Nationality					
Italian	60%	67.2%	–	71.6%	53.6%
Foreigner	82%	40%		46%	72%
Age					
≤31	–	51.3%	–	–	–
>31		69.9%			

*inverted score.
HBM: Health Belief Model.

Table 3
Logistic regression model

	Intention or uptake of pertussis vaccination during pregnancy (yes *vs* no) ORa (CI 95%)
Parity	
1 or ≥2	1
Nulliparous	2.8 (1.5 - 5.2)
Receiving the recommendation to vaccinate from a health professional (general practitioner, gynaecologist, midwife)	
Disagree	1
Agree	2.8 (1.4 - 5.7)
Trust in guidelines recommending vaccination during pregnancy	
Disagree	1
Agree	3.5 (1.9 - 6.4)
Perception of having received all the information needed to take an informed choice	
Disagree	1
Agree	5.8 (3.2 - 10.7)

DISCUSSION

Our results show that HBM is a good model to explain and predict the intention or actual uptake of pertussis vaccination in pregnancy. About half (48.3%) of pregnant women said they had been vaccinated or plan to get vaccinated against pertussis. This percentage is higher than in other studies. In a previous study that investigated knowledge, attitude and practice toward pertussis vaccination during pregnancy among 347 pregnant and postpartum Italian women, 21% of pregnant women expressed a willingness to be vaccinated [30]. It is possible that, despite vaccination rates in pregnancy are still not sufficient, the ministerial recommendations and health services campaigns have positively influenced the increase in vaccination coverage [15].

In our study, the high frequency of pertussis vaccination intention or actual uptake is associated to higher frequency of risk susceptibility and severity (concern of contagion or transmission to the baby, considering pertussis contracted in the first months of life as very serious). Previous studies investigated the knowledge about the severity of pertussis, showing that it is considered a serious threat to newborns [31, 32], with increased risk of hospitalization [33]. For this reason, most women consider the pertussis vaccination necessary for the newborn protection [33].

While knowledge and attitudes are determinant to health behaviour, in a previous study [30] 35% of women did not know that children <1y represent the age group with the highest risk of infection. Furthermore, although few, some women believe that the vaccine does not protect newborns from pertussis during the first months of life and that it is harmful to the development of the foetus [30].

Most of our women agreed that vaccination against pertussis in pregnancy was able to reduce the mother's risk of contracting pertussis but some were unsure. This is consistent with a previous study in which several women, despite being aware of the potential useful of the vaccine, were not convinced that maternal immunization should be done [33]. Although in most cases women disagreed on the perception of the vaccine as unsafe to the health of the foetus, some were unsure. This is also confirmed by a previous study that investigated attitudes, practices and perceived barriers by gynaecologists regarding vaccination against influenza and pertussis during pregnancy [34]. In this study, fear or scepticism about pertussis vaccination during pregnancy often led to rejection, despite a thorough explanation of the benefits. Agricola *et al*., show that some women considered the vaccine as harmful for the foetus' development and believed that the vaccination did not protect the infants against pertussis during the early months of life [30]. This attitude recalls the "good mother myth" regarding the use of medication during lactation, according to which the breastfeeding women tend to give up the medicine to avoid exposing the children to a risk [35].

Our results show that fear of injection did not represent a barrier to vaccine, despite some suggestions in the literature on blood and injection phobia among pregnant women [36].

Studies on the determinants of vaccine refusal indicated that low perception of immunization safety, poor information and lack of professional encouragement represent the main barriers to vaccination [31, 37, 38]. The HCPs are considered as a trustable source of vaccine information, followed by national Public Health Organizations and Scientific Societies, but only few women receive a recommendation by their health care professionals to receive pertussis immunization during pregnancy [30]. Safety information regarding the mother and the newborn are considered the most important information in deciding whether to be vaccinated and often gynaecologists were the preferred HCPs for the provision of information, followed by paediatricians, and local health unit staff [33]. The recommendation given by a HPC is positively associated to other women's health behaviours, e.g. the participation to cervical cancer screening, and considered among the most relevant factors for screening uptake [39]. The fundamental role of professionals is also recognized in our study, where women considered the recommendations to vaccinate given by a HCP as a cue to action, regardless their socio-cultural background, and show a greater intention or actual vaccination uptake. Thus, health systems should be encouraged to promote individual evidence-based communication interventions. The time dedicated to effective communication provided to women by HCPs produces results in terms of intentions to get vaccinated or vaccinated. This is confirmed by previous studies showing an increase in vaccine intention and coverage after the motivational interviewing intervention of 15-20 min [40, 41]. However, it is important to make sure that women truly have the perception that they have asked all the questions and resolved all the knots and all the doubts. To achieve this, the communication time must be considered within the care provision.

Our logistic-regression model shows that nulliparous women tend to get more vaccinated or have a higher intention to get vaccinated against pertussis than multiparous confirming what reported in another study which determined the facilitators and barriers to pertussis and influenza vaccine [42]. This could be explained by the fact that multiparous women do not consider necessary to repeat the vaccination in the next pregnancy, therefore they should be one of the main targets of vaccination campaigns.

This study has some limitations: the use of a convenient sample of women and a questionnaire that includes items from validated questionnaires, but overall it has not undergone a validation process.

CONCLUSIONS

Our study shows that theoretical frameworks such as HBM are an effective tool for identifying facilitators and barriers to health-generating behaviours, such as pertussis vaccination. Vaccinations during pregnancy are an important strategy to reduce morbidity and mortality from infectious diseases in women and their newborn and this is confirmed by the ItOSS report on maternal mortality, which reports that some maternal deaths from sepsis have been attributed to influenza in unvaccinated women [43]. Moreover, strategies to promote vaccination during pregnancy are needed, including educational interventions and effective communication campaigns. Recommending pertussis vaccination during preconception period can be a further strategy that allows higher acceptance of vaccination and therefore higher vaccination coverage. The action plan to increase vaccination levels in pregnancy must also start with the professionals training in the birth pathway. In this way, they will be able to provide adequate and standardized information to women in order to obtain an informed choice. Midwives play a fundamental role in protecting the health of the mother, the child and the community, and they can promote vaccinations during pregnancy.

Acknowledgments

Authors would like to thank all women who gave their availability and participated to the survey, as reported in the present study.

Author contribution statement

All Authors participated in the interpretation of the study results and approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Conflict of interest statement

Authors have no conflicts of interest. Authors have no financial relationships relevant to this article. This research received no grant from any funding agency in the public and private sectors for the research, authorship, and/or publication of this article.

Received on 20 January 2021.
Accepted on 23 April 2021.

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