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Original article

Knowledge and attitudes of employees at the Faculty of Medicine Foča about the concept and ethical issues in genetics

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Summary

Introduction. The improvement of new genetic testing strategies are getting to be progressively integrated into different parts of medicine. Progress has not been accompanied by the satisfactory level of genetic education but it has been accompanied with many ethical issues concering testing among medical students, doctors and the common population. Subsequently, the requirements for an adequate education in genetics for each group are expanding. The main goal of this paper is to examine attitudes regarding different aspects of genetic testing, and to determine differences in attitudes with respect to socio-demographic characteristics among the employees at the Faculty of Medicine in Foča, University of East Sarajevo.

Methods. Sixty-one employees of four study programs of the Faculty of Medicine in Foča participated in the research. An anonymous survey was conducted based on the voluntary consent of the respondents. It included two parts. The first part of the survey included socio-demographic questions (age, gender, educational level). The second part consisted of eight questions about genetic testing, which were related to the ethical justification of genetic testing.

Results. Out of the total number of respondents, 90.2% of respondents would undergo genetic testing for health reasons. A significantly higher number of respondents who had a master's degree (96.2%) would undergo genetic testing, compared to (88.9%) respondents who had an undergraduate degree (p=0.001). A significantly larger number of older respondents (29.6% over the age of 36) considered abortion justified in case of prenatal diagnosis of cancer at a later age, compared to 8.8% of the respondents belonging to the younger age group (from 26 to 35) (p=0.036).

Conclusion. We have shown that there is a different understanding among the population of different educational status and different age. Further on in the near future, it is our opinion that seminars should be organized regarding this science, in order to promote its importance.

Keywords: genetic testing, ethics, abortion

Introduction

Growing information about the human genome creates modern therapeutic insights, which can influence people who use health care administrations, and confront them with a new type of decision-making. How people handle such choices depends on their information, and on their view of human genetics. The capacity of people to form these decisions on the premise

of genetic data generally depends on communication with health care specialists. Medical faculty employees have to keep up with the scientific progress that they need to pass on to the next generation of doctors, so their knowledge and attitude about the concept and ethical issues in genetic testing and generally genetics is important [1].

The development of genetics contributed to noticing the connection between certain genes and diseases, which further conditioned the development of various diagnostic molecular tests. The aim of these tests is to detect individual genetic markers which presence or absence is a prerequisite for the occurrence of various diseases [2]. Genetic diagnostics and methods have gained an increasingly important role in medicine with the development of knowledge about gene mutations as a factor in the occurrence of many diseases [3]. Genetic research is progressing more and more and every day a large number of scientists discover new markers.

In relation to the level of observation, all genetic tests can be divided into: molecular genetic tests analyzing individual genes, chromosomal tests analyzing entire chromosomes and biochemical tests studying the amount and activity of individual proteins [4]. Depending on the purpose of the test, there are several different tests, such as: predicative and presymptomatic testing, prenatal testing, forensic testing and ancestry testing [5]. According to the indications, genetic testing is divided into: diagnostic, determination of carrier status, screening in the population and pharmacogenomic [6].

There are many questions about the application of prenatal diagnostics and the ethical acceptance of abortion. One of these is preimplantation genetic testing, which began in the eighties of the last century. Preimplantation testing, as the earliest form of prenatal diagnosis, greatly increased the success of embryo transfer. This type of prenatal diagnosis is justified in persons who are at risk of having offspring with a hereditary disease or chromosomal aberration, also in persons with infertility, recurrent miscarriages, failed fertilizations or the existence of a child with a certain disease [7]. Prenatal diagnostics can be non-invasive and invasive. Invasive methods are used only when an anomaly is suspected in high-risk pregnancies [8].

Given that invasive methods can harm both the fetus and the mother, in recent years more and more effort has been invested in the development of non-invasive methods. The most common invasive methods used today are biopsy of chorionic villi and amniocentesis, however, non-invasive methods, ultrasound or measurement of various concentrations of biochemical parameters are used much more often [9]. Today, non-invasive genetic tests are extremely popular, in which fetal cells are isolated from the mother's blood sample and further screening for chromosomal aberrations is carried out [10].

Confidentiality in the context of genetics means that the results of genetic testing will not be disclosed to third parties, while the principle of fairness means that testing will be available to all social classes equally [11]. Special attention is focused on analyzing the consequences that certain results can have on the concept of race and ethical community. Namely, it is feared that differences in genetic material could encourage the development of racial and ethical discrimination [12]. For this reason, during each test, informed consent is requested from the tested person, parents or guardians, during which the person is informed in detail about the testing that is being performed, as well as about its purpose [13]. The insufficient development of the appropriate tests and the inaccuracy of the data greatly affect the self-determination of individuals and the consent itself [14].

The main goal of this paper is to determine and to explore attitudes regarding different aspects of genetic testing, and to determine differences in attitudes with respect to

socio-demographic characteristics among the employees at the Faculty of Medicine in Foča, University of East Sarajevo.

Methods

Study design

The research was conducted as a cross-sectional study in the population of employees of Faculty of Medicine. The sample consisted of 61 employees of four study programs (Medicine, Dentistry, Health Care and Special Education and Rehabilitation) working at Faculty of Medicine in Foča, University of East Sarajevo. The study was conducted in May 2019. Prior to the start of the research, the consent of the competent institutions was obtained, in writing. Participation in the study was voluntary, and the survey was anonymous.

Instrument

Data were collected by questionnaire which was orginally designed for the purpose of this study, based on the review of relevant literature. The instrument included two parts. The first part was related to socio-demographic characteristics age, gender and educational structure (secondary school, undergraduate degree, master's degree and doctorate). The second part consisted of eight questions about genetic testing, which were related to the ethical justification of genetic testing. Six of them were 2 way closed-ended questions (yes/no) and two questions had a Likert scale which contained 4 response options.

Statistical analyses

The methods of descriptive and analytical statistics were used in the paper. Among the methods of descriptive statistics the relative numbers for categorical variables were used. Among the methods of analytical statistics nonparametric chi-square test was used to assess the difference between the groups divided by gender, age and education. The usual value of $p<0.05$ was taken as the level of statistical significance of differences. Results were statistically analyzed in SPSS software package version 21.0 (Statistical Package for Social Sciences SPSS 21.0 Inc, USA).

Results

Socio-demographic characteristics of the respondents

The study included 61 respondents aged 26 and above, among whom 55.7% of the respondents belonged to the age group of 26 to 35 years, and 44.3% of the respondents belonged to the age group of over 36 years. There were 17 (27.9%) men and 44 (72.1%) women among the respondents. When it comes to the respondents' education, 3.3% completed secondary school, 14.8% had an undergraduate degree, 42.6% master's degree, and 39.3% of respondents have completed doctoral studies (Table 1). The closely related professions of the respondents were not inquired.

Table 1. Gender, education and age of respondents

Socio-demographic characteristics	Number (%)
Gender	
Male	17 (27.9)
Female	44 (72.1)
Education	
Secondary school	2 (3.3)
Undergraduate degree	9 (14.8)
Master's degree	26 (42.6)
Doctorate	24 (39.3)
Age	
26–35 years old	34 (55.7)
> 36 years old	27 (44.3)

Attitudes about genetic testing

As we can see from table 2, 88.5% of respondents were familiar with the concept of genetic testing, compared to 11.5% of respondents who were

not familiar. Of the total number of respondents, 90.2% would undergo genetic testing for health reasons, 4.9% would undergo it in case of a life-threatening disease, 1.6% would undergo it only in case they have symptoms, and the remaining 3.3% of respondents would not undergo genetic testing for health reasons. When it comes to genetic testing out of curiosity (identification of origin, carrier of risk factors for various diseases, nutritional and sports tests), more than half of the respondents (57.4%) would undergo testing in contrast to 42.6% who would not. Of the total number of respondents, 70.5% did not consider modern methods of prenatal diagnosis to be ethically justified, compared to 29.5% of respondents who considered such tests to be ethically justified. The majority of respondents (93.7%) considered medically induced abortions to be justified in case genetic abnormalities of the fetus had been detected with the help of modern methods of prenatal diagnosis, in contrast to 6.6% of respondents who had the opposite opinion. Eighty-two percent of respondents did not consider medically induced abortions justified if, using modern methods of prenatal diagnosis, it was discovered that the fetus had a predisposition to develop cancer at a later age, compared to 18% of respondents who justified medically induced abortion in this case. In the case of learning that a family member was a carrier of a genetic disease, the majority of respondents (70.5%) who had a desire to learn about genetic disease would turn to a doctor, 26.6% to a nearby institute, 1.6% to a priest, and the remaining 1.6% of respondents would look the information about genetic disease on the Internet. The majority of respondents (86.9%) did not think that the existence of a genetic disease would damage their social relationships, compared to 13.1% of respondents who believed that the existence of a genetic disease would damage their social relationships.

Socio-demographic differences in attitudes towards genetic testing

Between respondents of different genders, a statistically significant difference ($\chi 2=8.299$; $p=0.040$) was observed regarding the respondents' attitude towards genetic testing for health reasons, with a significantly larger number of female respondents (95.5%) believing that they would undergo genetic testing for health reasons, compared to 76.5% of respondents of the opposite sex. Between the aforementioned groups of respondents, a statistically significant difference ($\chi 2=4.730$; $p=0.030$) was observed in relation to the opinion of respondents on the justification of medically induced abortion in the event that genetic abnormalities of the fetus were determined by prenatal diagnostic methods, with 97.7% of female respondents who considered abortion justified in the case of prenatal diagnosis of genetic abnormalities of the fetus, compared to 82.4% of male respondents. No statistically significant difference was observed between respondents of different genders when it comes to the concept of genetic testing, undergoing genetic testing out of curiosity, the ethical justification of modern methods of prenatal diagnosis, the justification of abortion in the case of prenatal diagnosis of cancer, the spread of knowledge about the genetic disease of a family member and the disruption of social relations in the case of genetic disease (Table 2).

As we can see from table 3, a high statistically significant difference ($\chi 2=44.532$; $p=0.001$) was observed between respondents of different levels of education in terms of undergoing genetic testing for health reasons, with a significantly larger number of respondents who had a master's degree (96.2%) compared to 88.9% of respondents who had an undergraduate degree. No statistically significant difference was observed between respondents of different levels of education when it comes to the concept of genetic testing, undergoing genetic testing out of curiosity, the ethical justification

of modern methods of prenatal diagnosis, the justification of abortion in the case of prenatal diagnosis of genetic abnormalities of the fetus, prenatal diagnosis of cancer, spreading knowledge about genetic disease of the family member and disruption of social relations in the case of genetic disease (Table 3).

Table 2. Knowledge and attitudes regarding genetic testing with respect to gender

	Gender Number (%)		Total Number (%)	$\chi 2$ - F	p
	Male	Female			
Familiarity with the concept of genetic testing					
Yes	14 (82.4)	40 (90.9)	54 (88.5)	0.884	0.347
No	3 (17.6)	4 (9.1)	7 (11.5)		
Readiness to undergo genetic testing for health reasons					
Yes	13 (76.5)	42 (95.5)	55 (90.2)		
Only if it is life-threatening	1 (5.9)	2 (4.5)	3 (4.9)	8.299	0.040
Only if I have symptoms	1 (5.9)	0 (0)	1 (1.6)		
No	2 (11.8)	0 (0)	2 (3.3)		
Readiness to undergo genetic testing out of curiosity					
Yes	10 (58.8)	25 (56.8)	35 (57.4)	0.020	0.887
No	7 (41.2)	19 (43.2)	26 (42.6)		
Justification of modern methods of prenatal diagnosis					
Yes	5 (29.4)	13 (29.5)	18 (29.5)	0.001	0.992
No	12 (70.6)	31 (70.5)	43 (70.5)		
Justification of abortion in the case of prenatal diagnosis of genetic abnormalities of the fetus					
Yes	14 (82.4)	43 (97.7)	57 (93.4)	4.730	0.030
No	3 (17.6)	1 (2.3)	4 (6.6)		
Justification of abortion in the case of prenatal diagnosis of cancer in the fetus					
Yes	4 (23.5)	7 (15.9)	11 (18.0)	0.482	0.488
No	13 (76.5)	37 (84.1)	50 (82.0)		
Source of information about the genetic disease					
Internet	0 (0)	1 (2.3)	1 (1.6)		
Priest	1 (5.9)	0 (0)	1 (1.6)		
Nearby institute	5 (29.4)	11 (25.0)	16 (26.2)	3.178	0.365
Doctor	11 (64.7)	32 (72.7)	43 (70.5)		
Disruption of social relations in case of genetic disease					
Yes	4 (23.5)	4 (9.1)	8 (13.1)	2.243	0.134
No	13 (76.5)	40 (90.9)	53 (86.9)		

Table 3. Differences in knowledge and attitudes regarding genetic testing with respect to educational level

	Education Number (%)				Total Number (%)	χ^2 - F	p
	Secondary school	Under-graduate degree	Master's degree	Doctorate			
Familiarity with the concept of genetic testing							
Yes	2 (100)	7 (77.8)	25 (96.2)	20 (83.3)	54 (88.5)	3.409	0.333
No	0 (0)	2 (22.2)	1 (3.8)	4 (16.7)	7 (11.5)		
Readiness to undergoing genetic testing for health reasons							
Yes	0 (0)	8 (88.9)	25 (96.2)	22 (91.7)	55 (90.2)		
Only if it is life-threatening	1 (50.0)	0 (0)	0 (0)	2 (8.3)	3 (4.9)	44.532	0.001
Only if I have symptoms	1 (50.0)	0 (0)	0 (0)	0 (0)	1 (1.6)		
No	0 (0)	1 (11.1)	1 (3.8)	0 (0)	2 (3.3)		
Readiness to undergoing genetic testing out of curiosity							
Yes	0 (0)	7 (77.8)	14 (53.8)	14 (58.3)	35 (57.4)	4.365	0.225
No	2 (100)	2 (22.2)	12 (46.2)	10 (41.7)	26 (42.6)		
Justification of modern methods of prenatal diagnosis							
Yes	0 (0)	3 (33.3)	7 (26.9)	8 (33.3)	18 (29.5)	1.153	0.764
No	2 (100)	6 (66.7)	19 (73.1)	16 (66.7)	43 (70.5)		
Justification of abortion in the case of prenatal diagnosis of genetic abnormalities of the fetus							
Yes	2 (100)	8 (88.9)	23 (88.5)	24 (100)	57 (93.4)	3.182	0.364
No	0 (0)	1 (11.1)	3 (11.5)	0 (0)	4 (6.6)		
Justification of abortion in the case of prenatal diagnosis of cancer in the fetus							
Yes	0 (0)	0 (0)	5 (19.2)	6 (25.0)	11 (18.0)	3.233	0.357
No	2 (100)	9 (100)	21 (80.8)	18 (75.0)	50 (82.0)		
Source of information about the genetic disease							
Internet	0 (0)	0 (0)	1 (3.8)	0 (0)	1 (1.6)		
Priest	0 (0)	1 (11.1)	0 (0)	0 (0)	1 (1,6)	9.270	0.413
Nearby institute	0 (0)	1 (11.1)	7 (26.9)	8 (33.3)	16 (26.2)		
Doctor	2 (100)	7 (77.8)	18 (69.2)	16 (66.7)	43 (70.5)		
Disruption of social relations in case of genetic disease							
Yes	0 (0)	0 (0)	2 (7.7)	6 (25.0)	8 (13.1)	5.307	0.151
No	2 (100)	9 (100)	24 (92.3)	18 (75.0)	53 (86.9)		

Between respondents of different ages, a statistically significant difference (p=0.036) was observed regarding the justification of abortion in the case of prenatal diagnosis of cancer at a later age, so that a significantly larger number of older respondents (29.6%) (>36 years) considered abortion justified in that case, compared to 8.8% of respondents who belonged to the younger age group (from 26 to 35). No statistically significant difference was observed between the mentioned groups of respondents when it comes to the notion of genetic testing, undergoing genetic testing for health reasons, undergoing genetic testing out of curiosity, the ethical justification of modern methods of prenatal diagnosis, the justification of abortion in the case of prenatal diagnosis of genetic abnormalities of the fetus, spreading knowledge about genetic disease of a family member and disruption of social relations in the case of genetic disease (Table 4).

Table 4. Differences in knowledge and attitudes regarding genetic testing with respect to age groups

	Age Number (%)		Total Number (%)	$\chi 2$ - F	p
	26-35 years old	36 > years old			
Familiarity with the concept of genetic testing					
Yes	29 (85.3)	25 (92.6)	54 (88.5)	0.789	0.374
No	5 (14.7)	2 (7.4)	7 (11.5)		
Readiness to undergo genetic testing for health reasons					
Yes	30 (88.2)	25 (92.6)	55 (90.2)		
Only if it is life-threatening	1 (2.9)	2 (7.4)	3 (4.9)	3.024	0.388
Only if I have symptoms	1 (2.9)	0 (0)	1 (1.6)		
No	2 (5.9)	0 (0)	2 (3.3)		
Readiness to undergo genetic testing out of curiosity					
Yes	20 (58.8)	15 (55.6)	35 (57.4)	0.066	0.798
No	14 (41.2)	12 (44.4)	26 (42.6)		
Justification of modern methods of prenatal diagnosis					
Yes	8 (23.5)	10 (37.0)	18 (29.5)	1.320	0.251
No	26 (76.5)	17 (63.0)	43 (70.5)		
Justification of abortion in the case of prenatal diagnosis of genetic abnormalities of the fetus					
Yes	31 (91.2)	26 (96.3)	57 (93.4)	0.644	0.422
No	3 (8.8)	1 (3.7)	4 (6.6)		
Justification of abortion in the case of prenatal diagnosis of cancer in the fetus					
Yes	3 (8.8)	8 (29.6)	11 (18.0)	4.407	0.036
No	31 (91.2)	19 (70.4)	50 (82.0)		
Source of information about the genetic disease					
Internet	1 (2.9)	0 (0)	1 (1.6)		
Priest	1 (2.9)	0 (0)	1 (1.6)	1.802	0.615
Nearby institute	8 (23.5)	8 (29.6)	16 (26.2)		
Doctor	24 (70.6)	19 (70.4)	43 (70.5)		
Disruption of social relations in case of genetic disease					
Yes	3 (8.8)	5 (18.5)	8 (13.1)	1.241	0.265
No	31 (91.2)	22 (81.5)	53 (86.9)		

Discussion

In contrast to our country, in Western countries genetic testing is very popular and is represented in various spheres of medicine. In this regard, there is a need for greater education of health workers about the advantages and disadvantages of genetic testing, as well as the development of genetic counseling. Our research was based on the employees of the Faculty of Medicine, Dentistry, Health Care and Special Education and Rehabilitation, their knowledge of the concept of genetic testing, as well as determining their attitude towards different aspects of genetic testing. Almost all respondents would undergo genetic testing for health reasons, 4.9% of respondents would undergo genetic testing if there was a life-threatening disease, 1.6% would be confirmed if they had symptoms, while the rest of 3.3% would not undergo testing at all. Female respondents expressed readiness to get tested for health reasons in significantly larger proportion, in contrast to a study conducted in America, where 63% of men had a positive impression of genetic research, compared to 46% of people of the opposite sex [15]. However, US residents believe that in the event of a complete genetic investigation, tendencies for the occurrence of certain diseases would be revealed, and thus they would be denied health insurance - as many as 22% of respondents have this opinion [16]. Moreover, in the event that prenatal diagnostic methods determine appropriate abnormalities of the fetus, significantly larger proportion of women consider abortion justified in case of the positive prenatal diagnosis. Similar research was conducted in Serbia, and special attention should be paid to those results. Namely, 47.3% of women on such prenatal test gave the man the right to decide about the offspring, while only 34% believe that women have the right to decide about their bodies and inheritance [17]. When we compare the results of our research with the attitudes of the population of the United States of America, out of 1,824 women, the majority consider abortion justified in the presence of abnormalities, while 33% of respondents denied this attitude [18]. Because of these results, it is very important to increase the knowledge of pregnant women about prenatal diagnosis and its outcomes [9].

An equally important issue is abortion in cases of confirmed anomalies. A pregnancy that is older than 10 weeks must not, in principle, be terminated, unless there is clear medical evidence that the child has mental or physical abnormalities, that the conception occurred as a result of a criminal act, rape, or when it is established on the basis of medical documentation that there is not another way to save the life of the mother as a carrier of the fetus [19]. According to this paper, we found that our respondents did not differ much from their colleagues from countries in the region, primarily Croatia. A patient who is diagnosed with a corresponding fetal anomaly goes through various ethical, moral and religious dilemmas.

Also, in our research, a highly statistically significant difference was observed between respondents with different levels of education in terms of undergoing genetic testing for health reasons, whereby a significantly larger number of respondents who had the master's degree, would undergo testing, compared to respondents who had the undergraduate degree.

We found that a huge impact had higher educational level, resulting in development of positive attitudes to genetic testing. The study conducted at the Faculty of Medicine in Rijeka showed the importance of educating both students and medical workers about genetic factors and the occurrence of various diseases, since fifth and sixth year students showed that they did not sufficiently understand the importance of human genetics as the science and its application [20].

Therefore, it is necessary to increase the education and awareness of workers and

patients about this increasingly applied branch of medicine [21].

Through this education, they would be informed about genetic tests, various ways of testing, their safety and accuracy, as well as about a series of legal regulations confirming their safety [22]. The development of genetic counseling in the health sector is extremely important.

Conclusion

Based on the results of this study, we conclude that there is sufficient education and awareness of the employees of the Faculty of Medicine in Foča, but it is necessary to improve the education about genetic testing, its application, as well as its positive and negative consequences. There is a different understanding among employees of different educational status. Further on in the near future, it is our opinion that seminars should be organized regarding this science, in order to promote its importance. Also, ethical issues represent a major problem that conflicts with scientific achievements. Further investigations in our country of ethical norms and dilemmas we face in various testing are necessary. We believe that many ethical issues will be resolved once these tests are more reliable. Finally, it should be emphasized that the future of genetics, the ways in which it will be used and whether it will be misused depends solely on us.

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Ethical approval. The Ethics Committee of the University East Sarajevo, Faculty of Medicine Foča, Republic of Srpska, Bosnia and Herzegovina, approved the study and informed consent was obtained from all individual respondents. The research was conducted according to the Declaration of Helsinki.

Conflicts of interest. The authors declare no conflict of interest.

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Znanje i stavovi zasposlenih na Medicinskom fakultetu Foča o pojmu i etičkim pitanjima u genetici

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Uvod. Poboljšanje novih strategija u genetskom testiranju progresivno se pripaja u različite dijelove medicine. Napredak nije u zadovoljavajućem nivou usaglašen sa obrazovanjem iz genetike i praćen je mnogim etičkim dilemama koje se tiču testiranja među studentima medicine, ljekarima i zajednicom. Posljedično, povećavaju se zahtjevi za adekvatnim obrazovanjem iz genetike za pomenute grupe. Osnovni cilj ovog rada je da se ispitaju stavovi o različitim oblicima genetskog testiranja, te da se utvrde razlike u stavovima u pogledu socio-demografskih karakteristika među zaposlenima na Medicinskom fakultetu Foča, Univerziteta u Istočnom Sarajevu.

Metode. U istraživanju je učestvovao 61 radnik četiri studijska programa Medicinskog fakulteta Foča. Rađena je anonimna anketa na bazi dobrovoljnog pristanka ispitanika. Obuhvatala je dva dijela. Prvi dio se odnosio na socio-demografske karakteristike (starost, pol, obrazovanje). Drugi dio se sastojao od osam pitanja o genetičkom testiranju, koja su se odnosila na etičku opravdanost genetskog testiranja.

Rezultati. Od ukupnog broja ispitanika, 90,2% ispitanika bi se podvrglo genetskom testiranju iz zdravstvenih razloga. Značajno veći broj ispitanika koji su magistrirali (96,2%) bi se podvrgao genetskom testiranju, naspram (88,9%) ispitanika koji su završili osnovne studije (p=0,001). Značajno veći broj starijih ispitanika (29,6% starijih od 36 godina) smatra opravdanim abortus u slučaju prenatalne dijagnostike tumora u kasnijoj životnoj dobi, u odnosu na 8,8% ispitanika koji pripadaju mlađoj starosnoj grupi (od 26 do 35 godina) (p=0,036).

Zaključak. Pokazali smo da među stanovništvom različitog obrazovnog statusa i dobi postoji različito shvatanje. S tim u vezi, smatramo da bi u budućnosti trebalo pokrenuti seminare koji bi unaprijedili značaj ove nauke.

Ključne riječi: genetsko testiranje, etika, abortus