ORIGINAL ARTICLE

Eastern Journal of Medicine
East J Med 24(4): 434-436, 2019
DOI: 10.5505/ejm.2019.48378

# Nurses as a New Stakeholder in Genetics and The Place of Genetics in Educational Processes: A Study From Turkey

**Ayse Yacan Kok[1], Cigdem Aydin[2*]**

*[1]Akdeniz University, Faculty of Nursing, Fundamentals of Nursing Department, Antalya, Turkey*
*[2]Mehmet Akif Ersoy University, Bucak School of Health, Department of Nursing, Burdur, Turkey*

**ABSTRACT**

Nurses having post graduate degree are ready to take responsibility in health care systems and should also be well-prepared to involved in genetic/genomic health care services. The purpose of this study was to assess the undergraduate students' awareness, perception and understanding of several human genetic topics, tests and disorders.

**Methods:** This is a descriptive and cross-sectional study. A self-report questionnaire which was designed to evaluate undergraduate nursing students' theoretically knowledge of genetic concepts, disease and the perception of students about medical biology and genetic lesson. Two hundred and twenty two pre-licensured nursing students compromised the sample. A 54-item questionnaire prepared by literature-based researchers was used as a data collection tool. Descriptive statistics and Fisher's Exact Test or Pearson Chi-square test were used to analyze the relations between categorical variables.

The majority of nursing students in this study (%70,1) took Medical Biology and Genetics lesson. But, more than half of nursing students (58,1%) reported "No" to adequate level of knowledge about genetic. Competence about genetic were not changed level of class. However, students who taking medical biology and genetic lesson had more genetic disease knowledge than no taking group. The evaluation of responses to the section on basic genetic information showed that the lowest levels of description were prenatal diagnosis (31,5%) and locus (36,9%). Also, 82,4% of the nursing students agreed that nurses' role in genetic diseases diagnosis.

With the advances in the field of genetics, there was a need for nursing students to integrate genetic information into nursing practice. It is thought that the results of this study may help to reorganize and improve new educational strategy related to medical biology and genetics in nursing education.

**Key Words:** Genetics, Nursing students, Nursing education, Genetic education

## Introduction

The Human Genome Project is groundbreaking development in healthcare field in recent years. Human genome project conducted between 1990 and 2003 was an international project aimed at sequencing of the human genome. New informations that have emerged after the completion of this project, it has acquired a new dimension on researches related to molecular techniques and diseases. The time period from after the completion of the Human Genome Project dominates diagnosis and treatment of human diseases, indicating that the post-genomic era was entered. Post-genomic era, it is an undeniable fact that new technologies have accelerated the transition from research to clinical applications (1). Ongoing research area of genetics and reflections on the clinic of acquired findings have gone beyond single gene disorders and become genomics (2). Genomics define all the genes that encode the structural and functional properties of any organism and examines the control of the interactive relations of these genes with one another and with the environment (3).

Understanding the molecular and genetic basis of diseases, treatment modalities and evaluation of response to treatment is a necessity for quality nursing practice. Many genetic tests used in the clinic are important not only for the patient but also for family members at risk (4). Nowadays, health practices based on genomic science are becoming increasingly part of routine care. In recent years, developments in genetics have introduced new roles in nursing and also whole health care staff, along with new opportunities in health care (5). This process has led to the need

***Corresponding Author:** Cigdem Aydin, Mehmet Akif Ersoy University, Bucak School of Health, Department of Nursing, Burdur, Turkey
e-mail: cacar@mehmetakif.edu.tr, Phone: +90 248 325 99 00
**Received:** 05.03.2019, **Accepted:** 02.05.2019

for all nurses working in different areas to be trained in accordance with the developments in the field of genetics in order to ensure the best practices in the diagnosis, prevention and/or treatment of diseases (6-8).

However, there are inconsistencies in the provision of genetic training and evidence that nurses lack competence in the genetic field in many countries (9). In early 1962, Brantl and Esslinger called for the integration of medical genetics into the nursing curriculum so that nurses with core competencies could be trained (10). Following this, Kenen pointed out that the genetic counseling is essential interdisciplinary field for nurses (11). In 2006, the American Nurses Association (ANA) published The Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines, which includes strategies for genetically health professional education.

Scientific understanding in genetics and genomics fields are forced healthcare disciplines to swiftly redefining the understanding of health and disease and composing a significant change in practice. Nurses having post graduate degree are ready to take responsibility in health care systems and should also be well-prepared to be involved in genetic/genomic health care services (12).

This study is aimed at determining the nursing students awareness, perception and understanding of several human genetic topics, tests and disorders.

## Materials and Methods

**Design and Sample:** The cross-sectional and descriptive study was conducted in the Nursing Department of Health School, Mehmet Akif Ersoy University. Participants were first and second year undergraduate students in the Bachelor of Nursing Science Degree (n:222). Written permission from Mehmet Akif Ersoy University Ethical Committee and the Mehmet Akif Ersoy University Bucak School of Health was also obtained.

**Data collection:** Data for the current study were collected by questionnaire. The items on the questionnaire were developed based on a comprehensive review of the literature by researchers (13-15). Questionnaire items were designed sample characteristic, the perception of nursing students about Medical Biology and Genetics, theoretical knowledge of genetic concepts and diseases. In this study, under the titles mentioned above, with the multiple-choice questions were examined the students' awareness, perception and understanding of various human genetics topics, tests and disorders.

Seven items assessed sample characteristic, 2 items assessed that whether or not to take genetic courses and which course providing genetic knowledge to student, 7 items assessed the way students would like educational activities about genetics, 27 items assessed to define on genetic concepts, 11 items assessed level of knowledge about genetic disorders, students comfort level of conditions assessed in 4 items and last item gets a suggestion about medical biology and genetics lesson from nursing students. All students were informed they were not required to partake in this study, nor would their course grade be affected by not participating. The researcher was not present for any of the data collection process. The first education year in this school, Medical Biology and Genetics lesson is compulsory and second year its education was changed to optional lesson.

**Data Analysis/Statistics:** For data analysis, the SPSS 20.0 package program was used. P value of $<0.05$ was considered statistically significant. Descriptive statistics were used to determine students' characteristics. Descriptive statistics are presented with n (%) and mean ± standard deviation. Fisher's Exact Test or Pearson Chi-square test was used to analyze the relations between categorical variables.

## Results

**Sample characteristics:** Two hundred and twenty two surveys were distributed to undergraduate nursing students, including 119 (53,6 %) freshmen and 103 (46,4 %) sophomores. The majority of participants were women (66,7 %), and their mean age of 19,6. Greater part of the students (68,5%) were high school graduates from vocational high schools. Relationship of the students' family were scarce (16,7%). Also, rarely percentage of the students (14%) had a family history of genetic diseases which were visual disorders, thalassemia, multi-malformation, epilepsy and cardiac malformations. Table 1 gives additional demographic informations on the nursing students.

**The Perception of Nursing Students About Medical Biology and Genetics Lesson/Education:** The majority of nursing students in this study (%70,1) took Medical Biology and Genetics lesson. But, more than half of nursing students (58,1%) reported "No" to

**Table 1.** Sample characteristics of nursing students (n=222)

| | n=222 |
|---|---|
| Age, mean+ss | 19.6±1.2 |
| Gender, n(%) | |
| Male | 74(33.3) |
| Female | 148(66.7) |
| Graduated high school, n(%) | |
| Health Vocational High School | 69(31.08) |
| High School | 153(68.9) |
| School year, n(%) | |
| Freshmen | 119(53.6) |
| Sophomores | 103(46.4) |
| Relationship in family history, n(%) | |
| Yes | 37(16.7) |
| No | 185(83.3) |
| Genetic diseases in family, n(%) | |
| Yes | 31(14) |
| No | 191(86) |

adequate level of knowledge about genetics. Moreover, nursing students were most wanted education on issues that were cancer genetics (68%) or communication techniques with individual/family has genetic diseases (36,5%). Also, 82,4% of the nursing students agreed that nurses' role in genetic diseases diagnosis.

**Theoretically Knowledge Of Genetic Concepts and Diseases:** The evaluation of responses to the section on basic genetic information showed that concepts of mitosis-meiosis were identified by the majority of nursing students (93,2%), and the lowest levels of description were prenatal diagnosis (31,5%) and locus (36,9%).

The responses about knowledge of some genetic abnormalities and diseases expressed that the highest was 60,8% who knew about trisomy 21 and the lowest was 8,1% who knew Huntington disease and Duschenne Musculer Dystrophy. Additionally, knowledge of genetic abnormalities and diseases were not changed level of class. Because of all sophomeres took lesson, statistically differences were formed Thalassemia, Turner Syndrome and Trisomies (p=0,001). Besides, graduated school of health compared the other groups Cyctic Fibrosis and Thalassemia diseases' were statistically significant results.

The survey also quested for the opinions of students' competence about genetics, including searches on the internet about genetic diseases, drawing pedigree, determining of genetic disorders type in pedigree or getting a family history. While 69,4% of students answered "No" to drawing a pedigree, only 58,1% of students felt competence getting a family history. Competences about genetics were not changed level of class. However, students who taking medical biology and genetics lesson had more genetic diseases knowledge than no taking this lesson group (see Table 2).

Table 3 indicated that comparison of the definition of genetic concepts according to taking medical biology and genetics lesson. DNA and RNA structures/functions, genotype, fenotype, karyotype, chromosome, allele, mutation and gene therapy were statistically different according to medical biology and genetic lesson. Table 3 gives additional informations on the students responded about genetic concepts.

Finally, survey also asked for students' opinions about medical biology and genetics lesson with open ended questions. Their replies included increase of lesson time and giving lesson in the years of advancing education.

## Discussion

Nowadays, genetic and genomic investigations lead to a better understanding of common complex diseases such as cancer, diabetes, obesity and cardiovascular diseases, and the creation of novel, gene-based technologies for screening, prevention, diagnosis and treatment of these diseases. Nursing clinical practice, including all specialties has integrated into genetics and

**Table 2**. Comparison of the answers given by nursing students questions about genetic diseases

| Genetic diseases | Taking lesson n(%) | No taking lesson n(%) | p |
|---|---|---|---|
| Trisomy 21/Down syndrome | | | |
| No information | 12(7.7) | 22(33.3) | |
| Need more information | 33(21.2) | 20(30.3) | <0.001 |
| Knowledgeable | 111(71.2) | 24(36.4) | |
| Trisomy 18/Edwards syndrome | | | |
| No information | 23(14.7) | 37(56.1) | <0.001 |
| Need more information | 53(34) | 26(39.4) | |
| Knowledgeable | 80(51.3) | 3(4.5) | |
| Trisomy 13/Patau syndrome | | | |
| No information | 31(19.9) | 40(60.6) | <0,001 |
| Need more information | 58(37.2) | 25(37.9) | |
| Knowledgeable | 67(42.9) | 1(1.5)b | |
| Turner syndrome | | | |
| No information | 24(15.4) | 21(31.8) | 0.001 |
| Need more information | 41(26.3) | 24(36.4) | |
| Knowledgeable | 91(58.3) | 21(31.8) | |
| Klinefelter syndrome | | | |
| No information | 34(21.8) | 25(37.9) | 0.013 |
| Need more information | 36(23.1) | 18(27.3) | |
| Knowledgeable | 86(55.1) | 23(34.8) | |
| Thalassemia | | | |
| No information | 36(23.1) | 20(30.3) | 0.385 |
| Need more information | 44(28.2) | 20(30.3) | |
| Knowledgeable | 76(48.7) | 26(39.4) | |
| Cystic fibrosis | | | |
| No information | 65(41.7) | 32(48.5) | 0.602 |
| Need more information | 49(31.4) | 17(25.8) | |
| Knowledgeable | 42(26.9) | 17(25.8) | |
| Sickle cell anemia | | | |
| No information | 26(16.7) | 19(28.8) | 0.120 |
| Need more information | 49(31.4) | 17(25.8) | |
| Knowledgeable | 81(51.9) | 30(45.5) | |
| Fragile X syndrome | | | |
| No information | 88(56.4) | 45(68.2) | 0.139 |
| Need more information | 42(26.9) | 16(24.2) | |
| Knowledgeable | 26(16.7) | 5(7.6) | |
| Huntington Disease | | | |
| No information | 89(57.1) | 49(74.2) | 0.051 |
| Need more information | 52(33.3) | 14(21.2) | |
| Knowledgeable | 15(9.6) | 3(4.5) | |
| Duschenne muscular dystrophy | | | |
| No information | 108(69.2) | 52(78.8) | |
| Need more information | 37(23.7) | 13(19.7) | 0.169 |
| Knowledgeable | 11(7.1) | 1(1.5) | |

**Table 3.** Comparison of the definition of genetic concepts according to students' taking medical biology and genetic lesson

| Genetic concepts | No taking lesson | | Taking lesson | | p |
|---|---|---|---|---|---|
| | Yes n(%) | No n(%) | Yes n(%) | No n(%) | |
| DNA structure/function | 51(75) | 17(25) | 140(90,9) | 14(9,1) | 0,0021 |
| RNA structure/function | 44(64,7) | 24(35,3) | 134(87) | 20(13) | <0,0011 |
| DNA replication | 50(73,5) | 18(26,5) | 133(86,4) | 21(13,6) | 0,0211 |
| Transcription | 37(54,4) | 31(45,6) | 115(74,7) | 39(25,3) | 0,0031 |
| Translation | 31(45,6) | 37(54,4) | 111(72,1) | 43(27,9) | <0,0011 |
| Mitosis | 61(89,7) | 7(10,3) | 146(94,8) | 8(5,2) | 0,2442 |
| Meiosis | 60(88,2) | 8(11,8) | 147(95,5) | 7(4,5) | 0,0772 |
| Chromosome | 58(85,3) | 10(14,7) | 144(93,5) | 10(6,5) | 0,0491 |
| Genome | 42(61,8) | 26(38,2) | 121(78,6) | 33(21,4) | 0,0091 |
| Gene | 56(82,4) | 12(17,6) | 131(85,1) | 23(14,9) | 0,6091 |
| Locus | 20(29,4) | 48(70,6) | 62(40,3) | 92(59,7) | 0,1231 |
| Allele | 38(55,9) | 30(44,1) | 111(72,1) | 43(27,9) | 0,0181 |
| Homozygous | 57(83,8) | 11(16,2) | 142(92,2) | 12(7,8) | 0,0591 |
| Heterozygous | 57(83,8) | 11(16,2) | 146(94,8) | 8(5,2) | 0,0071 |
| Hemizygous | 34(50) | 34(50) | 126(81,8) | 28(18,2) | <0,0011 |
| Genotype | 51(75) | 17(25) | 146(94,8) | 8(5,2) | <0,0011 |
| Fenotype | 54(79,4) | 14(20,6) | 144(93,5) | 10(6,5) | 0,0021 |
| Mutation | 52(76,5) | 16(23,5) | 141(91,6) | 13(8,4) | 0,0021 |
| Karyotype | 37(54,4) | 31(45,6) | 110(71,4) | 44(28,6) | 0,0131 |
| Dominant | 49(72,1) | 19(27,9) | 141(91,6) | 13(8,4) | <0,0011 |
| Recessive | 50(73,5) | 18(26,5) | 134(87) | 20(13) | 0,0141 |
| Autosomal dominant ınheritance pattern | 38(55,9) | 30(44,1) | 119(77,3) | 35(22,7) | 0,0011 |
| Autosomal recessive ınheritance pattern | 39(57,4) | 29(42,6) | 116(75,3) | 38(24,7) | 0,0071 |
| X linked ınheritance pattern | 42(61,8) | 26(38,2) | 131(85,1) | 23(14,9) | <0,0011 |
| Mitochondrial inheritance pattern | 31(45,6) | 37(54,4) | 96(62,3) | 58(37,7) | 0,0201 |
| Prenatal Diagnosis | 20(29,4) | 48(70,6) | 50(32,5) | 104(67,5) | 0,6511 |
| Gene Therapy | 31(45,6) | 37(54,4) | 94(61) | 60(39) | 0,0321 |

[1]Pearson chi-square test. [2]Fisher's Exact test

genomic developments (16). Nurses should be competent to determine patients' and families' educational needs, comprehend and communicate patterns of inheritence, describe risks for genetic health, identify genetic tests and treatments' beneficence and limitations. Thus, patients and families are learned and get to be privatized information for their needs (17). Also, nursing education goal is to ensure knowledgeable and competent nurse for profession. Lea et al. declare that genetics, genomics and convenient clinical environment are formed with genetic educated nurses (18). These developments related to genetic have highlighted needs within nursing education and course content.

Each nursing program designs their curriculum and the arrangement through which genetic course content is taught. A number of nursing education programs in Turkey infuse genetic content different course. Besides, some nursing programmes integrated genetic lesson with different content and name. This study revealed that significant differences knowledge of genetics concepts in taking medical biology and genetic lesson. And also, meaningful gap still be in nursing students' reported knowledge of genetic concepts, diseases and perception of medical biology and genetics lesson.

The majority of the participants said knowledgeable of basic genetic terms such as mitosis, meiosis, DNA and RNA. The ratio of students stated a high level of genetic concepts is found higher than similar studies in USA and Taiwan (15, 19). Also, asking with likert scale items students' evaluation of medical genetics concepts and disorders study in Turkey revealed similar knowledge about basic genetic concepts (14). The reason for this can be explained as the inclusion of genetic terms in the courses given at the primary and secondary school level in the Turkish education system.

The knowledge of turner syndrome, trisomy 13, 18 and 21 which are genetic disorders was higher in the group receiving the lesson. This findings is also higher than similar study in Turkey (14). Also, over half of the students indicated "no knowledge" Huntington disease and Duschenne's muscular distrophy as well as Hsiao et al. study (19).

In our study, nursing students' opinions about some genetic competence evaluated and reported drawing pedigree was not able to draw in participants. Maradigue et al. and Vural et al. were reported their studies being able to draw pedigree (14,15). Additionally, students signified that the most wanted education issues were cancer genetic and Individual/family communication techniques with genetic diseases.

In our study taking genetic lesson increased knowledge of genetic concepts and perception of genetic disease. In recent years, there have been many efforts to decrease gaps in genetic knowledge of the nursing profession. Many beginning was the organization of the NINR Summer Genetics Institute (SGI), which for has been supplying compacted studies in molecular genetics at the bench with application to clinical practice and train the next generation of nursing researchers. Also, another important development was determine of the essential nursing competencies in genetics and genomics (20-22). However, nursing program curriculum hasn't integrated into sufficiently genetic competencies in Turkey as many country (23-28).

Previous studies stressed that the majority of nurses agree in need of more training on genetics (29, 30). Also, during the period of nursing education, students in the last years of education have been informed that they want more education about genetics (14, 19). Similarly, studies inferred that nurses have more interest in learning genetic (31-34). These results show that today's genetic education need more compherensive about genetic concepts, disease and skills. More study should be conducted in order to get integration genetic education into the nursing curriculum.

In our study; nursing students preferred ongoing genetic education, irrespective of their taking medical biology and genetics lesson. But those who had medical biology and genetics lesson across nursing curriculum were more motivated to get more education in genetic topics.

This study has shown that nursing curriculum should contain genetic education to prepare student nurses for today and future healthcare needs. In Turkey limited researches have been fulfilled on the perception and knowledge about genetics of students for nursing programme. For qualified nurses, medical biology and genetic lesson might be an oppurtunity to minimize knowledge gap about genetic during nursing education. Also, a continuing educational programme regarding genetic might be enabled to integrate genetics into practice.

## References


1. Um YR. Post genome era and the future of nursing. The Koean Nurses Association News, 2001.
2. Feero WG, Guttmacher AE, Collins FS. Genomic medicine--an updated primer. N Engl J Med 2010; 362: 2001-2011.
3. Guttmacher AE, Collins FS. Genomic medicine--a primer. N Engl J Med 2002; 347: 1512-1520.
4. Connors L, Schorn M. Genetics and Genomics Content in Nursing Education: A National Imperative. J Prof Nurs 2018; 34: 235-237.
5. Calzone KA, Jerome-D'Emilia B, Jenkins J, et al. Establishment of the genetic/genomic competency center for education. J Nurs Scholarsh 2011; 43: 351-358.
6. Thompson HJ, Brooks MV. Genetics and genomics in nursing: evaluating Essentials implementation. Nurse Educ Today 2011; 31: 623-627.
7. Burton H, Stewart A. From mendel to the human genome project: the implications for nurse education. Nurse Education Today 2003; 380-385.
8. Barr O, McConkey. Health visitors' perceived priority needs in relation to their genetics education. Nurse Education Today 2006; 293-303.
9. Calzone KA, Jenkins J, Culp S, Caskey S, Badzek L. Introducing a New Competency Into Nursing Practice. J Nurs Regul 2014; 5: 40-47.
10. Brantl V, Esslinger P. Genetics implications fornursing education. Nursing Forum 1962; 90-100.

11. Kenen RH. Genetic counseling: the development of a new interdisciplinary occupational field. Soc Sci Med 1984; 18: 541-549.
12. Greco KE, Tinley S, Seibert D. Development of the essential genetic and genomic competencies for nurses with graduate degrees. Annu Rev Nurs Res 2011; 29: 173-190.
13. Dodson CH, Lewallen LP. Nursing students' perceived knowledge and attitude towards genetics. Nurse Education Today 2011; 31: 333-339.
14. Vural BK, Tomatır AG, Kurban NK, Taşpınar A. Nursing students' self-reported knowledge of genetics and genetic education. Public Health Genomics 2009; 12: 225-232.
15. Maradiegue A, Edwards QT, Seibert D, Macri C, Sitzer L. Knowledge, perceptions, and attitudes of advanced practice nursing students regarding medical genetics. Journal of the American Academy of Nurse Practitioners 2005;17: 472-479.
16. Camak DJ. Increasing importance of genetics in nursing. Nurse Education Today 2016; 44: 86-91.
17. Tonkin E, Skirton H. The role of genetic/genomic factors in health, illness and care provision. Nursing Standard 2013; 28: 39-46.
18. Lea DH, Skirton H, Read CY, Williams JK. Implications for educating the next generation of nurses on genetics and genomics in the 21st century. Journal of Nursing Scholarship 2011; 43: 3-12.
19. Hsiao CY, Van Riper M, Lee SH, Chen SJ, Lin SC. Taiwanese nursing students' perceived knowledge and clinical comfort with genetics. Journal of Nursing Scholarship 2011; 43: 125-132.
20. Calzone K, Jenkins J, Rust JE. Establishing and implementing the essential nursing competencies and curricula guidelines for genetics and genomics. Clin Nurs Spec 2007; 21: 265-266.
21. Consensus Panel on Genetic/Genomic Nursing Competencies, 2009. Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines, and Outcome Indicators, 2nd ed. American Nurses Association, Silver Spring, MD.
22. Calzone KA, Jenkins J. Genomics education in nursing in the United States. Annu Rev Nurs Res 2011; 29: 151-172.
23. Kirk M, Calzone K, Arimori N, Tonkin E. Genetics-genomics competencies and nursing regulation. J Nurs Scholarsh 2011; 43: 107-116.
24. Conley YP, Heitkemper M, McCarthy D et al. Educating future nursing scientists: recommendations for integrating omics content in PhD programs. Nurs Outlook 2015; 63: 417-427.
25. Henly SJ, McCarthy DO, Wyman JF, et al. Emerging areas of science: recommendations for nursing science education from the Council for the Advancement of Nursing Science Idea Festival. Nurs Outlook 2015; 63: 398-407.
26. Henly SJ, McCarthy DO, Wyman JF, et al. Emerging areas of nursing science and PhD education for the 21(st) century: response to commentaries. Nurs Outlook 2015; 63: 439-445.
27. Henly SJ, McCarthy DO, Wyman JF, et al. Integrating emerging areas of nursing science into PhD programs. Nurs Outlook 2015; 63: 408-416.
28. Wyman JF, Henly SJ. PhD programs in nursing in the United States: visibility of American Association of Colleges of Nursing core curricular elements and emerging areas of science. Nurs Outlook 2015; 63: 390-397.
29. Terzioğlu F, Dinç L. Nurses' views on their role in genetics. JOGNN 2004; 33: 756-764.
30. Tomatir AG, Sorkun HC, Demirhan H, Akdag B. Nurses' prefessed knowledge of genetics and genetic counselling. Tohoku J Exp Med 2006; 210: 321-332.
31. Calzone KA, Jenkins J, Culp S, Bonham VL, Badzek L. National nursing workforce survey of nursing attitudes, knowledge and practice in genomics. Per Med 2013; 1: 10(7).
32. Calzone, KA, Jenkins J, Yates J, Cusack G et al. Survey of nursing integration of genomics into nursing practice. J Nurs Scholarsh 2012; 44: 428-436.
33. Coleman B, Calzone KA, Jenkins J, et al. Multiethnic minority nurses' knowledge and practice of genetics and genomics. J Nurs Scholarsh 2014; 46: 235-244.
34. Seven M, Akyüz A, Elbüken B, Skirton H, Öztürk H. Nurses' knowledge and educational needs regarding genetics. Nurse Education Today 2015; 35: 444-449.