

## Original Article

## Midwifery Students' Knowledge and Opinions About and Behaviors Towards Biotechnology

**Yurtsal Zeliha Burcu, PhD**

Assistant Professor, Midwifery Department, Faculty of Health Sciences, Cumhuriyet University, Sivas, Turkey

**Corresponce:** Yurtsal Zeliha Burcu, Assistant Professor, Midwifery Department, Faculty of Health Sciences, Cumhuriyet University, Sivas, 58140, Turkey. E-mail: burcuyurtsal@hotmail.com

### Abstract

**Introduction:** Biotechnology is quite a new area of science and affects our lives worldwide from health care and food products to environmental issues and energy sources.

**Aim:** This study was aimed at determining midwifery students' knowledge and views about and behaviors towards genetically modified foods because they are to provide education and counseling about nutrition for people in the community in which they will work after graduation.

**Methodology:** This descriptive study was conducted with midwifery students attending the Faculty of Health Sciences, Cumhuriyet University. The population of the study comprised 307 students studying at a midwifery department during the 2015/2016 academic year.

No sampling method was implemented; 273 students who agreed to participate in the study were included in the study. Data were collected through face-to-face interviews using a questionnaire developed by the researchers after a literature review. For the analysis of the data obtained, frequency distribution and chi-square analysis were performed by using the SPSS 22.0. P-values < 0.05 were considered statistically significant.

**Results:** Of the participating midwifery students, 68.5% agreed with the statement "Genetic modification of plants and animals can affect biodiversity", 62.3% agreed with the statement "Gene technology can be used in the health field" and 58.2% agreed with the statement "Gene technology can help prevent or cure diseases".

**Conclusions:** This present study shows that the participating midwifery students' knowledge of biotechnology was insufficient. However, their views on genetically modified foods, biotechnology and consumption status were satisfactory. The participants' insufficient knowledge about the issue makes it difficult to give advice on the safety of biotechnology.

**Keywords:** Biotechnology; Knowledge, Opinions, Behaviors; Midwifery Students.

### Introduction

Biotechnology is quite a new area of science and affects our lives worldwide from health care and food products to environmental issues and energy sources (Borgerding et al., 2013; Dawson & Venville, 2009). Modern biotechnology involves genetic engineering and genomics, and technologies associated with it. It is one of the most important scientific and technological revolutions in the 21<sup>st</sup> century (Kirkpatrick et al., 2002). However, this technology also leads to several controversies regarding the risk, ethics, and usefulness of its products (Reiss & Straughan, 1996; Bailey & Lappe, 2002). If young students of today are to contribute to

public debate and make personal decision in the future related to biotechnology, they should learn basic concepts of this technology in schools (Dawson, 2006). Among the areas biotechnology is involved in are biochemistry, immunology, genetics, chemical engineering, and molecular biology, and the economic, legal, and social aspects related to biotechnology.

During the last decade, medical innovations and genetically engineered products in food industry have been important developments in biotechnology. On the other hand, several objections have been raised with regard to ethics, the level of acceptable risk, and usefulness of the new products (Reiss & Straughan, 1996; Bailey

& Lappe, 2002). Although many studies reject the possibility of serious health hazards from the use of genetically modified (GM) foods (Jones et al., 2000; Lopez & Carrau, 2002).

Supporters of GM foods and crops claim that these foods and crops offer several benefits such as higher productivity and lower pesticide costs for consumers; less environmental pollution from pesticides and herbicides, and new crop varieties to eliminate or at least to lessen hunger in developing countries (Welsch, 1991). Even though the public's view regarding GM products is controversial (Aerni, 2002; Busch, 1991), the majority of experts are optimistic and think that the benefits outweigh possible risks (Prokop et al., 2007).

Several studies on peoples' understanding of and attitudes toward biotechnology have indicated that women lean towards GM products less than men do (Mangusson & Hursti, 2002; Moerbeek & Casimir, 2005). Age and educational differences also play an important role in preference; however, findings vary from one study to another (Baker & Burnham, 2002; Dawson & Schibeci, 2004; Hamstra & Smink, 1996). That policy and legislation regarding GM organisms vary from one country to another is another important factor.

On the other hand, studies have investigated GM products from several aspects so far, but no study has focused on Midwifery students' knowledge of and attitudes toward biotechnology in Turkey. This study was aimed at determining midwifery students' knowledge and views about and behaviors towards genetically modified foods because they are to provide education and counseling about nutrition for people in the community in which they will work after graduation.

### Material and methods

This descriptive study was conducted with midwifery students attending the Faculty of Health Sciences, Cumhuriyet University. The population of the study comprised 307 students studying at a midwifery department during the 2015/2016 academic year.

No sampling method was implemented; 273 students who agreed to participate in the study were included in the study. Before the study was performed, necessary permission was obtained from the school administration, and written

consents were obtained from the participating students. Data were collected through face-to-face interviews using a questionnaire developed by the researchers after a literature review (Bilen & Ozel, 2012). For the analysis of the data obtained, frequency distribution and chi-square analysis were performed by using the SPSS 22.0. P-values < 0.05 were considered statistically significant.

### Results

The mean age of the students participating in the study was  $20.79 \pm 1.5$ . Of the participants, 38.8% were from the central Anatolia region and 97.8% had health insurance. Of the participants, 15.4% were knowledgeable about biotechnology. Of them, 72.5% obtained this information through the social media, and 92.7% were knowledgeable about the genetically modified foods included in the food they bought. While 22.7% of the participants thought that the safety of biotechnology was ensured, 49.1% of them thought that the main source of products including biotechnology was agriculture. Some socio-demographic characteristics of the participating midwifery students and their knowledge and views about biotechnology are listed in Table 1.

Of the participating midwifery students, 68.5% agreed with the statement "Genetic modification of plants and animals can affect biodiversity", 62.3% agreed with the statement "Gene technology can be used in the health field" and 58.2% agreed with the statement "Gene technology can help prevent or cure diseases". The midwifery students' knowledge and views on biotechnology are given in Table 2.

We investigated the participants' knowledge and views about the biotechnology whether it is hazardous to health, and determined that they were not knowledgeable enough about biotechnology and consumption of genetically modified foods. However, there was a significant relationship between their knowledge levels and views about biotechnology such as "Through genetic modification, healthier products are obtained", "Genetic modification of a plant is not harmful", "Genetic modification of plants and animals can affect biodiversity" ( $p < 0.05$ ). The data related to the level of knowledge and views about biotechnology and consumption of genetically modified foods status are given in Table 3.

**Table 1.Socio-demographic characteristics of the participants and their knowledge and views about biotechnology (n=273)**

<b>VARIABLES</b>	<b>n</b>	<b>%</b>
<b>Age</b>	20.79±1.5	
<b>Region of birth</b>		
Marmara Region	18	6.6
Aegean Region	13	4.8
Central Anatolia	106	38.8
Black Sea Region	30	11.0
Mediterranean Region	51	18.7
Eastern Anatolia	23	8.4
South East Anatolia	32	11.7
<b>Social Security</b>		
Yes	267	97.8
No	6	2.2
<b>Household monthly income(\$)</b>		
≤\$430	92	33.7
\$431-\$761	107	39.2
>\$761	74	27.1
<b>Knowledge of biotechnology</b>		
Yes	42	15.4
No	231	84.6
<b>Source of the Information about biotechnology</b>		
Midwifery department	53	19.4
Social media	198	72.5
Printed media	22	8.1
<b>Safety of biotechnology use is ensured</b>		
Yes	62	22.7
No	211	77.3
<b>Think of the genetically modified foods consumed</b>		
Yes	253	92.7
No	20	7.3
<b>Mainly sectors that it includes biotechnology</b>		
Agriculture	167	49.1
Animals	18	39.2
Health	46	8.8
No comment	42	2.6
<b>Total</b>	100	100.0

**Table 2. Knowledge and views about biotechnology (n=273)**

<b>Knowledge and views about genetically modified foods</b>	<b>n</b>	<b>%</b>
Genetic modification of plants and animals can affect biodiversity		
Yes	187	68.5
No	39	14.3
No idea	47	17.2
Genetic modification can make plants more resistant to insects		
Yes	118	43.2
No	84	30.8
No idea	71	20.6
Through genetic modification, healthier products are obtained.		
Yes	39	14.3
No	189	69.2
No idea	45	16.5
Thanks to genetic modification, it is possible to produce vegetables and fruits that do not spoil immediately		
Yes	116	42.5
No	98	35.9
No idea	59	21.6
Gene technology can be used in the health field		
Yes	170	62.3
No	38	13.9
No idea	65	23.8
Genetic modification of a plant is not harmful		
Yes	27	9.9
No	215	78.8
No idea	31	11.4
Genetic modification of an animal is not harmful		
Yes	34	12.5
No	214	78.4
No idea	25	9.2
Positive aspects of gene technology are more than its negative aspects		
Yes	53	19.4
No	133	48.7
No idea	87	31.9
Thanks to gene technology, new treatment methods can be developed		
Yes	158	57.9
No	35	12.8
No idea	80	29.3
Gene technology can help prevent or cure diseases		
Yes	159	58.2
No	36	13.2
No idea	78	28.6
Environment can be cleaned by biotechnological methods		
Yes	122	44.7
No	61	22.3
No idea	90	33.0
Gene technology can contribute to the country's economy by obtaining more products		
Yes	80	29.3
No	105	38.5
No idea	88	32.2

**Table 3. The participants' knowledge and views about biotechnology, and their consumption status**

Biotechnology	Consumption status				Pearson Chi-Square
	Yes (n=253)	%	No (n=20)	%	
Genetic modification of plants and animals can affect biodiversity					
Yes	175	69.2	12	60.0	0.007
No	39	15.4	0	0.0	
No idea	39	15.4	8	40.0	
Genetic modification can make plants more resistant to insects					
Yes	110	43.5	8	40.0	0.620
No	79	31.2	5	25.0	
No idea	64	25.3	7	35.0	
Through genetic modification, healthier products are obtained					
Yes	31	12.3	8	40.0	0.001
No	182	71.9	7	35.0	
No idea	40	15.8	5	25.0	
Through genetic modification, it is possible to produce vegetables and fruits that do not spoil immediately					
Yes	108	42.7	8	40.0	0.281
No	93	36.8	5	25.0	
No idea	52	20.6	7	35.0	
Gene technology can be used in the health field					
Yes	159	62.8	11	55.0	0.086
No	32	12.6	6	30.0	
No idea	62	24.5	3	15.0	
Genetic modification of a plant is not harmful					
Yes	22	8.7	5	25.0	0.005
No	205	81.0	10	50.0	
No idea	26	10.3	5	25.0	
Genetic modification of an animal is not harmful					
Yes	30	11.9	4	20.0	0.096
No	202	79.8	12	60.0	
No idea	21	8.3	4	20.0	
Positive aspects of gene technology are more than its negative aspects					
Yes	48	19.0	5	25.0	0.687
No	125	49.4	8	40.0	
No idea	80	31.6	7	35.0	
Thanksto gene technology, new treatment methods can be developed					
Yes	147	58.1	11	55.0	0.944
No	32	12.6	3	15.0	
No idea	74	29.2	6	30.0	
Gene technology can help prevent or cure diseases					
Yes	148	58.5	11	55.0	0.947
No	33	13.0	3	15.0	
No idea	72	28.5	6	30.0	
Environment can be cleaned by biotechnological methods					
Yes	114	45.1	8	40.0	0.785
No	57	22.5	4	20.0	
No idea	82	32.4	8	40.0	
Gene technology can contribute to the country's economy by obtaining more products					
Yes	71	28.1	9	45.0	0.151
No	101	39.9	4	20.0	
No idea	81	32.0	7	35.0	

## Discussion

People usually hold different beliefs and opinions about any new technology. Since the last two decades, many researchers have investigated students' perceptions of biotechnology. Some reports determined a positive correlation between knowledge and attitudes (Sturgis et al., 2005; Fonseca et al., 2012) while others found that being knowledgeable about biotechnology did not always affect attitudes (Verdurme & Viaene, 2003 ; Sörgo & Ambrozic-Dolinsek, 2010).

Fonseca et al. (2012) suggested that not gender but high school education determines perceptions of and behavior toward biotechnology. Non-science students also have some knowledge of biotechnology. Most students displayed positive attitudes toward different applications of biotechnology except for the manipulation of animals. Slovakian students (especially females) show less positive attitudes toward biotechnology regardless of their knowledge about genetic engineering (Prokop et al., 2007). Females' lower acceptance of biotechnology supports recent evidence that females have different views on science (Jones et al., 2000; Miller et al., 2006), technology, and technological innovations (Cockburn & Ormrod, 1995). In a study, Slovakian university students have been indicated to have a poor knowledge of what biotechnology processes mean (Prokop et al., 2007). In the present study, midwifery department students' knowledge of biotechnology was poor (15.4%). While only 19.4% of them said that the source of their knowledge of biotechnology was their school, 72.5% of them stated that their source was the social media.

In one study, Turkish students' most favorable attitudes were toward genetically modified plants. But most of the Turkish students' negative attitudes were toward genetic manipulations on genetic modification production, shopping genetically modified products, GM plants, and public awareness of genetically engineered foods. These results are in strong contrast with those findings reported from the USA, where more favorable attitudes toward GM products were observed (Wie et al., 1998). But, other research reports from Europe are more similar to those found in the present study, which is probably due to the more conservative policy of the European Union toward biotechnologies (Herrick, 2005). In the present study, of the participating students,

77.3% stated that they were not sure whether biotechnology was safe, and 92.7% thought that they may have consumed GM foods. The high rate of people who think that they have consumed GMOs in Turkey can be explained by the fact that Turkish people are suspicious of GMOs and biotechnology.

In Yen Chen's study, students' attitudes toward Genetically Modified Organisms (GMO) were reported to be significantly different from those toward medical biotechnology, even though current students perceived more risk of medical biotechnology than former students (Yen Chen et al., 2016). In another study, students in Taiwan and the UK seemed to only hold more positive attitudes towards the area of biomedical technology (Raffan, 1999).

The controversial opinion regarding "desirable" biomedical (RED) and "undesirable" agri-food (GREEN) biotechnology reflects the findings reported in the UK (Bauer, 2002). According to the results of Cheng's study, many people around the world hold mixed feelings or contradictory ideas toward food and medical biotechnology (Yen Chen et al., 2016). In the present study, the majority of midwifery students in Turkey have negative views about biotechnology.

In a study, when students take formal biology classes, they tend to construct new ideas about plants and start to take more notice of up-to-date knowledge on transgenic plants. In contrast to GE plants, regardless of what the students majored in and their level of education, their opinions had similar opinions about GE animals. Perhaps students fear use of the products of GE animals, because they have not been provided with much information about them. Another possible reason is that students have a moral obligation to animals. Students notice mobile objects and are introduced to animals in everyday life during their childhood (Tunnicliffe et al., 2008; Patrick & Tunnicliffe, 2011).

In the present study, of the students, only 9.9% had the opinion that genetic modification of a plant is not harmful and 12.5% stated that genetic modification of an animal is not harmful. In Usak's study, there was no significant difference between male and female students with regard to their attitude toward ecological consequences of cultivation of genetically modified plants. University students displayed more positive attitudes toward GMP than did high school

students. University students were not afraid of the impact of GM plants on wild plants in the natural habitats, whereas high school students were afraid of the impact of GM plants on wild plants in the natural habitats. So, high school students believed that GM plants may have greater competitive abilities in comparison with wild plants and that they could hybridize and endanger original genetic resources (Usak et al., 2009).

Unlike Usak's study, 68.5% of the students in the present study stated that genetic modification of plants and animals could affect biodiversity. In Usak's study, current biotechnology awareness in Turkish students favors practical applications of (agricultural) biotechnology, but somewhat exceeds students' understanding of the core of biotechnology processes. These trends are evident both in high school and in university students suggesting that science curriculum probably might not provide enough place for teaching biotechnology (Usak et al., 2009). In Taiwanese students whose native concepts of animals are already deeply formed before they begin taking formal classes (Philip Bell et al., 2009; Dierking & Falk, 2010). Thus, as a result, most current Taiwanese students develop a negative attitude to animal biotechnology. More recently, the researches have designed an emerging biotechnology curriculum which includes not only GE animals (a genetically engineered Atlantic salmon) but also GE plants. High school teachers and university faculty together designed and developed the curriculum. After teaching activities, it showed an obvious change of attitude among 187 high school students, not only on GE plants but also on GE animals (Yen Chen et al., 2016).

Biotechnology education becomes very important since today's citizens have often to make decisions about the products of gene technology. In one study, the study of AB (Advanced Biology) did not significantly affect Taiwanese students' attitude towards animals. It has been suggested that greater scientific knowledge would induce favorable attitudes toward genetic study (Fife-Schaw, 2003). This could be due to the fact that genetic engineering is not adequately covered in current textbooks. Therefore, teachers are expected to help students develop their scientific perception and improve their understanding of transgenic animals. Students tend to show negative attitudes toward genetic

engineering because of limited knowledge and their fear of accepting new technology products (Yen Chen et al., 2016). In the present study, according to 19.4% of the students, positive aspects of gene technology are more than its negative aspects and according to 44.7% of them, environment can be cleaned by biotechnological methods. The students often had negative opinions of biotechnology.

## Conclusions

In conclusion, this present study shows that the participating midwifery students' knowledge of biotechnology was insufficient. However, their views on genetically modified foods, biotechnology and consumption status were satisfactory. The participants' insufficient knowledge about the issue makes it difficult to give advice on the safety of biotechnology. Training of students on this issue who are younger consumers is important for the protection of public health. That midwifery students who are to provide people with education and counseling on nutrition in order to protect and improve mothers', infants' and communities' health have adequate and correct knowledge about biotechnology is of great importance.

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