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ORIGINAL ARTICLES

Distance learning training in genetics and genomics testing for Italian health professionals: results of a pre and post-test evaluation

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ABSTRACT

BACKGROUND: Progressive advances in technologies for DNA sequencing and decreasing costs are allowing an easier diffusion of genetic and genomic tests. Physicians' knowledge and confidence on the topic is often low and not suitable for manage this challenge. Tailored educational programs are required to reach a more and more appropriate use of genetic technologies.

METHODS: A distance learning course has been created by experts from different Italian medical associations with the support of the Italian Ministry of Health. The course was directed to professional figures involved in prescription and interpretation of genetic tests. A pretest-post-test study design was used to assess knowledge improvement. We analyzed the proportion of correct answers for each question pre and post-test, as well as the mean score difference stratified by gender, age, professional status and medical specialty.

RESULTS: We reported an improvement in the proportion of correct answers for 12 over 15 questions of the test. The overall mean score to the questions significantly increased in the post-test, from 9.44 to 12.49 (p-value < 0.0001). In the stratified analysis we reported an improvement in the knowledge of all the groups except for geneticists; the pre-course mean score of this group was already very high and did not improve significantly.

CONCLUSION: Distance learning is effective in improving the level of genetic knowledge. In the future, it will be useful to analyze which specialists have more advantage from genetic education, in order to plan more tailored education for medical professionals.

Key words: Distance education, Genetics, Genomics, Knowledge

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INTRODUCTION

Progressive advances in technologies for DNA sequencing, and more and more decreasing costs, are allowing an easier diffusion of genetic and genomic testing [1]. The proportion of healthy individuals that ask for genetic and genomic tests for common complex disorders is going to increase, and these questions will interest primary care physicians more than others [2, 3]. Nevertheless, genetic services and technologies are still underused by physicians due to a lack of specific knowledge [4]. Few studies have reported that physicians do not feel confident about genetic/genomic tests' prescription or interpretation for complex disorders [5-7]. Many researchers worldwide are calling for more comprehensive educational programs about genetics and genomics, as education is one of the most important steps needed to allow a correct use of genetic technologies [8, 9]. Continuous medical education is one of the fields where an improvement in genetics/genomics knowledge can be achieved more easily; e-learning and other modalities have been widely used in this context and have shown to be equally effective [10, 11]. A recent study conducted in Italy reported that physicians had a medium/low knowledge of predictive genomic testing for cancer, with a large proportion of them expressing a strong need for further education [12]. Since 2012, professionals from Italian universities, hospitals and regions have been involved in the national project "Predictive genomic tests: survey in some Italian regions for the establishment of a register of the offer, and promotion of training interventions for prescribers" of the Center for Diseases Control funded by the Italian Ministry of Health [13]. One of the aims of the project was to promote educational events for physicians who prescribe genetic and genomic tests. The aim of this study is to describe the distance learning course designed and promoted in the context of the project, as well as to report the results of the pretest and post-test in order to assess whether the course had any effect on physicians' knowledge on genetic and genomic testing.

MATERIALS AND METHODS

Educational design and content

The distance learning course, its content and the evaluation test were designed by experts from the Italian Network for Public Health Genomics (GENISAP), the Italian Society of Neurology (SIN), the Italian Society of Gynecology and Obstetrics (SIGO), the Italian Association of Medical Oncology (AIOM), the Italian Society of Family Medicine (SIMG) and local professional associations. The course was in Italian language and was titled "Applications of Public Health Genomics: evidences and recommendations for an appropriate use of genomic testing for complex diseases". The contents were organized in eight learning modules plus one module for exercitations and training, for a duration of eight hours, as reported in table 1.

Modules were made up of audio and video tools (the computer platform for the distance learning course was realized in cooperation with Prex S.p.A., an Italian society that supplies services for health education). The course was available online from March 2013 until March 2015.

Study participants

The course was primarily directed to general practitioners, neurologists, obstetricians-gynecologists, oncologists, and physicians working in preventive medicine departments, and to other health professionals potentially involved in the prescription of genetic tests or in the interpretation of the results of a genetic test for complex disease. The invitation to the course was diffused through public announcements, paper and computer invitations to the involved scientific societies, and local professional associations.

Data collection

Information on demographic characteristics (gender, age, region of origin), professional status and medical specialty were collected from participants. Genetic knowledge improvement was monitored by a pretest–post-test study. Namely, the test was made up of 15 multiple choice questions on the different topics of the course. Each question had only one correct answer, and the platform was structured as to register only the data of those participants who completed all the 15 questions of both the pretest and post-test. Participants accessed the post-test only after completing at least 80%

of the course modules. There was no time limitation for completing the questionnaire.

Statistical analysis

A descriptive analysis was conducted to report demographic characteristics, medical specialty, and professional status of participants.

We reported the results of each questions, for both the pretest and the post-test, as percentages of the correct answers before and after the course.

We calculated a score assigning one point for each correct answer, and we evaluated the pretest and post-test mean scores both overall as well as stratified by gender, age, medical specialty and professional status.

Comparison of the percentages of correct answer before and after the course was appraised by the McNemar's test, and comparison between the mean scores before and after the course was evaluated by the matched-pairs t-test.

Statistical analysis was performed using Stata software (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP).

RESULTS

Participants characteristics

One-hundred forty-two professionals completed all the questions of the pretest and post-test, and were therefore registered by the system. Table 2 shows the characteristic of course participants. Seventy-eight (54.9%) were males and 64 (45.1%) were females. The majority of participants was older than 50 years (66.9%), and came from Veneto region (35.2%). The most represented fields of work were primary care (44.4%), and public health/ healthcare system management (31.7%).

Knowledge

The results of the comparison between pretest and post-test are reported in Table 3. A significant improvement was reported for 12 out of 15 questions (80%). No significant difference has been demonstrated between pretest and post-test answers to question number 13. Oddly, question number 4 and number 5 were significantly more correct in the pretest evaluation; none of the collected covariates was significantly associated with this result in the stratified analysis (data not shown).

Table 4 reports the results of the comparison between the pretest and post-test mean scores both overall, as well as stratified by gender, age, medical specialty and professional status. The mean of the scores of the pretest and post-test were 9.44 and 12.49, respectively (p-value <0.0001).

After stratifying by medical specialty, all the specialties showed a significant improvement in the post-test mean score, except for the genetic specialty (p-value=0.80).

DISCUSSION

The aim of this study was to analyze the effect of a distance learning training course on genetics and genomics testing for common complex diseases on the physicians' knowledge. The results suggest that the course improved the general level of knowledge. However, the stratified analysis showed that the improvement was not equal for all participants based on their medical specialties. Those already working in a genetic context showed no significant improvement of their knowledge level. This might be due to several reasons, for example the too much ease of the questions in term of contents or phrasing, as well as the basic contents of the lessons. Nevertheless, we reported a significant improvement of knowledge for the other groups of specialists; this suggests that genetic courses could be more useful for those professionals without a specific education in genetics but dealing with genetic problems in their daily practice.

The Continuous Medical Education is internationally recognized as an useful instrument that guarantees that medical professionals remain updated with scientific innovation [14, 15]. In the last years, an increasing interest in promote courses on genetics/genomics topics is clearly emerging [8], due to the more and more available genetic technologies and to the not sufficient knowledge of medical professionals in this field [1, 4]. This tendency is confirmed also by the creation, in the last years, of several guidelines by American and European associations on the suitable contents of educational courses in genetics (e.g. National Coalition for Health Professional Education in Genetics, Cancer

TABLE 1

CONTENT OF THE MODULES OF THE COURSE		
MODULE N°	DURATION	SUBJECT
1	1,5 h	Public Health Genomics: state of the art in Italy and Europe
2	1,5 h	Basics notions on genetics and genetic/genomic testing
3	0,5 h	Genetic and genomic testing: diagnostic path
4	0,5 h	Genetic/genomic testing, genetic data, Informed Consent: Ethical, Legal and Social Implications (ELSI)
5	0,5 h	Oncology: which tumors, which genes
6	0,5 h	Neurology: fundamentals for daily practice
7	0,5 h	Gynecology: focus on Hereditary Breast Ovarian Cancer
8	1,5 h	Genetic services: role and care pathway. Genetic Counselling
9	1 h	Exercitations

TABLE 2

CHARACTERISTICS OF STUDY PARTICIPANTS (N=142)		
GENDER	N	%
Male	78	54.9
Female	64	45.1
AGE		
≤50 years	47	33.1
>50 years	95	66.9
REGION		
Emilia Romagna	25	17.6
Lazio	13	9.2
Liguria	11	7.8
Lombardia	29	20.4
Toscana	14	9.9
Veneto	50	35.2
MEDICAL SPECIALTY		
Genetics and genetic laboratory	15	10.6
Public health/healthcare system management	45	31.7
Primary care	63	44.4
Other specialties (oncology, gynecology, neurology)	19	13.4
PROFESSIONAL STATUS		
Freelance professionals	23	16.2
Employees	68	47.9
Freelance professionals conventioned with Healthcare System	50	35.2
Others	1	0.7

Genetics Education Program, Eurogentest, National Genetics and Genomics Education Centre). The efficacy of genetic courses in improving the level of knowledge of participants has been demonstrated in several experiences [16-19]. To our knowledge, however, this is the first study to report on a differential effect of the training course among geneticists compared with other groups of specialists. This could be explained by the fact that often such courses are not directly addressed to geneticists [17, 20-22]. Our study presents several limitations. First, we could have overestimated the positive effect of the course on knowledge, due to the fact that the system registered only the data of those participants who completed both the pretest and post-test. Therefore, it might be possible that other participants who did not complete the entire questionnaire were those who had lower improvement than others from the course. The second limitation is that our sample size was small, especially for the groups of geneticists and other specialties.

In conclusion, our study confirmed the utility of genetic and genomic courses in improving participants' knowledge on genetic testing for common complex disorders. It will be useful in the future to assess which specialties can have the most important benefit, in term of knowledge, from this kind of courses, in order to plan a more and more tailored education for medical professionals.

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TABLE 3

KNOWLEDGE OF PARTICIPANTS (N=142) BEFORE AND AFTER THE DISTANCE LEARNING COURSE ATTENDANCE

N°	QUESTION	CORRECT ANSWERS PRE-COURSE N (%)	CORRECT ANSWERS POST-COURSE N (%)	P-VALUE
1	What is the genetic heterogeneity?	87 (61.3)	134 (94.4)	<0.0001
2	Which of these analysis for the identification of prenatal chromosomic aneuploidy is less accurate?	57 (40.1)	135 (95.1)	<0.0001
3	Which is the most important aim of predictive medicine as it is defined in the National Prevention Plan?	42 (29.6)	95 (66.9)	<0.0001
4	Which is the aim of susceptibility tests?	114 (80.3)	95 (66.9)	0.02
5	Which is the definition of allelic variants with frequency >1% in the general population?	95 (66.9)	68 (47.9)	0.001
6	Which of the following answers about Direct-to-consumer genetic testing is true?	62 (43.7)	84 (59.2)	0.007
7	What is a cascade screening?	92 (64.8)	117 (82.4)	0.001
8	Which patients are referred for genetic counseling?	121 (85.2)	139 (97.9)	0.0003
9	Which is the correct behavior for a general practitioner dealing with a family with a potential familial predisposition to a certain neoplasia?	107 (75.4)	136 (95.8)	<0.0001
10	What kind of genetic transmition does mitochondrial heredity follow?	89 (62.7)	111 (78.2)	0.003
11	Which is the genetic transmition of cystic fibrosis?	114 (80.3)	141(99.3)	<0.0001
12	Which are the most important structures that take part to genetic services?	96 (67.6)	121 (85.2)	0.0009
13	Which of the following characteristics are fundamental for a good diagnostic-therapeutic pathway?	132 (93.0)	126 (88.7)	0.31
14	What is the familial genetic anamnesis?	96 (67.6)	130 (91.6)	<0.0001
15	Which of the following is not an alerting sign in a family tree?	37 (26.1)	141 (99.3)	<0.0001

TABLE 4

SCORE OF KNOWLEDGE OF PARTICIPANTS (N=142) BEFORE AND AFTER THE DISTANCE LEARNING COURSE ATTENDANCE

	MEAN SCORE BEFORE	MEAN SCORE AFTER	DIFFERENCE	P-VALUE
Overall	9.44	12.49	3.04	<0.0001
GENDER				
Male	9.3	12.7	3.4	<0.0001
Female	9.7	12.2	2.5	<0.0001
AGE				
≤50 years	9.9	12.7	2.8	<0.0001
> 50 years	9.2	12.4	3.2	<0.0001
MEDICAL SPECIALTY				
Genetics and genetic laboratory	12.1	12.2	0.1	0.8
Hygiene, epidemiology, management	9.8	12.6	2.8	<0.0001
General practice	8.6	12.5	3.9	<0.0001
Other specialties (oncology, gynecology, neurology)	9.4	12.2	2.8	0.0008
PROFESSIONAL STATUS				
Freelance professionals	9.4	12.3	2.9	0.0001
Employees	10	12.6	2.6	<0.0001
Freelance professionals with Healthcare System convention	8.7	12.5	3.8	<0.0001

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