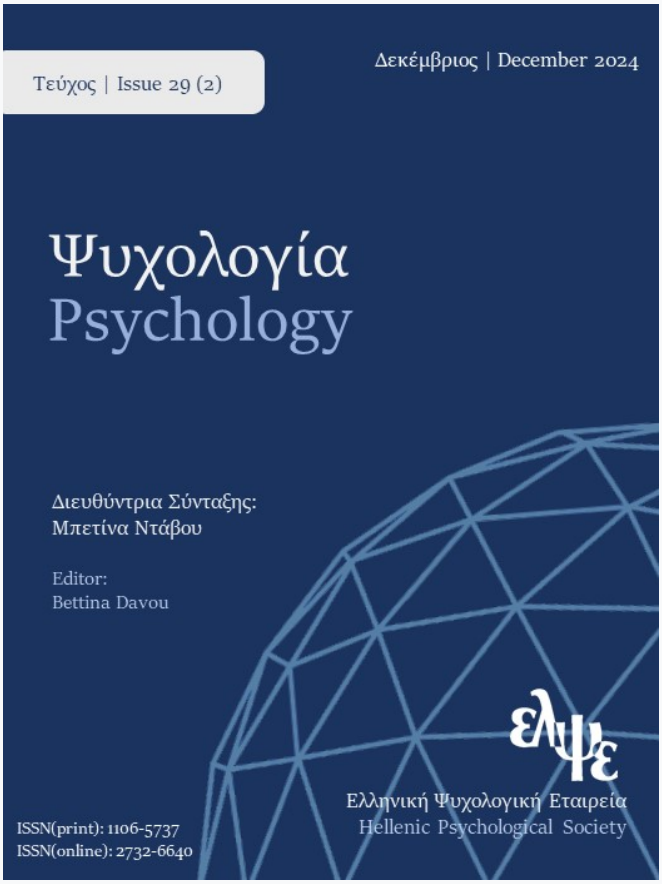
Psychology: the Journal of the Hellenic Psychological Society

Vol 29, No 2 (2024)

December 2024



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doi: 10.12681/psy_hps.39611

To cite this article:

Efkarpidis, A., Koulierakis, G., & Papastilianou, A. (2024). Parental intentions to vaccinate their daughters for HPV. A cross-sectional nationwide study in Greece using the COM-B model . *Psychology: The Journal of the Hellenic Psychological Society*, *29*(2), 367–388. https://doi.org/10.12681/psy_hps.39611

ΨΥΧΟΛΟΓΙΑ | PSYCHOLOGY, 29(2), 367-388

Ελληνική Ψυχολογική Εταιρεία
Hellenic Psychological Society

ΕΜΠΕΙΡΙΚΗ ΕΡΓΑΣΙΑ | RESEARCH PAPER

Parental intentions to vaccinate their daughters for HPV. A cross-sectional nationwide study in Greece using the COM-B model

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KEYWORDS

Human papillomavirus (HPV)
HPV vaccination
Intention
COM-B model
Capability
Opportunity
Motivation
Behaviour

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ABSTRACT

Human papillomavirus (HPV) infection is a common sexually transmitted disease in men and women worldwide. It accounts for the appearance of benign papillomatous or precancerous lesions, which sometimes can be evolved into cancer, especially in the anogenital area. For prevention, a vaccine is available worldwide including Greece, for girls and boys aged 9-18 years. The responsibility for the vaccination usually lies with parents/guardians. This study aimed to measure parental intention to vaccinate their daughters against HPV and identify the determinants that affect it. From September 2021 to March 2022, a cross-sectional nationwide study was carried out among a representative sample of students, and through them their parents/guardians, using multistage stratified sampling. 46 schools in the territory participated, with a representative sample of 3,203 parents/guardians of female students aged 11-18 years, who completed an anonymous questionnaire created based on the Capability, Opportunity, Motivation - Behavior (COM-B) and Theoretical Domain Framework (TDF) models. 905 parents out of the 1358 who hadn't vaccinated their daughters (66.6%) mentioned that they intended to do so or complete vaccination. Knowledge about the vaccine ($p < .001$), fear of possible side effects ($p < .001$), relief that serious diseases could be avoided ($p < .001$), expert influence ($p < .001$), and reminders through email ($p = .048$) were the significant determinates of parents' intention to vaccinate their daughters. The interconnected COM-B and TDF models are suitable frameworks for targeted interventions to foster HPV vaccination.

Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection worldwide, infecting the majority of sexually active men and women during their lives, most often at the beginning of sexual life (Centers for Disease Control and Prevention - CDC, 2022).

Cervical cancer is the fourth most common cancer in women globally (around 660,000 new cases and around 350,000 deaths in 2022), caused by persistent infection with the HPV (World Health Organization - WHO, 2024). It is estimated that for every one million women infected with HPV, 10% will develop precancerous changes in the cervix and about 8% of these women will develop early cancer limited to the entire epithelial layer of the cervix (Carcinoma In Situ; CIS), while some will develop invasive cancer (Nyengidiki et al., 2017).

https://doi.org/10.12681/psy_hps.39611

Within the European Union, in 2022, the estimated incidence and mortality of cervical cancer were, respectively, 11.7 and 5.3, per 100,000 women, for all ages (9.0 and 1.5, for ages 15-44), while the respective estimates for Greece were 8.0 and 4.1 (5.6 and 1.1, for ages 15-44). Thus, cervical cancer is the second most common cancer after breast cancer, affecting women aged 15–44 in the European Union (European Cancer Information System -ECIS, 2022). In terms of prevalence, 74% of invasive cervical cancers in Europe are attributed to HPV types 16 and 18 (Bruni et al., 2023).

In May 2018, the World Health Organization (WHO) declared cervical cancer a major public health problem and set three key goals for all countries to implement by 2030, to eradicate it: a) the full vaccination of 90% of girls with the HPV vaccine by the age of 15; b) screening, where 70% of women should be tested using high-performance tests by age 35 and again by age 45; and c) treatment, involving the ability of systems to manage 90% of women with precancerous treatment and 90% of women with invasive cancer. According to this strategy, all countries must achieve an incidence rate below 4 per 100,000 women (eClinicalMedicine, 2023).

Greece has added HPV vaccination to its National Vaccination Program for children and adolescents. The vaccination is offered free of charge for girls aged 9-18 years in a 2-dose regimen for people aged 11-14 years and in a 3-dose regimen for people aged 15-18 years. It is also free for boys aged 9-18 (Naoum et al., 2022). However, estimates for HPV vaccination coverage in Greece differ. Studies published in non-representative samples in the last 4 years report percentages ranging from 25.8% to 52.3% (Kanellopoulou et al., 2021; Naoum et al., 2022; Paraskevaidis et al., 2020; Sidiropoulou et al., 2022; Valasoulis et al., 2020).

The discovery of HPV as a causative agent of cervical cancer offered the opportunity to develop primary prevention approaches. Three HPV vaccines have been authorised: bivalent (Cervarix), quadrivalent (Gardasil), and nine-valent (Gardasil 9) (ECDC, 2018), yet HPV vaccination coverage remains low in the countries with the highest incidence, and screening performance is heterogeneous across European countries (Arbyn et al., 2021).

Vaccine hesitancy is a growing problem linked to the reduction of chances of eliminating vaccine-preventable diseases through immunisation (Zastawna et al., 2023). While it has occurred since vaccines were first introduced, over the past decade, hesitancy has increasingly been recognised as a problem that needs attention if high uptake rates are to be achieved and maintained (Nuwarda et al., 2022). Specifically, for HPV, low vaccination coverage among adolescents is closely associated with parental hesitancy towards vaccination (Vasudevan et al., 2022) and constitutes an important factor in the exacerbation of HPV infection (Nguyen et al., 2021). At the same time, "reluctance or refusal to vaccinate despite the availability of vaccines" is classified by the WHO as one of the ten biggest threats to public health (WHO, 2019) and is considered a key factor in delaying or refusing the HPV vaccine (Dang et al., 2024).

Parental hesitancy to vaccinate their children has been associated with several factors. These include conflicting attitudes towards the HPV vaccine (i.e. parents may think their child is at risk of HPV-related cancer but also worry about the side effects of the vaccine (Alhusayn et al., 2022), opinion of physicians, peer networks, and the media (Walker et al., 2020), knowledge about the vaccine and HPV (Kolek et al., 2022), perceptions of risk and benefits (Lelliott et al., 2023) and sociodemographic factors (Sonawane et al., 2024).

Intention

According to Theory of Planned Behaviour (TPB) (Ajzen, 1991), intention, together with perceptions of behavioural control, account for considerable variance in actual behaviour. Intention is defined as "*The willingness to achieve something planned or predicted. The state of being ready to do something*" (Garner, 2022, p. 883), while according to the APA Dictionary of Psychology, the intention is *"a prior conscious decision to perform a behaviour. In experiments, intention is often equated with the goals defined by the task*

instructions" (American Psychological Association, 2015, p. 549). The intention is closely related to and predicts behaviour (Sheeran, 2002), while more recent research has delved deeply into moderators of the relationship between intention and behaviour (Conner & Norman, 2022).

A considerable body of research has examined women's intention to uptake HPV vaccination and the associated factors (Santhanes et al., 2018; Si et al., 2021; Suzuki et al., 2022), as well as parents' intentions to vaccinate their daughters (Balogun & Omotade, 2022; Hussein et al., 2024; Zhu et al., 2023). The results of these studies show that the level of intention to vaccinate against HPV varies significantly among them. However, regardless of the level of intention found, the results of the studies conclude that there is a need to implement policies aimed at creating positive intentions towards HPV vaccination.

The COM-B model

Several popular theories in psychology have been developed and applied to understand and change behaviour through targeted interventions, namely Social Cognitive Theory (Bandura, 1986), Self Determination Theory (Deci & Ryan, 2000), and the Theory of Planned Behaviour (Ajzen, 1991). In addition, knowledge as a concept in psychology has been widely used to understand and design the appropriate interventions for vaccination, a major public health measure of prevention (Brewer et al., 2017) and specific vaccination-related models, like the 3C model (Complacency, Confidence, and Convenience) have been developed (WHO, 2014).

One of the most recent frameworks, formed from the combination of existing models in behaviour change is the Behaviour Change Wheel (BCW), developed from 19 frameworks of behaviour change (Michie et al., 2011) (Figure 1).

BCW is a method for developing interventions and policies to change behaviour and is officially used by Public Health England. The core of this framework is the COM-B model which is an appropriate starting point for any public health campaign, as it provides information about the determinants of behavior and indicates how some changes in them can encourage changes in health behaviors (West et al., 2020).

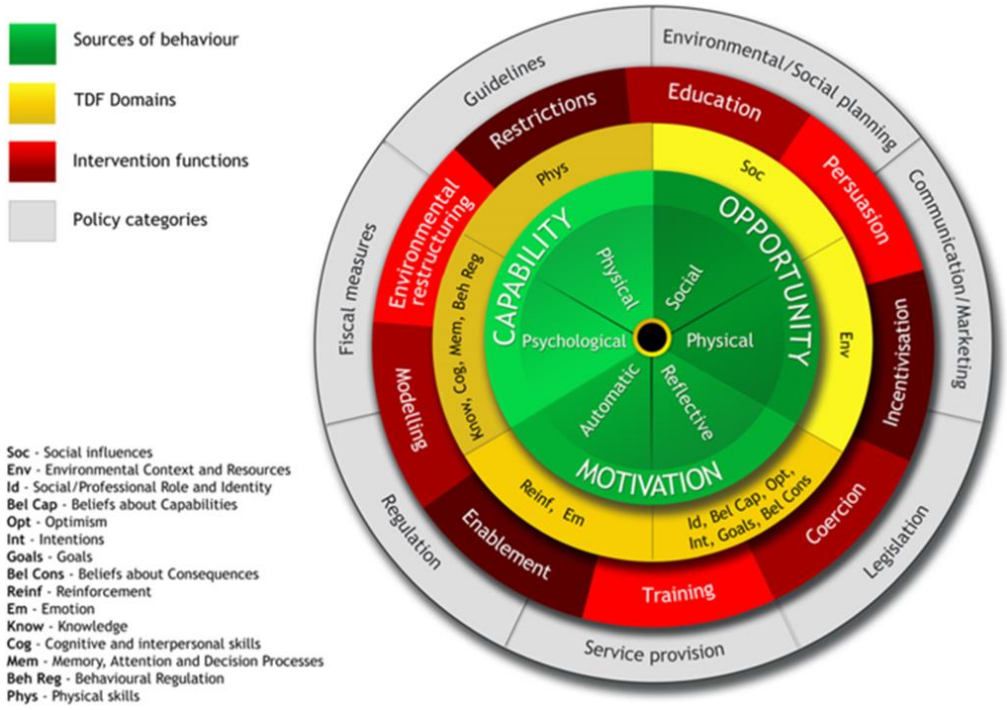
Its use is officially indicated by the WHO Regional Office for Europe for Tailoring Immunization Programmes (TIP), aimed to achieve high coverage and fair implementation of vaccination programs in Europe through research of the characteristics of each target group of the population. In this research process, which must precede each vaccination programme, the barriers and driving forces that shape citizens' behaviour to receive or refuse vaccination must be captured for each target group. The WHO indicates that this investigation should be structured based on the factors of COM-B as summarized below (WHO, 2019).

BCW consists of three levels and its ultimate goal is to identify behavioural sources that could indicate fruitful behavior change intervention targets. It describes a process of behavior change that starts by investigating its main sources and, through intervention functions, indicates the appropriate categories of policies to follow. The core of BCW is the COM-B model (Michie et al., 2014).

According to the COM-B model, to perform a given behaviour (B), at a given moment, one must have the Capability (C), the Opportunity (O), and the Motivation (M) to engage in the behaviour. (West & Michie, 2020). More specifically, one must have the psychological and physical capability to perform a behaviour, that is, to know what to do and how to do it. He also needs motivation, because if he doesn't care about the behaviour, he won't perform it. Motivation is divided into reflex processes, which focus on a mental cost-benefit analysis of whether the behaviour is worth doing, and automatic processes, which include existing emotional reactions, desires, needs, and habits. Finally, the environment must favour the said behaviour, that is, to perform a behaviour, one needs to have the opportunity to carry it out. This is influenced by the natural elements, appropriate resources, available time and money, the social environment, as well as the cultural context that guides daily rules of behaviour (Atkins, 2017). To achieve behaviour change, changing one or more of the

COM-B components is required. Behaviour change aims to reshape the existing perception in such a way as to minimize the risk of behaviour reoccurrence.

Figure 1. *Interconnection of TDF Sectors with COM-B components*
Source: (Michie et al., 2014)



Around the COM-B circle, there is a level of nine intervention modes which can be selected depending on the specific COM-B analysis (Education, Persuasion, Incentivization, Coercion, Training, Enablement, Modelling, Environmental restructuring, Restrictions). Next, the wheel's outer rim identifies seven policy types that one can use to implement these intervention functions (Environmental/Social planning, Communication/Marketing, Legislation, Service provision, Regulation, Fiscal measures, Guidelines).

The Theoretical Domain Framework (TDF) is an integrative framework synthesizing key constructs used in relevant theories. The framework consists of 15 domains (depicted on the yellow ring in Figure 1), namely social influences, environmental context and recourses, social/professional role and identity, beliefs about capabilities, optimism, intentions, goals, beliefs about consequences, reinforcement, emotion, knowledge, cognitive and interpersonal skills, memory/ attention and decision processes, behavioural regulation, physical skills) (Atkins et al., 2017; Michie et al., 2005, 2014), covering a wide range of behavioural determinants and is used directly in the formation of the three components of COM-B (Cane et al., 2012). As can be seen in Figure 1, the Capability component corresponds to knowledge, memory/attention and decision process, behavioural regulation, physical, cognitive, and interpersonal skills. Opportunity includes social influence, environmental context, and resources, while Motivation relates to social role, optimism, belief in capability, belief in consequences, intention, goals, reinforcement, and emotion (Atkins et al., 2017).

The COM-B model has been applied to a wide range of behaviours, such as STD testing (McDonagh et al., 2018), eating and physical activity (Willmott et al., 2021), diet (Timlin et al., 2021), weight management (Blebil et al., 2022) heart failure self-care (Whittal et al., 2021) and COVID-19 vaccination (Darabi et al., 2022; Liu & Liu, 2021; Patterson et al., 2023).

As far as HPV vaccination, the COM-B model has been used to explain attitudes towards HPV educational interventions (Flood et al., 2023), to feed intervention for increasing HPV vaccination (Garbutt et al., 2018), and HPV vaccine acceptance (Warsi et al., 2023). Regarding parental intentions, we identified only one theory-based study (Balogun & Omotade, 2022), which used the Integrated Behavioral Model (IBM) to explain the intentions of parents to vaccinate their adolescents with the HPV vaccine. Although integrated, the IBM was developed from the Theory of Reasoned Action and the Theory of Planned Behavior, with some constructs from the Health Belief Model, Social Cognition Theory, and Theory of Interpersonal Behavior. These popular theories address intra-individual, and occasionally interpersonal factors of behaviour, yet do not account for the complex social and physical environments in which behaviour occurs (Michie et al., 2014).

To the best of our knowledge, no study has used the COM-B model in association with TDF components to address this intention, either globally, or in Greece. Thus, this study aimed to measure the parents' expressed intention to vaccinate their daughters against HPV and investigate the relationship between parental intention and the components of the COM-B and TDF models.

Method

Participants and sampling procedure

A nationwide, cross-sectional public health survey was conducted from September 2021 to March 2022 among a representative sample of parents of female students aged 11 to 18, who attended the Gymnasium (students aged 11 to 14 years) and Lyceum (students aged 15 to 18 years).

A probabilistic multistage cluster sampling method was applied. During the first step, a stratification was carried out by the Regional Directorate of Education (RDE). All female high school students in the country were divided into strata (the 13 RDE). The desired sample size for each layer was proportionally calculated based on the number of students at the RDE level. Then, the clusters existing in each RDE were randomly selected with the school as a sampling unit. Finally, in each selected school, the study was carried out on a census basis, i.e. all students of all grades were included. At this stage, the sample unit was every female student in each class. The sample element of the survey was the respective parent/guardian of the student who answered the questionnaire which was received in a closed envelope by his/her daughter.

The study included 56 schools from all RDEs in the country. After the necessary permission granted from the Ministry of Education and Religious Affairs, the first author visited 48 public schools (25 Gymnasiums and 23 Lyceums). The directors of 4 public and 2 private schools refused participation, while 2 church schools were excluded due to the late granted permission.

In total, 6,329 closed envelopes with the questionnaire were distributed to female students to be delivered to their parents. 3,205 sealed envelopes with filled questionnaires were returned (response rate: 50.6%). The parents answered for all daughters in the family, between 11 and 18 years old. The total number of daughters was 4,697.

Data collection

A self-completed questionnaire was used to assess participants' demographic characteristics (nine questions), and elements of the models (a total of 48 questions for the 13 included TDF elements and the corresponding elements of COM-B). The formulation of the COM-B questions was based on instructions provided by the developers of the model (Michie et al., 2014). Each COM-B element was measured with one or two individual questions with categorical rather than scale-type replies ("Not at all", "A little", "Quite", "A lot" and "Yes", "Not sure", "No") (see Table 3). Vaccination and parental intention to vaccinate was assessed with four questions (each referring to the 1st, 2nd, 3rd, and 4th daughter) which indicated the course of vaccination ("No vaccination", "One dose", "Two doses", "Intention to vaccinate"). Parents checked the corresponding box

depending on whether they had proceeded to vaccination or they intended to do so in the future. The number of questions corresponding to each of the COM-B elements and the TDF domains are shown in Table 1. TDF's cognitive, interpersonal, and physical skills domains were not measured in the current study. The developers of BCW define "skill" as "*An ability or proficiency acquired through practice*" (Michie et al., 2014, p. 88). It comes from this definition that this type of ability is not applied to HPV vaccination.

Table 1. *Number of questions corresponding to COM-B elements associated with TDF domains*

COM – B	TDF	Questions
Capability Psychological	1) Knowledge	20
	2) Cognitive and interpersonal skills	-
	3) Memory, Attention, and Decision Processes	2
	4) Behavioural Regulation	2
Capability Physical	1) Physical skills	-
Opportunity Social	1) Social Influences	2
Opportunity Physical	1) Environmental Context and Resources	3
Motivation Reflective	1) Social/ Professional Role and Identity	1
	2) Beliefs about Capabilities	2
	3) Optimism	1
	4) Intentions	6
	5) Goals	3
	6) Beliefs about Consequences	1
Motivation Automatic	1) Reinforcement	3
	2) Emotion	2

Procedure

Following the approval of the study by the Greek Ministry of Education (No 90032/ΓΔ4/23-7-2021) and the Ethics Committee of the University of West Attica (No 37937/11-5-2021), the first author (AE) notified the selected schools and arranged his visits to distribute the questionnaires. He then visited each classroom, explained the aim of the study, emphasized the importance of parents' participation, and distributed the questionnaires. When students returned the sealed envelopes, a designated teacher securely collected and posted them to the first author.

Statistical analysis

Descriptive statistics were used to examine demographics and COM-B elements. A chi^2 test of independence was used to examine the relationship between the intention to vaccinate and the COM-B elements. Finally, a binary logistic regression model was used to identify the independent predictors of parental intention to vaccinate their daughters, after controlling for mutual confoundings. A significance level of .01 was employed for all analyses. The 22nd edition of SPSS software was used for all the analyses.

Results

Descriptive statistics

Of the 3,205 participating parents/guardians, 1,358 (42.4%) had not vaccinated their daughters, namely, 906 (28.2%) had not vaccinated any daughter, 315 (9.9%) had not vaccinated at least one of their daughters, and 137 (4.3%) had not completed all doses. Of the 1,358 parents, 905 (66.6%) mentioned that they intended to vaccinate their daughters or complete all prescribed doses of vaccination, while 453 (33.4%) said they had no intention to do so.

The demographic characteristics of this group are presented in Table 2. As can be seen, the vast majority of participants were parents (96.5%), females (91.8%), and older than 40 years (81.7%). More than half of them had finished secondary education (57.1%), while almost a third (34.6%) worked in the private sector. A significant majority lived in areas other than Attica (71.4%) and identified their family financial status at a medium level (70.8%). 54.8% of the participants had one daughter. Finally, 63% of the daughters attended Gymnasium.

The way participants replied to the COM-B questions is presented in Table 3. As the Table shows, the vast majority of the participants (94.1%) replied correctly that HPV is transmitted by sexual contact, causes warts on the genitals and genital area (89.5%) and potentially results in cervical cancer (92.9%). About 1 in 3 participants (33.4%) answered that they do not know if systematic mammography provides protection against HPV, while about 8 out of 10 did not recognize wart images (77.7% for the first image and 79.2% for the second image). About 6 in 10 said they were affected a lot (32.2%) and a lot (31.9%) by vaccination specialists, and 6 to 7 in 10 also had a positive intention to vaccinate all their daughters. Similarly, about 54% said they are considering getting vaccinated in the next period. At the same time, about 20% said they were concerned about the effectiveness of the vaccine, while about 58% said they feared its possible complications. Similarly, more than 5 in 10 were thinking quite 23.8% and a lot of 30.6% thinking about getting vaccinated in the next period. This comes at the same time that about 20% said they were concerned about the effectiveness of the vaccine and about 58% feared its possible consequences.

Table 4 presents the results of the chi² tests on the relationship between participants' intention to vaccinate their daughters and the COM-B elements. As can be seen, this relationship was statistically significant in most of the cases. More specifically, parents with a high level of knowledge about HPV x^2 (2, N = 1,358) = 21.5, p <.001 and HPV vaccine x^2 (2, N = 1,358) = 46.6, p <.001 were more likely to have a positive intention to vaccinate their daughters. Furthermore, parents who correctly recognized the 2 pictures of genital warts, x^2 (2, N = 1,358) = 16.6, p <.001, parents who sought enough or very much information on the topic of vaccination from any source, x^2 (1, N = 1,358) = 38.0, p <.001, parents influenced by specialists, x^2 (1, N = 1,358) = 171.9, p <.001, parents who wanted a financial reward from the state, x^2 (1, N = 1358) = 14.7, p <.001, were more likely to have a positive intention to be vaccinated. On the other hand, parents who had a dilemma that their daughter might receive the message that she can start her sexual activity prematurely, x^2 (2, N = 1,358) = 27.9, p <.001, parents who stated that they needed more knowledge about the vaccine, x^2 (1, N = 1,358) = 4.13, p = 0.024, parents who believed that there would be no problem if they did not vaccinate their daughters, x^2 (2, N = 1,358) = 157.4, p <.001, parents who were concerned about the effectiveness of the vaccine, x^2 (2, N = 1,358) = 141.8, p <.001 and parents who were concerned about possible complications of the vaccine, x^2 (2, N = 1,358) = 138.6, p <.001, were more likely to have a negative intention to be vaccinated.

Table 5 presents the results of the binary logistic regression model performed to examine the prediction of parents' intention to vaccinate their daughters, using the COM-B and TDF elements and sociodemographic variables as independent predictors.

Table 2. *Demographic characteristics of the sample (N=1,358)*

	N	%
Gender of the parent/guardian		
Female	1,246	91.8
Male	112	8.2
Parents' age groups		
≤ 40	247	18.3
>40	1,102	81.7
Educational level (highest completed)		
Primary education	41	3.0
Secondary education	776	57.1
Tertiary education	387	28.5
Postgraduate (MSc)	139	10.2
Doctorate	15	1.1
Occupation		
Civil servant	311	23.0
Private servant	468	34.6
Freelancer	218	16.1
Business person	35	2.6
Retired	22	1.6
Unemployed	219	16.2
Other	79	5.8
Relationship with the girl		
Parent	1,310	96.5
Guardian	47	3.5
Financial status (family)		
Very low/Low	298	22.0
Medium	960	70.8
High/Very high	97	7.2
Place of residence		
Attica	389	28.6
Other than Attica	969	71.4
Number of daughters (in 3,205 families)		
1	744	54.8
2	493	36.3
3	93	6.9
4	27	2.0
Total number of daughters	4697	
School of daughters' attendance		
Gymnasium	855	63.0
Lyceum	503	37.0

Table 3. *Participant answers to questions representing COM B through TDF (N=1,358)*

COM B	TDF							
		Human papillomavirus is transmitted by:	Right		Wrong		Don't know	
			n	%	n	%	n	%
		Droplets (W)	77	9.4	521	63.4	224	27.3
		Food (W)	16	2.0	658	82.0	128	16.0
		Kiss (W)	112	13.7	501	61.5	202	24.8
		Sexual contact (C)	1257	94.1	3	0.3	75	5.6
		HPV can cause:						
		Warts on the genitals and genital area (C)	1186	89.5	9	0.7	130	9.8
		Papillomas on the breasts (W)	84	10.1	362	43.7	383	46.2
		Papillomas on the bladder (W)	187	21.7	205	23.8	469	54.5
		HPV potential consequences are:						
		Breast cancer (W)	80	9.5	460	54.8	300	35.7
		Cervical cancer (C)	1229	92.9	10	0.8	84	6.3
		Bladder cancer (W)	163	19.4	224	26.7	452	53.9
		There are no consequences (W)	19	2.4	607	78.0	152	19.5
	Knowledge	**Knowledge of the HPV vaccine**						
		Having the HPV vaccine achieves:	Right		Wrong		Don't know	
			n	%	n	%	n	%
		Protection against breast papillomas (W)	84	10.8	366	46.9	330	42.3
		Protection against warts (C)	653	72.3	66	7.3	184	20.4
		Treatment of existing warts (W)	53	7.0	432	57.0	273	36.0
		Protection against cervical cancer (C)	1149	93.8	11	0.9	65	5.3
		Treatment of cervical cancer (W)	99	12.5	493	62.4	198	25.1
Capability		The proper age for women to have the HPV vaccine is:						
		All ages (W)	116	16.5	371	52.7	217	30.8
		11–18 years (C)	1127	94.6	26	2.2	38	3.2
		19–32 years (W)	170	24.5	276	39.7	249	35.8
		26–50 years (W)	58	8.5	357	52.6	264	38.9
			Right		Wrong		Don't know	
			n	%	n	%	n	%
	Memory, Attention, and Decision Processes	*We protect ourselves from HPV by getting the appropriate vaccine*	1074	92.8	24	2.1	59	5.1
		We are protected from HPV if we are systematically monitored by urologist	140	17.7	324	40.9	328	41.4
		We protect ourselves from HPV by doing systematic Pap test	974	85.7	53	4.7	109	9.6
		We protect ourselves from HPV by systematically mammography	107	13.5	419	53.0	264	33.4
		We protect ourselves from HPV by using a condom	783	78.6	68	6.8	145	14.6
			Yes		No			
			n	(%)	n	(%)		
		Do you know what is shown in Figure 1?	296	22.3	1030	77.7		
		Do you know what is shown in Figure 2?	274	22.8	1041	79.2		
	Behavioural Regulation		Not at all, or a little		Quite		A lot	
			n	%	n	%	n	%
		Have you sought information about the HPV vaccine from any source?	600	57.0	337	32.0	116	11.0
		Have you discussed vaccinating your daughter with someone you trust?	437	41.6	395	37.7	217	20.7
Opportunity Social	***Social Influences***	*Are you influenced by people who have vaccinated their daughters?*	723	69.7	210	20.2	105	10.1
		Are you influenced by specialists?	372	35.9	334	32.2	331	31.9

COM-B	TDF						
Opportunity Physical	*Environmental Context and Resources*		Yes		Not sure		No
			n	%	n	%	n	%
		Would you vaccinate your daughter against HPV if you were given a reward e.g. a tax break?	141	14.9	139	14.6	669	70.5
		Would you vaccinate your daughter if she were restricted from going to university, for example?	405	43.2	246	26.2	287	30.6
Motivation Reflective	*Social/ Professional Role & Identity*		Yes		Not sure		No	
			n	%	n	%	n	%
		I am convinced that vaccination gives the message of early onset of sexual activity.	130	14.4	134	14.8	639	70.8
	Beliefs about Capabilities		Yes		No			
			n	%	n	%		
		Do you think you need more knowledge about HPV?	1108	82.7	231	17.3		
		Do you think you need more knowledge about the vaccine?	1100	82.3	237	17.7		
	Optimism		Yes		Not sure		No	
			n	%	n	%	N	%
		I am optimistic that if I do not vaccinate my daughter there will be no problem	152	16.7	255	28.0	503	55.3
	Intentions		Yes		No			
			n	%	n	%		
		First daughter intention to vaccinate	625	60.1	415	39.9		
		Second daughter intention to vaccinate	364	70.0	156	30.0		
		Third daughter intention to vaccinate	70	66.0	36	34.0		
		Other daughters intention to vaccinate	16	66.7	8	33.3		
	Goals		Not at all, or a little		Quite		A lot	
			n	%	n	%	N	%
		Are you considering making a vaccine information appointment with a specialist?	421	54.5	186	24.1	166	21.5
		Do you plan to schedule the vaccination within the next period?	365	45.8	190	23.8	245	30.6
	Beliefs about Consequences		Yes		Not sure		No	
			n	%	n	%	N	%
		The thought of vaccinating my daughter makes me concerned about its effectiveness.	185	20.3	162	17.8	393	43.1
Motivation Automatic	*Reinforcement*		Yes		No			
			n	%	n	%		
		Are the following suggestions reasons that would make it easier for you to vaccinate your daughters?						
		As the time of vaccination approaches, I would like to receive an email informing me about the usefulness of the HPV vaccine	538	69.3	238	30.7		
		I would like to be informed about a booked vaccination appointment that I will accept or not	284	43.0	377	57.0		
		I would like to have a vaccination appointment near my home	271	41.4	383	58.6		
	Emotions		Yes		Not sure		No	
			n	%	n	%	n	%
		I am concerned about the possible complications of the vaccine.	541	57.7	135	14.4	262	27.9
		I am relieved that the risk of serious illness is reduced with HPV vaccination	655	69.8	188	20.0	96	10.3

*Notes: W = Wrong; C = Correct

Table 4. *Relationship between parental HPV vaccination intention and the components of COM-B model (N=1,358)*

COM B	TDF			Intention to vaccinate		Intention not to vaccinate		x^2	p
				n	%	n	%		
Capability Psychological	Knowledge	HPV knowledge	*Not at all / minimal*	400	62.3	242	37.7	21.5	<.001
			Moderate	211	64.1	118	35.9		
			Good to very good	294	76.0	93	24.0		
		HPV vaccine knowledge	*Not at all / minimal*	459	59.5	313	40.5	46.6	<.001
			Moderate	227	72.1	88	27.9		
			Good to very good	219	80.8	52	19.2		
	Memory, Attention, and Decision Processes	Awareness of HPV prophylaxis methods	*Not at all*	391	63.4	226	36.6	12.01	0.002
			Moderate awareness	226	66.3	115	33.7		
			Good awareness	264	74.2	92	25.8		
		Correct recognition of 2 images of genital warts	*No recognition*	620	63.6	355	36.4	16.6	<.001
			Correct recognition of one image	139	70.9	57	29.1		
			Correct recognition of two images	146	78.1	41	21.9		
	Behavioural Regulation	Have you sought information about the HPV vaccine from any source?	*Not at all / too little*	324	54.0	276	46.0	38.0	<.001
			Enough to great	329	72.6	124	27.4		
		Have you discussed vaccinating your daughter with someone you trust?	*Not at all / too little*	202	46.2	235	53.8	81.8	<.001
			Enough to great	451	73.7	161	26.3		
Opportunity Social	Social Influences	Influence from relatives who have vaccinated their daughters	*Not at all / too little*	412	57.0	311	43.0	27.9	<.001
			Enough to great	234	74.3	81	25.7		
		Influence from experts for HPV vaccination	*Not at all / too little*	134	36.0	238	64.0	171.9	<.001
			Enough to great	513	77.1	152	22.9		
Opportunity Physical	Environmental Context and Resources	Would you vaccinate your daughter against HPV if you were given a reward e.g. a tax break?	*Yes*	105	74.5	36	25.5	14.7	<.001
			No	463	57.3	345	42.7		
		Would you vaccinate your daughter if, for example, she was restricted from going to university?	*Yes*	305	75.3	100	24.7	74.0	<.001
			No	253	47.5	280	52.5		
	Social/ Professional Role & Identity	I am convinced that vaccination gives the message of early onset of sexual activity.	*Yes*	64	49.2	66	50.8	27.9	<.001
			I'm not sure	65	48.5	69	51.5		
			No	432	67.6	207	32.4		
	Beliefs about Capabilities	Do you think you need more knowledge about HPV?	*Yes*	739	66.7	369	33.3	0.1	0.386
			No	157	68.0	74	32.0		
		Do you think you need more knowledge about the HPV vaccine?	*Yes*	723	65.7	377	34.3	4.1	0.024
			No	172	72.6	65	27.4		
	Optimism	I am optimistic that if I do not vaccinate my daughter there will be no problem.	*Yes*	46	30.3	106	69.7	157.4	<.001
			I'm not sure	115	45.1	140	54.9		
			No	398	79.1	105	20.9		
Motivation Reflective	Intentions	Intention to vaccinate the first daughter.	*Yes*	621	99.4	4	0.6	982.4	<.001
			No	10	2.4	405	97.6		
		Intention to vaccinate the second daughter.	*Yes*	351	96.4	13	3.6	439.5	<.001
			No	5	3.2	151	96.8		
		Intention to vaccinate the third daughter.	*Yes*	68	97.1	2	2.9	93.1	<.001
			No	1	2.8	35	97.2		
		Intention to vaccinate a second daughter (if any) with a positive or negative intention to vaccinate the first.	*Yes*	134	97.8	3	2.2	219.2	<.001
			No	12	8.7	126	91.3		
		Intention to vaccinate a third daughter (if any) with a positive or negative intention to vaccinate the first.	*Yes*	15	88.2	2	11.8	26.4	<.001
			No	3	10.7	25	89.3		
		Intention to vaccinate a third daughter (if any) with a positive or negative intention to vaccinate the second.	*Yes*	24	92.3	2	7.7	46.5	<.001
			No	1	3.1	31	96.9		
	Goals	Are you considering making a vaccine information appointment with a specialist?	*Not at all to little*	157	37.3	264	62.7	83.0	<.001
			Pretty to a lot	247	70.2	105	29.8		
		Do you plan to schedule the vaccination within the next period?	*Not at all to little*	83	22.7	282	77.3	248.8	<.001
			Pretty to a lot	342	78.6	93	21.4		
	Beliefs about Consequences	I am convinced that the HPV vaccine is unnecessary, and I do not intend to vaccinate my daughter or/my daughters.	*Yes*	12	11.7	91	88.3	280.7	<.001
			I'm not sure	39	24.1	123	75.9		
			No	507	78.4	140	21.6		
		The thought of vaccinating my daughter makes me concerned about its effectiveness.	*Yes*	148	41.6	208	58.4	141.8	<.001
			I'm not sure	88	54.3	74	45.7		
			No	327	83.2	66	16.8		
Motivation Automatic	Reinforcement	Received an e-mail from a competent body explaining why vaccination is important for my daughters.	*Yes*	350	65.1	188	34.9	21.1	<.001
			No	113	47.5	125	52.5		
		The competent state body is to make an appointment for vaccination at the appropriate health service nearest to my home.	*Yes*	209	73.6	75	26.4	27.5	<.001
			No	202	53.6	175	46.4		
		The competent state body to make me a vaccination appointment. Let me know by SMS or email, whether I will accept or not.	*Yes*	188	69.4	83	30.6	13.6	<.001
			No	211	55.1	172	44.9		
	Emotions	I am concerned about the possible complications of the vaccine.	*Yes*	246	45.5	295	54.5	138.6	<001
			I'm not sure	95	70.4	40	29.6		
			No	230	87.8	32	12.2		
		I am relieved that the risk of serious illness is reduced with HPV vaccination.	*Yes*	514	78.5	141	21.5	219.9	<.001
			I'm not sure	57	30.3	131	69.7		
			No	22	22.9	74	77.1		

Table 5. *Binary logistic regression model for parents' intention to vaccinate their daughters against HPV*

Variables	SE	B	95% CI		p
			LL	UL	
School of daughters' attendance					
Lyceum	.207	1.983	1.322	2.974	**<.001**
High school = ref					
Parents' educational level					
Higher than lyceum	.282	1.476	.850	2.563	0.167
Up to high school = ref					
COM-B – Capability Psychological (**TDF knowledge:** Core HPV vaccine knowledge*	.112	1.684	1.352	2.097	**<.001**
COM-B - Opportunity Social (**TDF Social influence:** Influence of experts)					
Enough to great	.100	1.651	1.357	2.008	**<.001**
Not at all / too little = ref					
COM-B – Motivation Automatic (**TDF – Reinforcement:** Receiving information from a competent body explaining why vaccination is important)					
Yes	.220	.647	.420	0.997	**0.048**
No= ref					
COM-B - Motivation Automatic (Fear of side effects)					
No	.141	2.353	1.786	3.099	**<.001**
I'm not sure					
Yes = ref					
COM-B - Motivation Automatic (**TDF – Emotions:** Risk minimization relief)					
Yes	.099	1.831	1.508	2.223	**<.001**
I'm not sure					
No = ref					
COM-B - Opportunity Physical (**TDF – Emotions:** Restrictions on access to university or work in case of non-vaccination)					
Yes	.124	1.188	.931	1.515	0.166
I'm not sure					
No= ref					

Hosmer and Lemeshow test: χ2= 7.366 (8 df), p = 0.498 and Overall percentage = 79.3%

**Note.* The Core Vaccine Knowledge variable captures the score of correct answers regarding the vaccine and more specifically, what is achieved with the vaccine and at what age it is done. The correct answers are 3 and therefore the score ranges from 0 to 3.

As can be seen in Table 5, the school of daughters' attendance and the COM-B elements of Capability Psychological, Opportunity Social and Physical, and Motivation Automatic were the factors that significantly influenced the intention of parents to vaccinate their daughters. More specifically, the probability of vaccination increases about twice if one has a child at the lyceum (OR [95% CI] = 1.98 [1.32, 2.97]). Furthermore, with one unit of increase in Core vaccine knowledge, the relative probability of intention for

vaccination increases by 68% (OR [95% CI] = 1.68 [1.35, 2.09]). The probability of intention to vaccinate increases by 65% if the parents are influenced by the experts (OR [95% CI] = 1.65 [1.35, 2.00]). In addition, the probability of intention for vaccination increases more than double if parents are not worried about the possible side effects of the vaccine (OR [95% CI] = 2.35 [1.78, 3.09]). Furthermore, the probability of intention for vaccination increases by 83% if the parents feel relieved by minimizing the chances of suffering from serious illnesses (OR [95% CI] = 1.83 [1.50, 2.23]). Finally, receiving information from a competent body explaining why vaccination is important increases the relative probability of positive intention for vaccination by 36% (OR [95% CI] = .64 [.42, .99]).

Discussion

The results of the study showed that parents who had not vaccinated their daughters had an intention to vaccinate them as the girls moved towards a higher grade (Lyceum); they (the parents) had a nuclear knowledge about the vaccine (they know the benefits and when it's done); they received the opinion of experts and an informative email from a competent body explaining the necessity of vaccination; they felt relieved from the reduction of the risk of cancer disease and feared of possible complications from the vaccine.

In the context of HPV vaccination, the usefulness of the COM-B model is crucial, as all factors that significantly affect and shape parental intention to vaccinate their daughters with the HPV vaccine have been captured. More specifically, the component of Psychological Capability to engage in HPV vaccination was found to be closely associated with parents' level of knowledge about the HPV vaccine. Numerous studies conducted around the world on various groups (parents, students, patients, even health professionals) have shown that the high level of knowledge about HPV and especially the level of knowledge about the HPV vaccine are the most important factors in deciding prevention actions, as they shape positive intention and acceptance of the vaccine (Alshehri et al., 2023; López et al., 2020; Mekonnen & Mittiku, 2023). On the other hand, the low level of knowledge exacerbates hesitancy and promotes the negative intention for preventive actions (Dubé et al., 2013)

The low level of knowledge is also related to the misconceptions parents have about both HPV and the vaccine against the virus. It has been shown that even informed parents have many misconceptions about both the mode of transmission and the complications of the virus, as well as how exactly the vaccine protects (Costantino et al., 2020). It has been shown that when parents are informed about the vaccine's benefits and potential risks, they are more likely to vaccinate their daughters (Suzuki et al., 2021). Our results showed that about one in four parents did not know whether the virus was transmitted by droplets or kisses, while one in eight believed that we were protected from the virus was achieved through regular mammogram. These findings provide some evidence that properly informing parents plays an important role in their decision to vaccinate their daughters.

The current study showed that awareness of how to prevent complications of the virus was significantly related to the positive intention to vaccinate against HPV. These findings are consistent with the findings of a systematic review and meta-analysis of 15 studies conducted in China where, in addition to awareness, children's age, safety and efficacy were the determinants of positive intention and acceptance of HPV vaccination (Cui et al., 2023). In our study, being in Lyceum, that is being older, was found to be the second most significant predictor of intention to vaccinate.

Exposure to HPV information appears to be a factor that regulates behaviour through the influence of parents' intention to vaccinate their daughters against HPV. This was also demonstrated in the current study where parents who sought information from any source or discussed the issue with someone they trusted were significantly more likely to have a positive intention to be vaccinated. This result is consistent with the study by Wang et al (2023) who found that exposure to HPV-related information affected young Chinese

people's intentions to receive the HPV vaccine and related knowledge; that is, the more often they were exposed to HPV-related information, the stronger their intentions to receive the vaccine and the higher their knowledge about HPV. Additionally, the perception and support of HPV vaccination by their loved ones further influenced their attitude and intentions to receive the HPV vaccine (Wang et al., 2023). Similarly, in another study that investigated the reasons why parents did not vaccinate their daughters, it was shown that 25.6% of those who did not vaccinate (53% of the sample), reported that they lacked information about HPV vaccination (Bogka et al., 2024).

The Social Opportunity component of COM-B includes Social Influence. The current study found that parents who were influenced by both relatives who had vaccinated their daughters and experts were significantly more likely to have a positive intention to vaccinate. The role of experts in the acceptance of the vaccine by parents is crucial and has been highlighted in the literature (Chan et al., 2023; Efua Sackey et al., 2022; Gomes et al., 2020).

Incentives and restrictions by the state had no impact on parents' intention for vaccination. As shown by the results, parents would not be willing to vaccinate their daughters if they were provided with a financial incentive or if they faced restrictions on their daughter's access to insurance or university. Financial motivation appears to be a factor in vaccination acceptance, as shown in a systematic review of 35 studies (Mavoundza et al., 2021), as well as a corresponding behavioural economics intervention study (Caskey et al., 2017). The difference between the results of our study and other studies listed is probably due to the type of financial incentive. In the current study, an indirect financial incentive related to tax relief was proposed, instead of a direct one such as receiving a sum of money for each dose of vaccine.

The component of Reflective Motivation includes social/professional role and identity. This field reflects the possible dilemma that parents face through their role: by accepting vaccination (a protection measure), they may be conveying the message for the early onset of their daughter's sexual activity (a potential exposure to risk). This dilemma may affect their intention to vaccinate. Our study findings showed that parents who worry that vaccination may mean an early start to their daughter's sexual activity are much more likely to have no intention of vaccinating their daughters. Although HPV vaccination is not significantly associated with the onset of sexual activity (Brouwer et al., 2019; Vatopoulou et al., 2023), the particular finding of this study is consistent with similar studies which capture parents' thinking that vaccination will give their daughters “the green light” for early onset of sexual activity, making them hesitant to decide on their daughters” vaccination (Bobadilla et al., 2024).

Reflective motivation also includes beliefs about possibilities. This component was reflected in the question of whether parents needed more information and knowledge about the virus and the HPV vaccine. The results showed that parents who mentioned they needed more information about the HPV vaccine did not have an intention to vaccinate their daughters. Similarly, the need for more knowledge about the virus was not significantly related to the intention to vaccinate. These results are consistent with studies showing that parents' need for more knowledge about the HPV vaccine is a factor in not vaccinating their daughters (Brown et al., 2017; Waser et al., 2022).

The component of Automatic Motivation includes Reinforcement and Emotions. As far as Reinforcement is concerned, all kinds of reminders related to both informing the parent and scheduling the daughter's vaccination appointments have been included in the current study and found to be significant, which act as incentives that create an intention to vaccinate. The reinforcement resulting from the use of reminders through a centralized system related to primary health care is an effective strategy to increase HPV vaccination coverage (Geoghegan & Feemster, 2020; Glenn et al., 2023; Hanley et al., 2023). Regarding Emotions, questions related to fear of vaccine side effects and relief from minimizing the risk of illness from serious diseases prevented by vaccination have been included and found to be significant predictors of parental

intention. Parents who felt relieved reported a greater intention to vaccinate. Similarly, parents who felt fear of possible side effects showed a negative intention to vaccinate. These findings are consistent with studies in which fear of possible side effects creates a negative intention to vaccinate (Hussein et al., 2024; Wassie et al., 2023).

The cross-sectional design of the study did not allow to measure whether parental intention was indeed transferred into the real vaccination. Although this is a common issue in the intention-behaviour relationship (Sheeran, 2002), a longitudinal design in future studies may resolve this issue. Another limitation was that the overwhelming percentage of the participants (1,246, 91.8%) consisted of mothers. Although mothers may be the most influential parent regarding the decision for HPV vaccination (Lin et al., 2024), future research might need to focus on both parents, or specifically on fathers.

The implication of the current study is that showed the direct correlation of intention with the elements of COM-B, which is the core of the BCW model. This means that through its components, the model can be a useful tool for understanding the main elements driving a person's behaviour. Through this understanding, the COM-B enables the design and evaluation of targeted interventions for behaviour change. More specifically, intervention could target emotional state of the parents, and enhance the role of experts in providing information about the crucial role of vaccination and influencing parents in taking HPV vaccination decision.

Conclusions

The use of the COM-B Model through the TDF framework has practical application in investigating the intention to implement a behaviour or not. The BCW model has already been proposed and used in Public Health England for population health behaviour modification interventions, including vaccination (West et al., 2020). Similarly, in Greece, functional BCW-based interventions for parents who have not fully vaccinated their daughters with the HPV vaccine can feed into cervical cancer elimination policies, that is the country achieves the WHO goal of 90% of girls up to 15 years old being vaccinated with the HPV vaccine by 2030.

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ΕΜΠΕΙΡΙΚΗ ΕΡΓΑΣΙΑ | RESEARCH PAPER

Πρόθεση των γονέων να εμβολιάσουν τις κόρες τους για τον ιό HPV. Μια συγχρονική πανελλαδική μελέτη με το μοντέλο COM-B

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ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ

Ιός ανθρώπινων θηλωμάτων (HPV)
Εμβολιασμός για τον HPV
Πρόθεση
Μοντέλο COM-B
Ικανότητα
Ευκαιρία
Κίνητρο
Συμπεριφορά

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ΠΕΡΙΛΗΨΗ

Η λοίμωξη από τον ιό των ανθρώπινων θηλωμάτων (HPV) είναι ένα κοινό σεξουαλικά μεταδιδόμενο νόσημα σε άνδρες και γυναίκες παγκοσμίως. Ευθύνεται για την εμφάνιση καλοήθων θηλωματωδών ή προκαρκινικών βλαβών, οι οποίες μερικές φορές εξελίσσονται σε καρκίνο, ειδικά στην πρωκτογεννητική περιοχή. Για την πρόληψη, διατίθεται εμβόλιο παγκοσμίως, συμπεριλαμβανομένης και της Ελλάδας, για κορίτσια και αγόρια ηλικίας 9-18 ετών. Η ευθύνη για τον εμβολιασμό συνήθως βαρύνει τους γονείς/κηδεμόνες. Ο στόχος αυτής της μελέτης ήταν να μετρήσει την πρόθεση των γονέων να εμβολιάσουν τις κόρες τους κατά του HPV και να προσδιορίσει τους καθοριστικούς παράγοντες που τον επηρεάζουν. Από τον Σεπτέμβριο του 2021 έως τον Μάρτιο του 2022 πραγματοποιήθηκε συγχρονική πανελλαδική μελέτη σε αντιπροσωπευτικό δείγμα μαθητών και μέσω αυτών, των γονέων/κηδεμόνων τους, χρησιμοποιώντας στρωματοποιημένη δειγματοληψία πολλαπλών σταδίων. Συμμετείχαν 46 σχολεία της επικράτειας, με αντιπροσωπευτικό δείγμα 3,203 γονέων/κηδεμόνων μαθητριών ηλικίας 11-18 ετών, οι οποίοι συμπλήρωσαν ανώνυμο ερωτηματολόγιο που δημιουργήθηκε με βάση τα μοντέλα Capability, Opportunity, Motivation - Behavior (COM-B) και Theoretical Domain Framework (TDF). 905 γονείς από τους 1,358 που δεν είχαν εμβολιάσει τις κόρες τους (66,6%) ανέφεραν ότι σκόπευαν να το κάνουν ή να ολοκληρώσουν τον εμβολιασμό. Η γνώση σχετικά με το εμβόλιο ($p < .001$), ο φόβος πιθανών παρενεργειών ($p < .001$), η ανακούφιση ότι σοβαρές ασθένειες θα μπορούσαν να αποφευχθούν ($p < .001$), η επιρροή εμπειρογνωμόνων ($p < .001$) και οι υπενθυμίσεις μέσω email ($p = .048$) ήταν οι σημαντικοί καθοριστικοί παράγοντες της πρόθεσης των γονέων να εμβολιάσουν τις κόρες τους. Τα διασυνδεδεμένα μοντέλα COM-B και TDF αποτελούν κατάλληλα πλαίσια για στοχευμένες παρεμβάσεις για την προώθηση του εμβολιασμού κατά του HPV.

https://doi.org/10.12681/psy_hps.39611

Ψυχολογία: Το περιοδικό της Ελληνικής Ψυχολογικής Εταιρείας
https://ejournals.epublishing.ekt.gr/index.php/psychology