

RESEARCH PAPER



## Meningococcal disease and vaccination: Knowledge and acceptability among adolescents in Italy

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### ABSTRACT

This study aimed to evaluate the knowledge, attitudes and practice about invasive meningococcal disease and the relative vaccine for adolescent in Italy. A cross-sectional study was conducted from March to May 2017 among a sample of 771 adolescents in the geographic area of Naples (Italy). A self-administered anonymous questionnaire was used to collect demographics, knowledge about meningitis and preventive measures, perceived risk for contracting meningitis, attitude towards the utility of meningococcal vaccine, and adolescents' willingness to receive a meningococcal vaccine. 85.2% of participants have heard about meningitis, 57.2% knew that adolescents are a susceptible population but only 30.3% knew that meningitis is transmitted by respiratory droplets. Moreover, 40.5% of adolescents knew that meningitis is a vaccine-preventable disease and that adolescents could be vaccinated. This knowledge was significantly greater among female participants, among those who talk with parents about vaccinations, among who have received information about vaccinations from physicians, among who have positive attitude towards the utility of information received on vaccinations and among who don't feel the need of additional information about meningitis. As regard the attitudes, 25.7% of adolescents thought that the vaccine was very useful. Males, adolescent aged 11–13 years, those who had the positive attitude towards the utility of information received about vaccinations and those who had received at least one vaccination in the last year were more likely to have this attitude. The our finding identifies the need to improve adolescents' knowledge about meningitis and its related vaccinations, through correct health education, in order to have a good acceptance of vaccination.

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### Introduction

It is well established that meningococcal disease is rare, but it can be potentially lethal. Among people who survive approximately one in five will have serious long-term disabilities, such as lost limbs, brain damage, deafness and nervous system difficulties.<sup>1</sup> The majority of the global disease burden is caused by invasion of the bacterium *Neisseria meningitidis* and most of the cases are caused by serogroups A, B, C, W-135, and Y. In Europe the majority of cases are given by meningococcus B and C. The highest rate of meningococcal disease is registered in children, in adolescents and young adults.<sup>2,3</sup> Relatively to adolescents, social situations where there is crowding such as dormitories, boarding schools and sleep-away camps; going to bars, active or passive smoking, irregular sleep habits and attendance at a new school with students from geographically diverse areas seem to be linked to the disease.<sup>1</sup> A dose of the quadrivalent MenACWY conjugate vaccines is strongly recommended and free in adolescents with age 11–18 years.<sup>4</sup> In these age population, the efficacy of conjugate vaccines against carriage is equal to 75%.<sup>5</sup> In Italy, the levels of vaccine coverage in this age group are often low compared to the 95% coverage target. Indeed, data published by the Ministry of Health immunization coverage show that 50.1% and

19.7% of the adolescents for the birth cohort in 2000 and 46.2% and 7.6% for the birth cohort in 1998 received, respectively, the required MenC conjugate vaccine and quadrivalent MenACWY conjugate vaccine.<sup>4</sup> Parents and adolescents should speak with a healthcare professional about vaccine against meningococcal disease, but at the same time, it is well know that fewer adolescents, compared with other pediatric age groups, access the health care services. When they do access the medical visits, it is most often for acute care and the probability of having a primary care visit in a given year declines substantially with increasing age.<sup>6</sup> Indeed, a recent study conducted in Italy regarding the use of health care services in children and adolescents showed that the use of preventive health care services was significantly higher amongst younger children.<sup>7</sup> Adolescents could play an important role in acceptance of the vaccination in addition to parents and health care providers. However, very few studies have been dedicated on this topic<sup>8–13</sup> and it is particularly important to understand this issue in order to provide information for the development of effective immunization initiatives. This study aimed to evaluate the knowledge of meningococcal disease and acceptability of the relative vaccine for adolescents in Italy.

## Results

In total, 771 on 776 adolescents agreed to participate with a response rate of 99.4%. The sample was composed for more than half of females, the mean age was 15.1 years (range 11–19), 95.5% were Italian, and 6.9% had at least a parent who is a health care professional.

### Adolescent's knowledge and attitude

85.2% of adolescents reported that they had heard about meningitis, only 30.3% of them knew that respiratory droplets are a mode of transmission of meningitis and 57.2% knew that adolescents are a susceptible population (Table 1). 80.7% knew that meningitis can be prevented with vaccines, 77% knew that in Italy these vaccines are available, and 62.2% knew that the vaccines are not mandatory. Moreover, 40.5% of participants knew that meningitis is a vaccine-preventable disease and that adolescent could be vaccinated. The results of multivariate logistic regression model showed that females (OR = 1.69; 95% CI 1.24-2.32), those who had talk with parents about vaccinations (OR = 2.33; 95% CI 1.53-3.56), those who had received information about vaccinations from physicians (OR = 1.75; 95% CI 1.28-2.39), those who had a positive attitude towards the utility of information received about vaccinations (OR = 1.7; 95% CI 1.18-2.44), were more likely to know that meningitis is a vaccine-preventable disease and that adolescent could be vaccinated. Moreover, adolescents who felt the need of additional information about meningitis were less likely to have this knowledge (OR = 0.68; 95% CI 0.48-0.97). However, in adolescent aged 11–13 (OR 0.56; 95% CI 0.38-0.8) compared with age group 17–19 the odds was lower (Model 1 in Table 2).

**Table 1.** Adolescent's knowledge about meningitis.

	N	%
Had heard about meningitis <sup>a</sup>		
Yes	657	85.2
No	114	14.8
Knowledge that adolescents are a susceptible population <sup>b</sup>		
Yes	376	57.2
No	281	42.8
Knowledge that respiratory droplets are a mode of transmission of meningitis <sup>b</sup>		
Yes	199	30.3
No	458	69.7
	Correct response	
Knowledge of preventive measures of meningitis		
Vaccine (True)	530	80.7
Cover one's mouth after coughing (True)	422	64.2
Cover one's nose after sneezing (True)	361	54.9
Avoid some foods (False)	295	44.9
Use of preservative (False)	232	35.3
Avoid crowded places (True)	217	33
Had heard about the availability of meningococcal vaccine in Italy <sup>b</sup>		
Yes	506	77
No	151	23

<sup>a</sup>All sample (n.771).

<sup>b</sup>Only for those who had heard about meningitis.

As regard the attitudes, 23.6% and 77% of adolescents considered the meningococcal disease a rare and serious illness. Moreover, 25.7% of participants thought that the vaccines against the meningitis were very useful with a mean of 7.5 on a ten-point Likert scale ranging from 1 scores to 10. The multivariate logistic regression shows that adolescent aged 11–13 years (OR = 2.31; 95% CI 1.49-3.56), those who had a positive attitude towards the utility of information received about vaccinations (OR = 3.48; 95% CI 2.32-5.21) and those who had received at least one vaccination in the last year (OR = 1.51; 95% CI 1.01-2.27) were more likely to thought that the vaccines against the meningitis were very useful. Finally, females (OR = 0.53; 95% CI 0.36-0.8) were less likely to thought that the vaccines against the meningitis were very useful (Model 2 in Table 2).

The mean value of the perceived personal risk of contracting meningitis was 5.5, on a scale from 1 to 10 with values  $\geq 6$  indicating a perception of being at risk. However, only 29.2% reported that they are at high risk of contracting meningitis with a responding value from 8 to 10 to the question. The results of multivariate logistic regression analysis showed that females (OR = 1.45; 95% CI 1.01-2.1), adolescents under 14 years of age (OR = 3.19; 95% CI 1.94-5.24) and those who had 14–16 years (OR = 1.62; 95% CI 1.04-2.54) compared with the adolescents of 17–19 years, those who did not have at least one parent who is a health care professional (OR = 0.38; 95% CI 0.15-0.95), those who need of additional information about meningitis (OR = 1.56; 95% CI 1.04-2.33), and those who had talk with physician about meningococcal vaccines (OR = 2; 95% CI 1.32-3.01) were more likely to perceive them to had a higher risk of contracting meningitis (Model 3 in Table 2).

### Adolescent's behaviors

Only 116 adolescents (15.1%) reported having undergone meningococcal vaccination, the majority of them (56.9%) were female, with a mean age of 14.5.

Table 3 presents the socio-demographic characteristics of study population associated to the willingness to receive meningococcal vaccine. Approximately two third of adolescents (65.1%) who did not undergone meningococcal vaccination responded “yes” on being asked about willingness to receive meningococcal vaccine. The results of multivariate logistic regression analysis showed that adolescent of age group 11–13 years (OR = 2.89; 95% CI 1.52-5.5) compared with age group 17–19 years, those who had a positive attitude towards the utility of information received about vaccinations (OR = 5.15; 95% CI 3.13-8.49), those who had at least one visit to the physician in the last year (OR = 1.72; 95% CI 1.04-2.83), and those who need of additional information about the meningitis (OR = 1.64; 95% CI 1.02-2.61) were found to express the positive attitude toward the willingness to receive the vaccine (Model 4 in Table 2).

Overall, 79% of adolescents had talk with parents about vaccinations and 33.3% of adolescents reported having at least one vaccination in the last year. In particular, 14.9% of adolescents had received the papillomavirus vaccine and

**Table 2.** Multivariate logistic analysis to characterize factors associated with the different outcome of interest.

Variable	OR	SE	95% CI	p value
<b>Model 1. Knowledge that meningitis is a vaccine-preventable disease and that adolescent could be vaccinated</b>				
Log likelihood = -468.06, $\chi^2 = 80.15$ (8 df), $p < 0.0001$ (sample size = 752)				
Who talk with parents about vaccinations	2.33	0.5	1.53-3.56	<0.001
Who have received information about vaccinations from physicians	1.75	0.28	1.28-2.39	<0.001
Females	1.69	0.27	1.24-2.32	0.001
Age 11-13	0.56	0.1	0.38-0.8	0.002
Age 17-19	1.0*	—	—	—
Positive attitude towards the utility of information received about vaccinations	1.7	0.31	1.18-2.44	0.005
Who don't need additional information about meningitis	0.68	0.12	0.48-0.97	0.032
Who have at least a parent that work	1.24	0.21	0.89-1.73	0.195
Who have at least one graduate parent	1.23	0.2	0.89-1.7	0.215
<i>Backward elimination</i>				
Age 14-16				
<b>Model 2. Positive attitude towards the utility of vaccinations in order to prevent meningitis</b>				
Log likelihood = -324.11, $\chi^2 = 90.59$ (8 df), $p < 0.0001$ (sample size = 654)				
Age 11-13	2.31	0.51	1.49-3.56	<0.001
Age 17-19	1.0*	—	—	—
Positive attitude towards the utility of information received about vaccinations	3.48	0.72	2.32-5.21	<0.001
Males	0.53	0.11	0.36-0.8	0.002
Who have at least one vaccination in the last year	1.51	0.31	1.01-2.27	0.05
Who have at least one visit to the physician in the last year	1.8	0.56	0.98-3.3	0.057
Physician discussed about meningococcal vaccine	1.43	0.32	0.93-2.21	0.107
Knowledge that adolescents could get meningitis	1.23	0.25	0.82-1.83	0.309
Who talk with parents about vaccinations	1.31	0.37	0.75-2.28	0.336
<i>Backward elimination</i>				
Age 14-16				
Knowledge that meningitis is a vaccine-preventable disease and adolescent could be vaccinated				
Who have received information about vaccinations from physicians				
Who have heard about meningococcal vaccine				
<b>Model 3. Perception of being at high risk of contracting meningitis</b>				
Log likelihood = -356.49, $\chi^2 = 66.78$ (9 df), $p < 0.0001$ (sample size = 655)				
Age 11-13	3.19	0.81	1.94-5.24	<0.001
Age 14-16	1.62	0.37	1.04-2.54	0.034
Age 17-19	1.0*	—	—	—
Physician discussed about meningococcal vaccine	2	0.42	1.32-3.01	0.001
Who need additional information about meningitis	1.56	0.31	1.04-2.33	0.030
Who did not have at least one parent who is a health care professional	0.38	0.18	0.15-0.95	0.039
Females	1.45	0.27	1.01-2.10	0.050
Knowledge that meningitis is a vaccine-preventable disease and adolescent could be vaccinated	1.46	0.28	1.01-2.14	0.051
Who have received information about vaccinations from physicians	1.25	0.24	0.86-1.83	0.239
Who don't have at least one graduate parent	0.82	0.15	0.56-1.19	0.296
<i>Backward elimination</i>				
Who have at least one visit to the physician in the last year				
<b>Model 4. Willingness to receive meningococcal vaccine</b>				
Log likelihood = -282.51, $\chi^2 = 107.08$ (11 df), $p < 0.0001$ (sample size = 520)				
Age 11-13	2.89	0.95	1.52-5.5	0.001
Age 14-16	1.32	0.3	0.85-2.06	0.211
Age 17-19	1.0*	—	—	—
Positive attitude towards the utility of vaccinations	5.15	1.31	3.13-8.49	<0.001
Who have at least one visit to the physician in the last year	1.72	0.44	1.04-2.83	0.034
Who need additional information about meningitis	1.64	0.39	1.02-2.61	0.039
Knowledge that meningitis is a vaccine-preventable disease and adolescent could be vaccinated	1.42	0.3	0.94-2.16	0.097
Who have at least a chronic disease	1.49	0.37	0.92-2.42	0.108
Who talk with parents about vaccinations	1.5	0.4	0.89-2.55	0.129
Who have received information about vaccinations from physicians	1.34	0.29	0.88-2.04	0.175
Perception of risk of contracting meningitis	1.4	0.35	0.86-2.3	0.175
Who don't have at least one parent who is a health care professional	0.71	0.25	0.35-1.43	0.343
<i>Backward elimination</i>				
Positive attitude towards the utility of information received about vaccinations				
Physician discussed about meningococcal vaccine				

\*Reference category in multivariate analysis.

7.8% influenza vaccine; therefore, 18.3% of adolescents stated to have received the booster doses of tetanus, polio, diphtheria and pertussis vaccination. 81.7% had reported at least one visit to the physician in the last year and only 27.5% of them had received the physicians' recommendations for the vaccination.

### Sources of knowledge

As regard sources of information, the majority of adolescents indicated that they acquired the vaccination knowledge from physicians (43.6%). Moreover, 25.4% believed useful the information received about vaccination and only

**Table 3.** Socio-demographic characteristics of study population associated to the willingness to receive meningococcal vaccine.

	Willingness to receive meningococcal vaccine				Univariate p
	No (212)		Yes (395)		
	N	%	N	%	
Age					
11–13	33	15.6	124	31.4	<0.001
14–16	99	46.7	175	44.3	
17–19	80	37.7	96	24.3	
Gender					
Male	96	45.3	193	48.9	0.4
Female	116	54.7	202	51.1	
Nationality					
Not Italian	15	7.1	15	3.8	0.076
Italian	197	92.9	380	96.2	
School attended					
Primary school	60	28.3	157	39.8	0.005
Secondary school	152	71.7	238	60.2	
Number of siblings					
None	32	15.1	62	15.8	0.825
≥1	180	84.9	331	84.2	
Graduate parent					
No	113	53.3	215	54.4	0.79
Yes	99	46.7	180	45.6	
Parent who is a health care professional					
No	191	90.1	371	93.9	0.086
Yes	21	9.9	24	6.1	
Having chronic disease					
No	170	80.2	295	74.7	0.127
Yes	42	19.8	100	25.3	

27.1% reported the need of additional information about meningitis.

## Discussion

To our knowledge, this study represents the first cross-sectional survey that evaluated the knowledge of meningococcal disease and its prevention in the Italian adolescent population. The investigation provides important information about the knowledge and beliefs of adolescents which may be useful to public decision-makers for programming prevention actions on this population group to improve the vaccination coverage rate. Indeed, the data analysis showed that only 15.1% of the study participants reported having undergone meningococcal vaccination. This value is very worrying because in Italy the latest National Vaccination Prevention Program recommends the meningococcal vaccination during the adolescence, including those who have already received the vaccine in childhood, as prevention is effective if there are a high titer of antibodies.<sup>4</sup>

Regarding the other results of our survey, the comparison with the studies in the literature is very difficult because few previous investigations had our same aims, and due to the different methodological approaches used. In this study only one third of adolescents who have heard about meningitis knew the mode of transmission and more than half that the adolescents are a susceptible population. These findings are comparable with the results of a study conducted in Australia where more than half of participants (54.9%) of 15–24 years had a poor knowledge regarding the invasive meningococcal disease.<sup>10</sup> Moreover, 77% knew that in Italy are available vaccines against the meningitis. Similar

results (76%) were reported in a study conducted among adolescents of 14–17 years in Belgium.<sup>14</sup>

Another main result was that more than two third of sample considered serious the meningococcal disease but only one third perceived themselves at risk of contracting the disease. Similar results regarding the perception of the disease's severity were reported in two studies conducted in Canada, although only about the meningococcal B disease.<sup>8,9</sup>

It is interesting to note that two-thirds of participants had expressed its willingness to make the meningococcal vaccine while few adolescents felt themselves at risk of meningococcal disease. This result is very important because it highlights the need to improve the vaccination strategies against meningococcal disease by preventive healthcare services to make the most of this propensity of the adolescents and then to increase the vaccine coverage in this population. It is mandatory also to involve in the preventive strategies the parents because the attitude of parents to vaccinate their children is a determining factor to bring the rates of vaccination coverage at optimal values. Indeed, regarding this, the findings of a previous study conducted in the same geographical area, regarding the meningococcal B vaccine, showed that most parents (67.2%) had a positive attitude toward vaccinating their children.<sup>12</sup>

At multivariate regression analysis, several factors were associated with the main outcomes of interest. In particular, the knowledge that the vaccination against the meningitis is recommended for adolescents was higher among who talk with parents regarding the vaccination and among those who had indicated the physicians as a source of information on the vaccinations. These findings confirm the importance of the parents' and physicians' role in determining the adolescent's vaccine choices. Indeed, the role of physicians as a source of

information that can influence the knowledge of vaccine-preventable diseases has also been confirmed in a previous survey conducted in Italy on the male adolescent's population.<sup>15</sup>

The importance of receiving appropriate information about the diseases and relative vaccinations is also confirmed by the results of logistic regression model that evaluated the determinants of the propensity of adolescents to get vaccinated against meningitis. Indeed, the utility of information received about vaccinations, physicians' visit in the last year and the need of additional information about meningitis were strongly associated predictors to willingness of adolescents to receive vaccine against meningitis. Furthermore, respondents of younger age have expressed a positive attitude towards to receive the vaccination. A previous already cited study has shown similar finding in adolescents, although regarding the willingness to receive the Human Papillomavirus vaccine.<sup>15</sup>

This survey has several potential limitations due to the study design and the methodology used for collecting information. The first is that is not possible in cross-sectional study to determine the causal and temporal relationship between the outcomes of interest and the independent variables. Secondly, the use of a questionnaire could favor the overestimation of positive attitudes and behaviors by respondents, especially regarding the positive attitude towards the utility of the vaccination and the willingness to receive the vaccines. This limit has been contained by ensuring the anonymity and privacy of the collected data. Thirdly, a recall bias may have occurred when the questionnaire asked about the previous vaccination status of adolescents. Despite these limitations, the study has important strengths, in particular the very high response rate and the appropriate sample size, and therefore we are confident that the findings of the survey are valid.

In conclusion, the findings of our study support the clear need to plan educational interventions to improve the adolescents' knowledge about the meningitis and about the relative vaccine recommendations. It is also urgent that health policy makers and healthcare providers implement vaccine strategies to facilitate adolescent access to vaccination against meningitis with aim to improve coverage rates, given the wide willingness to receive the vaccination of our sample of adolescents.

## Materials and methods

This investigation was conducted from March to May 2017 in the city of Naples, Italy, and the study population was a sample of 776 adolescents aged 11 to 18, recruited from 5 randomly selected public schools. The detailed description of the study design and methods has been published elsewhere.<sup>16</sup>

Before initiation of the study, the director of each school was informed about the project. Furthermore, a cover letter has been sent to the parents to explain the purpose of the survey, the methods which their children were selected, highlighting that participation in the survey was voluntary, and that privacy and confidentiality would be guaranteed. When the parental consent had been obtained, a researcher, in each classroom, gave oral instructions to the students to fill in the questionnaire.

The questionnaire collected the following data items: (1) student socio-demographics characteristics and health history, age, gender, nationality, number of cohabiting, number of

siblings, parent's educational level, parent's working activity, number and type of chronic diseases; (2) knowledge about meningitis (definition, mode of transmission, etc.); (3) attitudes about the risks of contracting meningitis and towards the utility of vaccination. In particular, the perceived of personal risk of contracting meningitis was defined by scale from 1 to 10 with values  $\geq 6$  indicating a perception of being at risk. Scale values from 8 to 10 corresponded to the perception of being at high risk of contracting meningitis; (4) willingness to receive the meningococcal vaccine; (5) sources and need of information about meningococcal vaccine.

Before the study initiation, the approval of the study was obtained by the Ethics Committee of the University of Campania "Luigi Vanvitelli".

## Statistical analysis

In this study there were four outcomes of interest: knowledge that meningitis is a vaccine-preventable disease and that adolescent could be vaccinated (no = 0; yes = 1) (Model 1), positive attitude towards the utility of vaccinations in order to prevent meningitis ( $<10 = 0$ ;  $10 = 1$ ) (Model 2), perception by adolescents of being at high risk of contracting meningitis ( $<8 = 0$ ;  $8-10 = 1$ ) (Model 3) and willingness to receive meningococcal vaccine (no = 0; yes = 1) (Model 4). The following independent variables were included in all models: age (three categories: 11-13 years; 14-16 years; 17-19 years), gender (male = 0; female = 1), nationality (not Italian = 0, Italian = 1), educational level of at least a parent (others = 0; college degree or higher = 1), number of siblings (none = 0;  $1 = \geq 1$ ), number of cohabiting (continuous), at least one parent who is a health care professional (no = 0; yes = 1), at least a chronic disease ( $0 = \text{none}$ ;  $1 = \geq 1$ ), physicians as source of information about vaccinations (no = 0; yes = 1), positive attitude towards the utility of information received about vaccinations (no = 0; yes = 1), need of additional information about meningitis (no = 0; yes = 1). The variables knowledge that meningitis is a vaccine-preventable disease and that adolescent could be vaccinated (no = 0; yes = 1), having heard about meningococcal vaccine (no = 0; yes = 1), knowledge that adolescents could get meningitis (no = 0; yes = 1), knowledge that respiratory droplets are a mode of transmission of meningitis (no = 0; yes = 1), speaking of vaccinations with parents (no = 0; yes = 1), at least one vaccination in the last year (no = 0; yes = 1), at least one visit to the physician in the last year (no = 0; yes = 1), physician discussed about meningococcal vaccines (no = 0; yes = 1) were included in Model 2, in Model 3 and Model 4. Finally, positive attitude towards the utility of vaccinations in order to prevent meningitis ( $<10 = 0$ ;  $10 = 1$ ), perception by adolescents of being at high risk of contracting meningococcal disease ( $<8 = 0$ ;  $8-10 = 1$ ) were included in Model 4.

Bivariate appropriate tests have been used to assess the univariate associations between each of the independent characteristics and the different outcomes of interest. After bivariate analyses, variables associated with the outcomes of interest at the  $p$ -value  $\leq 0.25$  level were subsequently introduced into a

multivariate regression model. Then, stepwise logistic regressions analysis had been performed to evaluate associations between the independent characteristics and outcomes of interest, and the level for variables entering in the logistic regression models was set at 0.2 and for removing at 0.4. The results of the multivariate analysis have been expressed in odds ratios (ORs) and 95% confidence intervals (CIs), with a statistically significant level of  $p$ -value  $\leq 0.05$ . Analyses were performed using Stata 10.1 software.<sup>17</sup>

### Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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