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Determination of Knowledge, Attitude, Behavior about Genetically Modified Organisms in Nursing School Students

Turker Turker (*), Necmettin Kocak (**), Ibrahim Aydin (***), Hakan İstanbulluoğlu (****), Nuri Yildiran (****), Yusuf Ziya Turk (*****), Selim Kilic (******)

ABSTRACT

BACKGROUND: The aim of this study is finding out the knowledge, attitudes and behaviors of nursing school students regarding Genetically Modified Organisms.

METHODS: This cross-sectional study was conducted students of Gulhane Military Medical Academy Nursing School on February–May 2010. In our study the sample is not selected, the research tried to involve the whole all population (n=354). The socio-demographical characteristics of the participants as well as their knowledge, attitudes and behaviors on Genetically Modified Organisms were gathered by a structured questionnaire developed by the researchers.

RESULTS: Of the participants 82.9% (n=287) stated that people in the community weren't adequately informed about GM foods, 77.7% (n=269) stated that they considered GM food production as risky for all living things in nature, 85.5% (n=296) stated that the food they currently preferred might include some GM products.

CONCLUSION: The risk perceptions of the participants of our study, who are going to make up the future workforce in health sector, was found out to be high while the results showed that they had insufficient information on the issue. It is recommended that educational activities aiming at eliminating the lack of information of students should be included in the curriculum plans.

Key words: *genetically modified organism, Knowledge, attitude, behavior.*

ÖZET

Hemşirelik yüksekokulu öğrencilerinin genetiği değiştirilmiş organizmalar hakkındaki bilgi, tutum ve davranışlarının belirlenmesi

AMAÇ: Bu çalışmanın amacı hemşirelik yüksekokulu öğrencilerinde genetiği değiştirilmiş organizmalar hakkında bilgi, tutum ve davranışlarını ölçmektir.

YÖNTEM: Bu kesitsel çalışma Gülhane Askeri Tıp Akademisi Hemşirelik Yüksek Okulu öğrencilerinde Şubat-Mayıs 2010 tarihleri arasında yapılmıştır. Herhangi bir örneklem seçimi yapılmamış olup, araştırmacı popülasyonun tamamına ulaşmaya çalışmıştır. Katılımcıların sosyodemografik özellikleri ve genetiği değiştirilmiş organizmalar hakkındaki bilgi, tutum ve davranışları araştırmacılar tarafından geliştirilen soru formu ile toplanmıştır.

BULGULAR: Katılımcıların %82.9'u (n=287) toplumun GDO'lu gıdalar hakkında yeterince bilgilendirilmediğini, %77.7'si (n=269) genetiği değiştirilmiş gıda üretimini doğadaki tüm canlılar açısından riskli bulduklarını, %85.5'i (n=296) şu anda satın aldığı gıdalarda genetiği değiştirilmiş ürünlerin olabileceğini belirtmiştir.

SONUÇ: Geleceğin sağlık çalışanlarını oluşturacak olan araştırma grubumuzun GDO'lara yönelik risk algıları yüksek fakat bilgi düzeylerinin yetersiz olduğu saptanmıştır. Bilgi açıklarını gideren eğitim etkinliklerinin öğrencilerin eğitim öğretim planlarına eklenmesinin uygun olacağı düşünülmektedir.

Anahtar kelimeler: *genetiği değiştirilmiş organizmalar, bilgi, tutum, davranış.*

* Turkish Armed Forces Health Command, Ankara, Turkey.
** Turkish Coast Guard Command, Ankara, Türkiye.
*** Ministry of Defence, Ankara, Turkey.
*** Turkish General Staff, Ankara, Turkey.
**** MD, Assistant Profesor Gulhane Military Medical School Department of Military Health Services, Ankara, Turkey.
***** Gulhane Military Medical School Department of Public Health, Division of Epidemiology, Ankara, Turkey.

Reprint request: Necmettin Kocak, Turkish Coast Guard Command, 06018, Ankara, Türkiye
E-mail: drnkocak@gmail.com

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Introduction

Any organism which is transferred the modified genetic material that has been isolated -either from the same or a different organism- is called Genetically Modified Organism (GMO) or transgenic organism (1-3).

Today, GMO's are used in many different sectors, notably agriculture and health. Use of GMO's in the agricultural sector enables cultivation of plants which give higher yield and which are more resistant to herbicides; to the diseases caused by viruses and pests; and to the environmental conditions such as drought, cold and saltiness (4, 5). However, use of GMO's may lead to loss of genetic diversity in plants; standardization of the plant species; loss of diversity of nature; and the unintentional gene transfer due to contamination of the non-GMO plants cultivated in other lands by the modified genes. Moreover, useful insects which light on the plants provided with pest-resistance characteristic die, which may possibly disturb the natural balance (2,6,7).

Plants most produced via GMO technology throughout the world can be listed as soy, corn ad cotton. Cultivation of the GMO products -which started for the first time in 1996- has increased gradually and, as of 2009, the total land used for cultivation of the GMO products in 25 different countries increased to 134 million hectares. With 64 million hectares of land allocated for GMO products, the United States of America (USA) ranks first in the list of the countries cultivating GMO products (8-10).

Studies made nowadays on GMO's, importance of which increases gradually, have found that there are big differences between people's knowledge, attitudes and behaviours related to GMO's (11-21).

In this scope, present study was conducted to detect knowledge, attitudes and behaviours of a nursing high school students.

Material And Method

This study, designed as a cross-sectional study, was conducted with the participation of the students attending at Nursing High School of Gulhane Military Medical Academy (GMMA) in February-March 2010 period. All students of nursery consist of girl. In our study the sample is not selected, the research tried to involve the whole population.

Study data were collected by using the questionnaire form developed by the researchers after the literature review. At the beginning, the validity and reliability of the questionnaire have not been performed it has formed by the researchers after the literature searching. In our study questionnaire consists of two sections. These sections are, respectively, the questionnaire form included questions aimed to learn socio-demographic characteristics of the participant students and to detect their knowledge, attitudes and behaviours related to Genetically Modified Organism (GMO)'s.

After the required ethical permits were obtained from the Ethical Board of Gulhane Military Medicine Faculty (GMMF), the questionnaire form was administered, under the observation of the researchers, to the students of Nursing High school of GMMF, who volunteered to participate in the study.

All of those who had agreed to participate in the study were included in the research. It has planned to exclude the participant who filled the questionnaire within the scope of research unsuitable.

Data obtained through the questionnaire were analyzed via SPSS 15.0 statistical package programme. Numerical and percentage values were used in the interpretation of the study data. Chi-square test was used to compare the socio-demographic characteristics of the participants with their GMO-related attitudes and behaviours. Statistical significance was considered $p<0.05$.

Results

Target population of the study consisted of 354 students, 346 of whom (%97.7) agreed to participate in the study. The most crowded classrooms included in the scope of the present study were the 1st-grade classrooms. Families of more than the half of the participants were found to live in a city centre, mothers of 3/5 were recorded to be primary school graduates and fathers of approximately 1/3 were revealed to be senior high school graduates. Some socio-demographic characteristics of the study participants are listed in Table 1.

Three-fourths (3/4) of the participants stated that they heard the term "GMO" on TV/radio while 9.2% of them heard it through the questionnaire form prepared in the scope of the present study. Nearly 1/3 of the participants checked "soy, corn and cotton" choice correctly for the statement of "The

Table I. Some socio-demographic characteristics of the study participants (Ankara, 2010)

		N	*%*
Grade of the participant	1	109	31.5
	2	84	24.3
	3	86	24.9
	4	67	19.4
Place of residence of participant's family	Village/Town	45	13.0
	District	98	28.3
	City	199	57.5
	No answer	4	1.2
Educational background of participant's mother	Literate or illiterate	13	3.8
	Primary school graduate	194	56.1
	Secondary school graduate	46	13.3
	Senior high school graduate	78	22.5
	High school/university graduate	15	4.3
Educational background of participant's father	Literate or illiterate	4	1.2
	Primary school graduate	112	32.4
	Secondary school graduate	47	13.6
	Senior high school graduate	118	34.1
	High school/university graduate	65	18.8

Table II. **GMO Knowledge of the Participants (Ankara 2010)**

		N	*%*
The source from which you have heard the term GMO (More than one choice was checked by the students)	Internet	75	21.7
	Television/radio	257	74.3
	Newspaper	96	27.7
	Friend	77	22.3
	The questionnaire	32	9.2
Biotechnological product cultivated most in the scope of GMO	Soy, corn, cotton	112	32.4
	Tomato, pepper, courgette	202	58.4
	Mango, kiwi, papaya	2	0.6
	Potato, wheat, aubergine	19	5.5
	No answer	11	3.2
The country with the highest GMO production	The USA	202	58.4
	India	15	4.3
	Brazil	9	2.6
	China	82	23.7
	No answer	38	11.0

Table III. **Participant Knowledge, Attitudes and Behaviours about GMO'S (Ankara 2010)**

Statement	*Strongly Agree/ Agree (%)*	*Undecided (%)*	*Strongly Disagree/ Disagree (%)*
I approve use of genetically modified seeds in the production in Turkey.	20 (5.8)	34 (9.8)	291 (84.1)
I think the products I buy may contain genetically modified organisms.	296 (85.5)	37 (10.7)	9 (2.6)
I think the society is duly informed on GMO's.	26 (7.5)	32 (9.2)	287 (82.9)
Production of the genetically modified food is risky for all living things in the nature.	269 (77.7)	50 (14.5)	24 (6.9)
I approve modification of the genetic materials of foods to end the famine in the world.	13 (3.8)	57 (16.5)	272 (78.6)
I approve modification of the genetic materials of foods to enrich their nutritional content.	30 (8.7)	76 (22.0)	236 (68.2)
I approve modification of the genetic materials of foods to prolong their self life and to produce products more resistant to pests and herbicides.	36 (10.4)	97 (28.0)	211 (61.0)
I think product labels should contain information about GMO content of the products.	310 (89.6)	18 (5.2)	17 (4.9)
I see no harm in consuming a GMO-containing food.	14 (4.0)	79 (22.8)	252 (72.8)
I think I have sufficient knowledge on GMO's.	58 (16.8)	145 (41.9)	142 (41.0)

biotechnological products cultivated most in the scope of GMO technology" and nearly 3/5 of them checked "the USA" choice correctly for the statement of "The country that has highest GMO production" (Table-2).

According to the statements examining the knowledge, attitudes and behaviours of the participants about GMO's: 82.9% of the participants thought that the society was not duly informed on GMO's; 77.7% that production of the genetically modified food is risky for all living things in the nature; 85.5% that the foods they bought might contain GMO's; 89.6% that the product labels should contain information on the GMO content of the products; and 72.8% that it was dangerous to consume GMO-containing foods (Table-3)

Grade-based comparisons of the GMO-related attitudes and behaviours of the participant students produced statistically significant differences in terms of the statements "I approve use of genetically modified seeds in the production in Turkey", "Production of genetically modified food is risky for all living things in the nature", "I approve modification of the genetic materials of foods to prolong their self life and to produce products more resistant to pests and herbicides" and "I see no harm in consuming a GMO-containing food"($p<0.05$) (Table-4).

Table IV. **Grade-based comparisons of the GMO-related attitudes and behaviours of the participants (Ankara 2010)**

	Grade				Chi Square	p*
	1st grade (%)	2nd grade (%)	3rd grade (%)	4th grade (%)		
I approve use of genetically modified seeds in the production in Turkey.						
Strongly Agree/Agree	6.4	2.4	8.1	6.0	12.678	0.048#
Undecided	3.7	16.9	8.1	13.4		
Disagree/ Strongly Disagree	89.9	80.7	83.7	80.6		
I think the products I buy may contain genetically modified organisms.						
Strongly Agree/Agree	88.0	86.6	88.2	82.1	6.535	0.366
Undecided	9.3	9.8	8.2	17.9		
Disagree/ Strongly Disagree	2.8	3.7	3.5	0.0		
I think that the society is duly informed on GMO foods.						
Strongly Agree/Agree	9.2	7.2	8.1	4.5	4.603	0.596
Undecided	10.1	13.3	5.8	7.5		
Disagree/ Strongly Disagree	80.7	79.5	86.0	88.1		
Production of genetically modified food is risky for all living things in the nature.						
Strongly Agree/Agree	75.0	68.7	84.9	87.9	13.322	0.038#
Undecided	16.7	24.1	9.3	6.1		
Disagree/ Strongly Disagree	8.3	7.2	5.8	6.1		
I approve modification of the genetic materials of foods to end the famine in the world.						
Strongly Agree/Agree	3.7	3.6	2.3	6.1	6.299	0.391
Undecided	13.1	24.1	14.0	16.7		
Disagree/ Strongly Disagree	83.2	72.3	83.7	77.3		
I approve modification of the genetic materials of foods to enrich their nutritional content.						
Strongly Agree/Agree	5.6	13.4	7.1	10.4	8.519	0.202
Undecided	26.9	25.6	17.6	16.4		
Disagree/ Strongly Disagree	67.6	61.0	75.3	73.1		
I approve modification of the genetic materials of foods to prolong their self life and to produce products more resistant to pests and herbicides.						
Strongly Agree/Agree	5.6	19.3	7.0	11.9	14.081	0.029#
Undecided	26.9	31.3	31.4	22.4		
Disagree/ Strongly Disagree	67.6	49.4	61.6	65.7		
I think product labels should contain information on the GMO content of the products.						
Strongly Agree/Agree	85.3	89.2	93.0	94.0	6.372	0.383
Undecided	6.4	4.8	4.7	4.5		
Disagree/ Strongly Disagree	8.3	6.0	2.3	1.5		
I see no harm in consuming a GMO-containing food.						
Strongly Agree/Agree	6.4	2.4	4.7	1.5	26.294	<0.001#
Undecided	17.4	42.2	14.0	19.4		
Disagree/ Strongly Disagree	76.1	55.4	81.4	79.1		
I think I have sufficient knowledge on GMO's.						
Strongly Agree/Agree	19.3	14.5	18.6	13.4	5.353	0.499
Undecided	46.8	44.6	36.0	38.8		
Disagree/ Strongly Disagree	33.9	41.0	45.3	47.8		

*Chi-square test was used in these comparisons.
The value of p<0.05 is statistically significant.

Discussion

In the scope of the present study –which was conducted to detect the knowledge, attitudes and behaviours of the nursing high school students about the genetically modified organisms- 82.9% of the participants stated that the society was not duly informed on GMO's. This rate was recorded to be 71.9% in the study conducted by Koçak et al. in 2010 with the participation of the students of a medicine faculty (11) and to be 78.4% in the study conducted by Ergin et al. in 2008 with the participation of the students attending at a vocational health high school (2). In his study published in 2005, Pattron stated that the majority of the consumers in Trinidad had insufficient information on GMO's (12). In the study published in 2006 by Lan et al. also underlined that Chinese society had little information on GMO's. Lan et al. suggested the very limited number of publications made by the media organs as the grounds for such finding (13). Currency of the subject may be the main reason behind insufficient GMO knowledge of different societies.

In the present study, 84.1% of the participants stated that they disapproved use of genetically modified seeds in the production in Turkey. In the study by Koçak et al., this rate was calculated to be 62.4% (11). Both the present study and the study by Koçak showed that the participants whose families lived in city centres had more negative attitudes towards GMO's. This rate was found to be 81.6% in the study by Ergin et al. (2). In the study made by Pardo et al. in 2002 on the EU member states, 45% of the participants stated that they did not approve use of GMO technology (14). Magnusson et al. (2002) made a study on the Swedish consumers, which revealed that young male participants with higher education tended to develop more positive behaviours towards the GMO foods (15). In their study (2006), Huang et al. found that Chinese tended to be more positive towards the technological developments achieved in the field of GMO's in 2002-2003 period. In the concerned study, it was also revealed that the negative attitudes towards this technology increased in parallel with the increase in income level and metropolitan life (16). When compared to the European countries, the number of Turkish citizens who disapprove production with GMO technology is higher. This situation may have resulted from the fact that concerned Turkish studies have been made on the future healthcare professionals of Turkey, whose health-related risk perception is quite high.

Cognitive variables (information, thought, belief, etc) have significant effects on consumer preferences (17). In the present study, 72.8% of the participants stated that it was dangerous to consume a GMO-containing food. This rate was found to be 54.4% in the study by Koçak et al., (11) and to be 66.7% in the study by Ergin et al. (2). The present study and the studies by Koçak and Ergin et al. found that the number of those who disapproved production with GMO technology was higher than the number of those who deemed it dangerous to consume GMO-containing foods. Deeming GMO production dangerous gives rise to the thought that people do not associate this situation only with personal health. In the study made by Demir et al. in 2007 on various professional groups, 85.6% of the participants stated that they would not consume GMO-containing products (1). In the study made by Al-jebree (2010) on the students of Riad University, 31.2% of the participants stated that they found GMO's useful and 23.6% that they found them harmful. In addition, the participants of the same study expressed that knowledge was an important factor in the approval of GMO's and that knowledge was directly proportional with the disapproval of GMO's. Fifty-six percent (56%) of the participants of the concerned study were concerned about the possibility of uncontrolled spread of GMO-containing plants and 77% about possible negative effects of GMO's on human health (17). According to the study made Christoph et al. (2007) with the participation of food consumers in Germany, 40% of the consumers nationwide stated that they would not use GMO's despite their possible health and environmental benefits. Moreover, consumers in England, France, Spain and Italy also expressed that they would not use the products produced with GMO technology (18).

In the present study, 14% of the participants stated that they would consume the genetically modified foods. This rate was recorded to be 12.2% in the study by Koçak et al. (11). This situation may have resulted from the easy access facility of the participants of the both studies to non-GMO products. In their study published in 2007, Februhartanty et al. found this rate as 78% among the Indonesian scientists (19). In the study by Lan et al., the rural participants were found to have lower risk awareness in terms of GMO

foods. The ground for this situation was suggested to be the fact that Chinese population had higher risk tolerance due to their limited food alternatives (13). In the study by Al-jebree, 28% of the participants stated that they would by GMO products (17). The study conducted by Pachico et al. in Colombia (2002), on the other hand, showed that 66% of those who had low-quality food would buy and try GMO products (20). When compared to the study by Koçak, the present study found a higher number of both the participants who stated that consumption of GMO's was dangerous and the participants who expressed that they would consume GMO's. This difference may have resulted from the fact that the present study was conducted on a group composed only of women participants, who have higher risk perception.

Production of the genetically modified foods -which were put on the market for the first time in 1996- has increased year by year. In the present study, 85.5% of the participants thought that the products they bought might contain GMO's. This rate was found to be higher among the participants whose families lived in a city centre. This rate was recorded to be 83.2% in the study by Koçak et al. (11) and to be 77.7% in the study by Ergin et al. (2). In the studies conducted in the EU member states, China and Indonesia in 2002-2007 period, on the other hand, this rate was calculated to vary in 43.2% - 62.0% range (14, 16, 19). Values recorded in the studies made in Turkey are above the world values. This difference gives rise to the thought that Turkish society develops more suspicious attitudes than the populations of other countries towards the food products sold in the market. Lower level of suspicion of the rural people is thought to result from the fact that they produce a huge amount of the products they consume.

In the present study, 77.7% of the participants agreed with the statement that "production of genetically modified foods is dangerous for the all living things in the nature". This rate was calculated to be 56.9%in the study by Koçak et al. (11). In the study conducted by Demir et al, 51.7% of the participant nurses and 31.6% of the participant doctors stated that "GMO's may cause health problems" (1). This rate was found to be 65.3% in the study by Ergin et al. (2). Lan et al. stated in their study that the less-developed countries supported GMO technology more (13). In their study, Magnusson et al. found that Americans and Canadians developed more positive attitudes than Europeans towards the genetically modified foods (15). Risk perception related to use of GMO technology differs at a statistically significant level on the basis of country, profession and sex factors.

Regarding the use of GMO technology in the agricultural sector, this technology can prolong the shelf life of foods and can ensure production of products resistant to pests and herbicides (22). In the present study, 10.4 of the participants stated that they approved genetic modifications to prolong shelf life and to produce products more resistant to pests and herbicides. This rate was recorded to be 21.8% in the study by Ergin et al. (2) and to be 27.3% in the study by Koçak et al. (11). In the studies made in the EU member states and China, on the other had, this rate was found to vary in 54%-69% range (14, 16). The rates recorded in Turkey were recorded to be lower than the world rates. This situation may have resulted from the belief prevalent among the participants of the studies made in Turkey that the foods modified via GMO technology has harmful effects on health.

The key element in addressing the ethical and belief-related concerns about GMO products is labelling. Related legislation in Turkey stipulates GMO labelling procedure for the products with more than 0.9% GMO content (23). GMO labelling is discretionary in the USA and obligatory in the EU member states and Japan (17). The same rate (0.9) is applied in the EU Member States as well; however, this rate is 2% in Norway. In Japan, Obligatory Labelling Law was introduced for the first time in 2001 for 30 food products (21). In the present study, 89.6% of the participants stated that the labels of the GMO-containing products should include such information. In the study by Koçak et al., this rate was recorded to be 84.9% (11). The rate found in Turkey is higher than those of China and Indonesia. Obligatory labelling is the common suggestion of the previous literature studies (1, 2, 13, 19).

In the present study, 74.3% of the participants stated that they heard GMO's on TV/radio. This rate was recorded to be 67.8% in the study by Koçak et al. (11) and 42.0% in the study by Demir et al. (1). In a student-centred study made by Maekawa et al. in 2004, 90% of Japanese society stated that they heard GMO's on daily newspapers, TV or articles (21). In their study, Huang et al. found that 67% of the

Chinese, 77% of the USA, 77-92% of the EU and 87% of the Japanese populations heard about GMO's (16). Nine-point-two percent (9.2%) of the participants of the present study heard about GMO's through the study questionnaire form, which is a quite interesting finding. Media is one of the most important sources of GMO information in both Turkey and some other countries. In the study by Februhartanty et al., 47% of the participants stated that they encountered positive news and 12% that they encountered negative news on GMO technology. Most of the participants of the concerned study -who were against GMO- stated that their attitudes were affected by the negative news while nearly all study sample stated the necessity of the publication of GMO news (19).

In the present study, grade-based comparison of the attitudes and behaviours of the participants about GMO's showed that some answers produced statistically significant differences for the 2nd grade students. However, no clear explanation can be offered for such difference.

The rates and values obtained in the present study were generally higher than those recorded in the study by Koçak et al. and in the other studies made in Turkey (11). This may have resulted from the fact that risk perception of females -who constituted the whole sample population of the present study- is higher than that of males -who constituted nearly the whole sample population of the study by Koçak et al.

The limitations of our study are, the results are not generalized to the population, since the age of students who had been adopted the questionnaire was between 18-22 years, and the other is the absence of the validity and reliability of the questionnaire. The benefit of our study is the currency of handled subject such as GMO-to-date is thought to increase the interest to the article in the issue being taken up. It has assessed that in order to reveal the risk perception of population about the GMO, the study having wide perspective on different population (gender, different age groups, different region etc.) is being needed.

Conclusion

Population of the present study -the future healthcare professionals- were found to have high risk perception and low knowledge on GMO's. Inclusion of courses on GMO's into current curriculum may significantly contribute to development of knowledge on and attitudes towards GMO's.

Full rejection of GMO technology may mean turning away from scientific developments. Particularly the valuable chemicals produced by using micro organisms or the bacteria used to prevent environmental pollution are of great importance in terms of biological and environmental health and economy. However, there is no doubt that special attention should be paid to food and similar products offered for human consumption. Before introduction into the market, such type of products has to be subjected to long-term tests and, related risks should be analyzed.

In Turkey, fist of all, bio-safety organizations should be established and legal regulations should be closely monitored and supervised by the authorities in a continuous and effective way.

To raise public awareness on conscious and safe food consumption, campaigns should be organized by experts and healthcare professionals should participate in such activities. As also found in the present study, media organs serve as an important source of information on this issue. Publication of accurate news on the media organs will make significant contributions in ending public concerns about the genetically modified foods and in raising public awareness on this issue.

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