ORIGINAL ARTICLE

Improvement in vaccination knowledge among health students following an integrated extra curricular intervention, an explorative study in the University of Palermo

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Keywords

Medical education • Vaccination • Educational intervention • Survey • Medical students

Summary

Introduction. *Vaccination coverages threaten to decrease because of false beliefs in their unsafety and inefficacy. Therefore formation of future health-care workers on this topic is fundamental to deal with any doubt and to promote active immunization among general population.*

Methods. *In order to assess health-care students' knowledge about vaccination before an integrated seminar on this topic, and to evaluate their improvement after the educational intervention, an integrated educational intervention was held by a multidisciplinary team. Before and after the seminar, 118 students of medicine and biology schools at Palermo University were asked to answer 10 multiple-choice questions regarding vaccine history, mechanism of action, side effects, composition, use and nowadays issues (hesitancy). Two more questions investigating possible changes on students' attitudes towards vaccination and the usefulness of the formative intervention, were added at the post-test phase of the survey.*

Results. *Eighty-one out of 118 students (68.6%) answered to both pre- and post-test questions. 97.6% and 81.5% of the participating group also completed the two additional questions about their improvement in knowledge (question 11) and attitudes (question 12) towards vaccinations. The post-test results showed a significant improvement for all questions administered, except for number 3 (about a specific immunological content), with an overall percentage of correct answers increasing from 38.8% to 77.6% ($p\copyright < 0.001$).*

Conclusions. *The present explorative study put the basis for future studies, stronger in the methodology, and highlights the importance of educating health-care professions students by integrated extra-curricular intervention to be held early in their degree curricula and in order to improve knowledge and attitudes towards vaccinations and to prepare them to promote vaccines among the general population.*

Introduction

Vaccinations are one of most powerful public health strategy, saving millions of human lives every year [1]. Despite this undeniable success, nowadays vaccination is perceived as unsafe and unnecessary by a growing segment of population. A huge number of attacks by anti-vaccination movements, concerning not evidence-based issues on vaccine safety, have spread all over the industrialized countries due to the general belief of considering the Internet as a self-acknowledgement item for solving health problems [2]. This wide-spectrum of doubtful attitudes towards vaccine immunization represent a serious danger to public health, and has been collectively called "hesitancy" [3]. Current events involving vaccines negatively impacted the public opinion, resulting in coverage rates decrease. As a consequence of that, vaccine-preventable disease outbreaks and epidemics increased [4-7].

Despite influenza vaccination of health-care workers was strongly recommended by International and National Public Health Authorities [8, 9], vaccination coverage reported in Italy are still lower than 75% expected [10, 12]. Considering this background, health-care workers (HCWs) must be well prepared to increase people knowledge about vaccine safety and efficacy. Therefore, educating future generations of HCWs early in their career is a critical point in the strategy of promoting vaccines among the population, especially parents of young children. Evidences demonstrated how multidisciplinary formative interventions [11] are the preferred strategy for Italian HCWs to improve their adherence, attitude and knowledge about vaccinations, comparing with the ones proposed by other countries (mandatory vaccination, incentives to vaccination, *etc*.) [11-13]. Moreover, the "key role" of HCWs for a proper vaccination counseling to the patients and the importance of an up-to-date training on preventive medicine was frequently reported [15-18].

The aim of this study was to evaluate the efficacy of an integrated curricular intervention to improve knowledge and attitude towards vaccinations of biomedical students attending a seminar at Palermo University, South of Italy.

Methods

At the University of Palermo, located in the South of Italy, six of the twenty existing departments are related to biomedical disciplines. The Department of "Science for Health Promotion and Mother-Child care" organized an integrated educational intervention for Palermo University students of health-related faculties (Medicine, Health Assistance, Health Biology, Pharmacy, Nursing, Biology, Pharmaceutical and Chemical Technology).
Students were divided into three subgroups according to the attended faculty, respectively, in order to simplify and improve data analysis:

1. Medicine;
2. Master of Sciences (Health Biology, Pharmacy, Pharmaceutical and Chemical Technology);
3. Basic Sciences (Health Assistance, Nursing, Biology).

The interdisciplinary intervention was held by university personnel belonging to Department for Prevention and public health physicians employed by the Local Health Units of the National Health Service. They were all experts in the fields of vaccination and immunization, and debated the following topics:

- history of vaccination (from the origins to the newest improvements);
- principal immunological aspects of vaccination;
- vaccination strategies of Sicilian Region;
- false myths about adverse effects of vaccines;
- communication on vaccination between health personnel and general population.

This pre-post test study contemplates information gathered through ten multiple choice questions survey, compiled both before and after lecturers' speeches. Questions were grouped two by two according to the five main topics of the educational intervention and were projected before and after the educational intervention in the meeting room screen for 1 minute to allow the response on a printed answers sheet. Pre and post-intervention results were analyzed separately. Students were informed about the protocol of the study, and they participated anonymously. Since the survey data did not influence students' privacy, and the issue being investigated is a matter of public record, ethical approval for the study was not required.

Statistical analysis

We entered all the information in a database created within Excel 5.0 software. Data analysis was performed using the EpiInfo 3.5.1 software. Absolute and relative frequencies were calculated for qualitative variables. Quantitative variables were normally distributed and summarized as means (standard deviation).
Socio-demographic, academic characteristics and the percentage difference between pre and post intervention test were evaluated by the Fisher Exact Test (dichotomous variables) or Chi-squared test (categorical variables). Differences in means were compared with the Student t-test for paired sample. The significance level chosen was $p < 0.05$ (two-tailed).

Results

Eighty-one out of 118 (68.6%) students actively participated to both pre and post educational intervention.
Socio-demographic data were reported in Table I. There were no significant difference between gender ($p = 0.63$), mean age (22.9 ± 4.6 and 23.1 ± 3.0 respectively, $p = 0.64$), attended courses ($p = 0.62$) and year of course ($p = 0.47$) among pre and post test groups. The majority of students were female (about the 65%), and attended Medicine course.
After the intervention, 97% of respondents stated their knowledge concerning vaccination had been improved at least partially and 81.5% of them admitted also an improvement of their attitude towards active immunization, thanks to the seminar.
Percentage of correct answers significantly improved after the seminar relating to historical, immunological aspects and vaccination strategy (number 1, 2, 4 to 8) ($p < 0.001$), and for questions on communication on vaccination between health personnel and general population (question 9 and 10) ($p < 0.05$ and $p < 0.01$, respectively). Question number 3 on specific immunological and pathogenetic mechanisms showed a not significant decrease of proper responses percentage (60.2 vs 56.8; $p = 0.80$) (Tab. II).
The mean value of correct answers was globally 38.8% in the pre-intervention survey, with the most trained students attending Medicine (44.2%) followed by students attending Basic Sciences (38.7%) and Master of Sciences courses (30.1).
The figures, as reported in Table III, increased to 77.6% after the seminar ($p < 0.001$), and significant improvements were attained by students of Medicine (81.3%), Master of Sciences courses (75.9%), and Basic Sciences courses (75.4%) ($p < 0.001$, in all cases).

Discussion

Vaccination has long been relegated as a secondary topic in Medicine *curricula* of most Italian universities, often with insufficient time dedicated to, or even entirely omitted [19], leaving it to spontaneous and autonomous diligence of students to deepen their own knowledge. Only in recent years Italian universities abandoned the traditional education pattern based on monographic courses adopting extracurricular interventions which may provide scholars a more complete view of each topic, thanks to a multidisciplinary approach. Our study was based on the evaluation of the efficacy of multidisciplinary formative course including different aspects

Tab. I. Socio-demographic and academic characteristics of study samples (pre and post intervention).

Determinant	Pre intervention questionnaries	Post intervention questionnaries	p-value
Number of respondents	118 (100)	81 (68.6)	
Age, mean in years ± SD	22.9 ± 4.6	23.1 ± 3.0	0.63
Gender, n (%)			
• Male	38 (32.5)	27 (34.2)	0.64
• Female	79 (67.5)	52 (65.8)	
Classes of degree, n (%)			
• Medicine	54 (45.7)	30 (37.0)	0.62
• Master of Sciences (Health Biology, Pharmacy, Pharmaceutical and Chemical Technologies)	31 (26.3)	24 (29.6)	
• Basic Sciences (Health Assistance, Nursing, Biology)	31 (26.3)	22 (27.2)	
• Missing	2 (0.02)	5 (0.06)	
Year of course , n(%)			
• I	31 (26.3)	18 (22.2)	0.40
• II	34 (28.8)	25 (30.9)	
• III	27 (22.9)	15 (18.5)	
• IV	7 (5.9)	3 (3.7)	
• V	9 (7.6)	7 (8.6)	
• VI or more	3 (2.5)	2 (2.5)	
• Missing	7 (5.9)	11 (13.6)	
Knowledge improvement after educational intervention, n (%)			
• Yes, fully		51 (63.0)	
• Yes, partially		28 (34.6)	
• No		0 (0.0)	
• Not answered		2 (2.5)	
Attitudes towards vaccination change after educational intervention, n° (%)			
• Yes, they will improve		66 (81.5)	
• Yes, they will worsen		0 (0.0)	
• No, they will remain unchanged (intervention not effective)		1 (1.2)	
• No, I was already aware of discussed topics		10 (12.3)	
• Not answered		4 (4.9)	

of vaccination that was held in one day, with a pre-post survey.

As stated in Table I, there were no significant differences between pre and post-test groups concerning demographic characteristics, degree or year of study course (attendance).

Efficacy of integrated intervention was self-reported by large majority of post-test group, since 97.6% admitted knowledge implementation and 81.5 % recognized attitude improvement towards vaccinations.

Objective success in strengthening vaccine learning was demonstrated by the radical increase in the percentage of correct answers after the seminar (Tab. II).

All the questions except number 1, 3 and 9 achieved statistical significant improvements ($p < 0.001$) after the seminar with more than 80% of correct answers (2, 5, 6, 7) and about 60% for the remaining ones (questions 4, 8 and 10).

On the other hand, the query concerning the reduction in pathogenicity obtained by the modification of a toxin into a toxoid (number 3), that resulted in the second better performance in the pre-test, was the only one to show a paradoxical worsening after the intervention, decreasing to 56.8% of appropriate responses, though not statistically significant ($p = 0.80$).

Finally, answers from question 9, highlighted that almost 84% of students were already aware that the main motivation to influenza vaccination for health-care workers was to prevent flu transmission to patients; the

Tab. II. Percentage of correct and incorrect/missing answers in pre and post intervention among study participants stratified for each question.

Questions	Before intervention (n = 118) Correct answer (%)	Post intervention (n = 81) Correct answer (%)	p-value
1) Who invented the term vaccination?	65 (55.1)	73 (90.1)	< 0.001
2) Protection against smallpox obtained by vaccine administration was an example of antigenic cross-reactivity?	27 (22.9)	66 (81.5)	< 0.001
3) Modification of a toxin into a toxoid reduces the pathogenicity of the toxin itself?	71 (60.2)	46 (56.8)	0.800
4) Salk and Sabine vaccines have the same efficacy?	33 (28.0)	50 (61.7)	< 0.001
5) What sex and age anti-papillomavirus vaccination is recommended in Sicily to?	22 (18.6)	75 (92.6)	< 0.001
6) What is the schedule of anti-pneumococcal vaccination in subjects with underlying health conditions?	32 (27.1)	69 (85.2)	< 0.001
7) Which vaccine was wrongfully related to autism onset by Wakefield study?	45 (38.1)	67 (82.7)	< 0.001
8) Which vaccine adjuvant was reported to alter neuro-psychological development in children?	19 (16.1)	48 (59.3)	< 0.001
9) What might be the main reason for influenza vaccination adhesion among health-care workers?	99 (83.9)	74 (91.4)	< 0.05
10) What is the estimate of parents that actually did not vaccinate their children because of hesitancy in Italy?	45 (38.1)	51 (63.0)	< 0.01

seminar managed to further increase this percentage to 91% ($p < 0.05$). This data seems to be different comparing what observed during the past years in other Italian study among medical resident and general practitioner trainees [12, 15, 19].

Stratifying the survey for study courses as reported in table 3, a substantial improvement was depicted for all classes of degrees with a significant p-value (< 0.001). The best results were attained in particular by Medicine and Health Assistance undergraduates, suggesting that they could represent a key subject for vaccines promotion among general population and themselves. Stratifying the survey for study courses as reported in Table III, a substantial improvement was depicted for most of them (in particular for Medicine, Health Assistance, Health Biology, Pharmacy, Pharmaceutical and Chemical Technology with a significant p-value < 0.001). The best results were attained by Medicine and Health Assistance undergraduates, suggesting that they could represent a key subject for vaccines promotion among general population and themselves. Anyway, the fundamental role of the other professional figures in the Health Care System should target on the need of substantial improvement of their education and motivation as well.

The limits of our survey are mainly two. Questionnaires anonymity represented a limit since matching of pre-intervention answers to post-intervention ones for each student was not possible. As a consequence of that, we could not exclude that leaving of less prepared scholars before completing the post-intervention phase contributed in increasing overall percentage of correct answers, thus biasing the survey.

On the other hand, it favored the achievement of higher response rates (far beyond the half of pre-phase interviewed students), since nominal questionnaires would have been considered by students as examinations.

Moreover, the absence of statistically significant differences between pre- and post-phase students socio-demographic distribution, along with the striking improvement in correct answers percentages (more than doubled for most of the queries), support the efficacy of our multidisciplinary seminar in an effective knowledge and attitudes enhancement.

Another important limitation of the study is the relatively small sample size and that it was conducted at an heterogeneous audience with different background. Moreover, it was an optional, not curricular intervention and, clearly, it was focused on a single university [11]. A national survey, that may reveal regional variations, should be structured in the future.

Synoptically, our data demonstrated a lack of knowledge of the history, the local schedules and organization of vaccination service in Sicilian territory and most importantly about the mechanism of action and appropriate indications of vaccines. These results suggest the need to incorporate multidisciplinary courses into biomedical curricula in order to clear any confusion and to overcome any doubt in future HCWs who are going to promote and supply immunization against preventable and potentially lethal infectious diseases [20].

Hopefully, such specific education should begin early in their formative training, in order to increase vaccination coverage rates among medical students during clinical training and medical residents [12].

Tab. III. Number and percentage of correct and incorrect/missing answers for all questionnaire in pre and post intervention among study participants, stratified by study course. (N.A. Not Assessable).

Classes of degree (Total n° of students)	Pre intervention (n = 118)		Post intervention (n = 81)		p-value
	N° of correct answers	% of correct answers	N° of correct answers	% of correct answers	
Overall (n = 199)	458	38.8	629	77.6	< 0.001
Medicine (n = 84)	239	44.2	244	81.3	< 0.001
Master of Sciences (n = 55)	93	30.1	181	75.4	< 0.001
Basic Sciences (n = 53)	120	38.7	167	75.9	< 0.001
Missing data (n = 7)	6	30.0	27	54.0	0.25

Conclusions

The present explorative study dealt with the first attempt to organize and fulfill an integrated course focused on vaccinations and oriented to undergraduates of biomedical faculties in the South of Italy, assessing their knowledge before and after the seminar. Multidisciplinary lectures should be included early in university curricula since they could improve students attitudes and strikingly increase their learning about the topics discussed [16, 21].
Education of HCWs on active immunization should therefore potentiate their preventive medicine skills, an essential step to promote vaccination practices among the general population [22]. To further confirm the success of these kind of initiatives, the correlation with vaccination coverages (against influenza for instance) among undergraduates might represent an helpful indicator and an interesting field for future research.

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Authors' contributions

FV and AC conceived, designed, coordinated and supervised the research project. CC, VR, FD, NC and CD performed the integrated lectures. CM and GV collected data. CM, DDR, CC, VR, and GV performed the data quality control, optimized the informatics database, performed the statistical analyses and evaluated the results. CM, DDR and GV wrote the manuscript. All Authors revised the manuscript and gave their contribution to improve the paper. All authors read and approved the final manuscript.

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