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University Students' Knowledge and Readiness to Practice Genomic Nursing in Nigeria

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UNIVERSITY STUDENTS' KNOWLEDGE AND READINESS TO PRACTICE GENOMIC NURSING IN NIGERIA

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ABSTRACT

Introduction

Genetic nursing education provides knowledge of traits and inherited diseases. This has not been well integrated into nursing practice in Nigeria.

Aim

This study evaluated university nursing students' knowledge of genomic concepts and readiness to practice genomic nursing in Nigeria.

Methods

A cross-sectional study was conducted. Three universities were purposively selected in Nigeria. A total of 136 participants were recruited using convenient sampling technique. A modified Genetic Nursing Concept Inventory questionnaire was distributed to participants in their classrooms. Data were analyzed

with SPSS (23); descriptive data were presented in tables and figures with their mean and standard deviations. Chi-square test and multivariate analysis were used to ascertain association between variables at $p<0.05$ level of significance.

Results

Findings indicated that participants have poor knowledge (89%) and lack readiness (66%) to practice genomic nursing in Nigeria. Their knowledge influenced their readiness ($\chi^2 = 21.033$, df=1, p=0.001). Institution type was the most consistent predictor of knowledge ($\chi^2 = 48.586$, df=2, p=0.001) and readiness (OR= 14.817, p= 0.326, C.I. = 3.190, 319.57) as those in federal institution were more knowledgeable and prepared to practice genetic nursing. Participants perceived that poor funding, lack of trained personnel, and social/environmental factors could affect their readiness to practice genetic nursing.

Conclusion

The study has brought to the fore that nursing students have low knowledge and were not ready to practice genetic nursing, efforts should be made to look into the adequacy of nursing training on genetic nursing and strategies needed for its integration in education and practice.

Key words: Genomic, Genetics, Knowledge, Readiness, Nursing students, Practice

Contributions of the paper

What is already known about the topic:

- The vast amount of genomic information obtained previously has provided crucial insight into various health issues.
- The importance of genetics education for all healthcare professionals including nurses has been recognized internationally

What this paper adds

- It demonstrates that nursing students in Nigeria has poor knowledge of genomic nursing.
- Also, there was lack of readiness to practice genomic nursing among participants in the selected universities, as it is expected in advanced clinical nursing practice and this calls for urgent integration.
- Being from federal university influenced participants' knowledge and readiness to practice genetic nursing.

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1. Introduction

Genomics provides a static and overall view of an organism's genetic material (Topol, 2014) while genetics is related to specific gene's structure as contained in the cell, genetic variation, and heredity in organisms (Borovska, 2017). Therefore, genetics/genomics should be an integral part of nursing practice because essentially all diseases and conditions have a genetic or genomic component (Consensus Panel on Genetic/Genomic Nursing Competencies (2009). Genetic disorders occur in 2%-5% of all live births with Sickle Cell Diseases as the most common severe genetic disorder (Adeyemo et al., 2018 & Ogamba et al., 2018). Its low prevalence could result from underreporting, the poor standard of healthcare facilities and ill-equipped healthcare personnel including nurses (Ogamba et al., 2018). Inadequate nurses' knowledge of genomics has led to insufficient patient' education (Camak, 2016), they could not help in identifying health risks that correlate with genomic factors (Donnelly et al., 2017) and were not conversant with screening tests and healthcare coordination for individuals and family's genomic issues (Bashore et al., 2018). This provides the premise for this study. Meanwhile, genomics has helped in the past to unravel and improve health-related issues especially within the area of diagnosis and treatment of many diseases (Whitley et al., 2016).

However, genetic training for health professionals has become a global phenomenon. A lot has been documented on what nursing students need to understand about genomic concepts (Collins & Stiles, 2011; Kiray, et al., 2009; Goda, et al., 2019), meanwhile, such has not become materialized. For example, one study identified nurses and physicians' inability to apply the knowledge on genomics to practice (Lopes-Júnior et al., 2017). Another study in Brazil concluded that both students and teachers of undergraduate nursing programs have not taken the chances to grasp genomic concepts, this could be attributed to the contents of current programs which fail to recognize nurses' roles and responsibilities in the practice of genomics (Lopes-Júnior et al., 2015). Munroe et al., (2016) further reported that nursing students' lack of readiness was influenced by their poor knowledge of genomic concept. In contrast to the current, a lack of competency was found among nursing students in a private university (Bashore et al. (2018).

Meanwhile, the Human Genome Project has been the basis for nursing education, and evidence-based practice (Lopes-Júnior et al., 2015). Lack of skill, experience, and knowledge has been found in healthcare professionals at the forefront to adopt and then integrate evidence-based genomic medicine into clinical practice. For that reason, manpower training and capacity building are needed in achieving this across all healthcare disciplines including nursing. So, their knowledge would be built through courses targeted at professional development (Nembaware et al., 2019).

Nursing professionals in this century will have to handle the challenges of modern genomic information to provide personalized care in collaboration with other healthcare providers (Lopes-Júnior et al., 2015). Therefore, the training of those sciences needs to be guided by established the curricula appropriate to the national education and health systems where nursing professionals act (Skirton et al., 2010). Lack of policies and limited implementation of genomic knowledge to practice was found in previous studies (Wonkam et al., 2006; Muzoriana et al., 2017; Abacan et al., 2019). For wider benefits, other African countries should be empowered and studies like this are needed. We hope that exploring genomic knowledge will expose the necessity for designing genetic content-specific curricula for nurses. By this, future nurses will be furnished with the information to cut-back genomic-related illnesses and their risks through risk assessment, diet, lifestyle modification, and personalized therapy.

2. Genetic-related studies are sparse in developing countries including Nigeria and only some were

found among the patients, relatives, and practicing nurses (Ngene et al., 2018; Adejumo et al., 2018). One out of which selected number of nurses were trained in three selected hospital but not widely extended to all Nigerian nurses (Adejumo et al., 2018). This study is first of its kind which examines university nursing students' knowledge and how well they are to practice genetic nursing in the Southern region of Nigeria.

3. Purpose of the study

The purpose of this study is to evaluate nursing students' knowledge and readiness to practice genomic nursing in Nigeria.

4. Specific objectives and research hypotheses

This study was set to address the following objectives:

i. To assess the knowledge of genomic concepts among university nursing students in Nigeria.
ii. To determine Nigeria university nursing students' readiness to practice genomic nursing.
iii. To identify factors influencing their readiness to practice genetic nursing in Nigeria.

The following hypotheses were tested:

i. There is no association between participants' knowledge and readiness to practice genetic nursing in Nigeria
ii. There is no association between association between participants' socio-demographic characteristics and their knowledge of genomic concepts
iii. There is no association between participants' socio-demographic characteristics and their readiness to practice genomic nursing in Nigeria.

The Kolb's experiential learning theory (ELT) was used to guide the study. It describes why students need to transform experiences to learning and apply the learning to practice (Kolb, 1984; 2015). Kolb emphasized that practice readiness and learning environment will assist in a successful transition to nursing practice.

4. Methods

4.1 Study design

A non-experimental cross-sectional study to evaluate students' knowledge and readiness to practice genomic nursing in selected universities offering nursing courses in a Southern state of Nigeria.

4.2 Study setting

Three out of four universities that are training nursing students were purposively selected within the state. Each represents the federal, state and privately own institutions respectively.

4.3 Study population

Participants were full-time final year nursing students.

4.3.1 Inclusion and exclusion criteria

The full-time final year students were included to participate in the study. Meanwhile, the study excluded those that were not physically fit at the time of data collection.

4.4 Sampling technique and sample size

One hundred and thirty-six (136) full-time final year nursing students were selected by a non-probability, convenient sampling technique which was the available students to the researchers at the time of data collection (limited number). Though, the targeted available population for the participants in the three universities was 175. Using the Yamane (1967) formula, the minimum sample size was calculated to be 122 but adjusted at 10% non-response rate to be 136 participants.

4.5 Data collection

Full-time final year nursing students were recruited for the study. In two universities, 50 nursing students were recruited each while 75 students were recruited from the third university (n =175). The instrument for data collection was an adapted Genetic Nursing Concept Inventory questionnaire (Consensus Panel on Genetic/Genomic Nursing Competencies, 2009). Originally, it contains one section on knowledge about genomic concepts covering issues related to human genome basics, mutations, inheritance, genomic healthcare applications and genetic testing, prepared in English language. For the internal consistent reliability of the inventory, the Cronbach's alpha was 0.79, indicating acceptable reliability (Wald, 2011). However, for the

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purpose of this present study, three sections (A, C and D) were added to the inventory in line with the study objectives. In all, there were 74 items in the tool used for data collection excluding the section D. Following the pilot study conducted among 20 nursing students in a school from another region, two ambiguous items were modified in section B and three repeated items were removed from section C. The correlation coefficient (Cronbach's alpha) for internal consistency was 0.76.

Meanwhile, the responses from the pilot study were not included in the analysis of the study population.

These include section A which contains four (4) items eliciting information about participants' socio-demographic characteristics, in section B, there are 60 items eliciting information on participants' knowledge of genomic concepts, with options ranging from A to E where each correct answer attracted '1'point (only one options correct out of the five). Scores below 30 were categorized as poor knowledge while scores of ≥30 were categorized as good knowledge. Section C contains 10 items which assessed participants' readiness to integrate genomic knowledge into practice which was on a 5-point Likert scale (strongly agree = 5, agree =4, undecided =3, disagree =2 and strongly disagree =1) with 50 as the aggregate score. The responses were later categorized into two (with 'strongly agree' and 'agree' responses under 'ready to practice' while undecided, 'disagree' and 'strongly disagree' were categorized under 'not ready'). Scores below 25 was categorized as non-readiness while scores of 25 and above were categorized as readiness to practice genomic nursing. Section D of the tool contains open-ended question inquiring information about participants perceived four (4) factors affecting their readiness to practice genomic nursing, same was presented in a frequency table. Each participant was given the adapted GNCI questionnaire to complete. Data were collected in February, 2020. The researchers gained access to the participants through a member of the study team (who is a lecturer in each of the institution) with the permission of the Heads of each Department. The participants were informed and met in their classrooms within the hours of 3 pm and 4 pm daily until the required sample size was achieved with the administrative supports. Following the explanation on the study purpose, the participants ticked the 'agreed' box on the consent forms, the same were retrieved and they were given the questionnaire to fill. Retrieval of the questionnaires was achieved immediately. Data collection spanned a total of three weeks across the participating institutions.

4.6 Method of data analysis

The data were cleaned, coded and Statistical Package for Social Sciences (SPSS) version 23.00 (IBM corp. released 2012 Armonk, NY, USA: IBM Corp) was used for data analysis; the descriptive data were presented in tables and figures, In this study, aggregate score was determined and 50% cut-off point was used to measure the knowledge and readiness of nursing students to practice genomic nursing, and descriptive analysis was conducted at same level for all categories of participants. The inferential statistical analysis was conducted at the different categories of students to determine the association between the demographic variables, and knowledge and readiness to practice genomic nursing. Sixty items were used to determine the nursing students' knowledge on genomic nursing concepts. Those who scored 50% and above on the measurement scale were considered as knowledgeable and those who scored less than 50% were considered as having insufficient knowledge. Ten items were used to determine the participants' readiness to practice genomic nursing. Those who scored above the average was considered being ready to practice genomic nursing, while those scored less than average of the readiness scale implied as being not ready to practice genomic nursing. The responses for knowledge were based on five options (A-E) out of which only one is correct and the responses for readiness which were initially based on a 5-point Likert scale (strongly agree = 5, agree =4, undecided =3, disagree =2 and strongly disagree =1), were later categorized into two (with 'strongly agree' and 'agree' responses under 'ready to practice' while undecided, 'disagree' and 'strongly disagree' were categorized under 'not ready'). In the categorical variables, tables and charts were used to present the findings. Analysis using the Chi-square was adopted to determine the association between participants' level of knowledge and their readiness to practice, and the association between participants' selected socio-demographic characteristics (age and gender) and their knowledge of genomic nursing concepts. Meanwhile, multivariate analysis was used to establish the association between socio-demographic characteristics and readiness to practice genomic concepts at $p<0.05$ level of significance.

4.7 Ethical considerations

Approval for the study was obtained from the UI/UCH Ethical Review Board with approval number UI/EC/19/0575. Departmental permission to obtain data was granted by the Heads of the participating departments, following the submission of a letter of request. Participants right to confidentiality was ensured by not sharing their responses to anyone but kept in the custody of the researchers for proper data

management, privacy was maintained as they were not required to include their names or any identifier, self-determination was also ensured because participants were not coerced or forced to participate and there was no punishment attached to refusal to participate in the study. Also, they were informed of their freedom to withdraw from participating at any point during the data collection. Consent was taken from the individual respondents after explaining the research purpose.

5 RESULTS

A total of 136 responses were found valid and same were analyzed.

5.1 Socio-demographic characteristics

Participants' socio-demographic characteristics can be found in Table 1 below.

Table 1 **insert here**

5.2 Nursing students' knowledge related to genomic concepts

In the knowledge section of the questionnaire, the mean score was 16.6±8.5 (Table 2). This study revealed that only 15 (11%) participants scored above 50% on the knowledge section of the modified GNCI as shown in Figure 1, this result indicates respondents' low knowledge of genomic concepts.

Table 2 **insert here**

Figure 1 **insert here**

5.3 Participants' readiness to practice genomic nursing

In the readiness section, generally, there was an overall low level of participants' readiness to practice genetic nursing. It is evident that only 46(34%) of the study participants indicated their readiness to practice genomic nursing (Figure 2). Majority 96(70.6%) of the participants declared that they might decide not to do anything related to genomic after they leave school (Table 3). The mean score for participants' readiness to practice genomic nursing was 18.5±13.1. As many as 43(31.7%) of the study participants declared that they would avoid genomics in practice if they have their ways. Some 55(40.4%) of them expressed their satisfaction in practicing genomic nursing in the future. The same proportion of those who responded 44(39.5%) agreed that practicing genomic worth venturing into (Table 3).

Table 3 **insert here**

Figure 2 **insert here**

5.4 Perceived factors affecting the practice of genomic nursing

As shown in Table 4, participants perceived that several factors could affect their decision to practice of genomic nursing in Nigeria. A number of the identified factors were majorly poor funding 15(11.0%), lack of trained personnel 14(10.3%), poor living conditions of most citizens 13(9.6%), environmental influence 11(8.1%), and social factors 10(7.4%). While lack of equipment 2(1.5%), religious factors 8(5.9%), and cultural factors were the least factors identified.

Table 4 **insert here**

5.4 Association between participants' level of knowledge and their readiness to practice genomic nursing.

The result also shows that the level of nursing students' knowledge statistically significantly influences their readiness to practice genomic nursing in Nigeria ($\chi 2 = 21.033$, df=1, p=0.001) as found in Table 5

Table 5 **insert here**

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5.6 Association between participants' selected socio-demographic characteristics (age, and gender) and their knowledge of genomic nursing concepts

Results of this study also indicated that the association between participants' selected socio-demographic characteristics (age and gender) and their knowledge of genomic nursing concepts is not statistically significant at ($\chi2 = 5.478$, df=5, p=0.360) for age and ($\chi2 = 0.199$, df=1, p=0.656) for gender respectively. In addition, the results indicated that association between participants' various institutions and their knowledge of genomic nursing concepts is statistically significant at $\chi2 = 48.586$, df=2, p=0.001 (Table 6).

Table 6 **insert here**

5.5 Association between socio-demographic characteristics (age and institutions) and readiness to practice genomic nursing

In this section, the results indicated that among the age-group of students, those within age 30-34years are ready to practice genomic nursing 0.228 times more than those in other age groups (OR=0.228, p= 0.523, C.I. = 0.002, 21.207) and this is not statistically significant. Also, in terms of institutions, students from School III are ready to practice genomic nursing 14.817 more times more than those from other schools (OR= 14.817, p= 0.326, C.I. = 3.190, 319.57), this is also not significant.

6 Discussion

The study investigated the knowledge and readiness of nursing students to practice genomic nursing in Nigeria. Most of the studies of genomic concepts have measured physicians and registered nurses' knowledge rather than nursing students and their readiness to practice genetic nursing which is the focus of our study. This is essential in particular, with the recent discoveries in genetic implications of most diseases, when nurses need to know the strategies involved in risk identification, reduction and management of genetic-related diseases in form of testing and counseling. In addition to the fact that genomics has helped in the past to unravel and improve health-related issues especially in the area of diagnoses and treatment of many diseases (Whitley et al., 2020 & Moreno et al., 2016), we found that the knowledge of genomic nursing concepts remains significantly poor among nursing students in their final year and the soon becoming healthcare professionals. This finding is consistent with the findings of a cross-sectional study conducted among 54 healthcare professionals (nurses and physicians) in Brazil, which reported poor knowledge of genomic education despite their exposure to genetic content during their undergraduate education (Lopes-Júnior et al., 2017). This suggests an inadequate preparation of

students on genomic-related issues. Therefore, there is an urgent need for stakeholders in nursing education in Nigeria to take relevant steps to meet the demands of the current technological advances in the healthcare landscape.

In our survey, we also found that nursing students were not ready to practice genetic nursing in the future despite its adventurous nature. This is comparable with what was found in a survey conducted among 120 generic undergraduate Bachelors of Science in nursing (BSN) students in Florida. In that study, most (65.1%) students were not ready to apply this knowledge of genomics in the clinical setting (Munroe & Loerzel, 2016). Similarly, in a descriptive, cross-sectional study among 501 Taiwanese undergraduate students where knowledge across students' levels of study was tested using one-way ANOVA, it was reported that their perceived knowledge and clinical comfort with genetics were limited (Hsiao et al., 2011).

Furthermore, inadequate funding of genomic-related research and curricula development, lack of trained personnel, social and environmental factors greatly affect genomic nursing practice in Nigeria as identified by the respondents. Inadequate training of personnel and limited expertise in the medical genetics and genomics field has also been recently reported in other studies among healthcare professionals, including nurses. These affected their inputs in clinical practice (Nembaware et al., 2019; Bashore et al., 2018; Mikat-Stevens et al., 2015). This is suggestive of the need for strategizing to ensure capacity building to at all levels of training and clinical practice. There is also need for administrative support in provision of funds for training, equipment and sustenance of genomic skills. Besides, the complexity of subject material, misconceptions from media, lack of infrastructure or resources for professional development, immature nature of genomic science among others were highlighted as challenges in incorporating genomic education into academic, professional, and public settings (Whitley et al., 2020). Therefore, all efforts to eliminate or reduce these barriers should be put in place through adequate funding towards research, education, training and continuous education, the institution of relevant policy, and its implementation.

The findings from our study also revealed that there seems to be a statistically significant association between participants' level of knowledge and their readiness to practice genetic nursing. A similar report was given about healthcare professionals in Hong Kong, Taiwan, and Mainland China where many gaps in the translation of genetic/genomic medicine into clinical practice were identified (Chair, et al., 2019)

and it was suggested that strategies to ensure effective translation of genomic knowledge should be established. This connotes that they cannot practice what they do not have adequate knowledge about. As such efforts should be intensified to plan genomic nursing training in an attractive manner. The participants' institution was found to statistically significantly associate with their level of knowledge and readiness to practice genetic nursing. This implies that, those with good knowledge were about 6 times more likely to be ready to practice it per chance especially nursing students from School III, as compared to those who were not ready to practice it. This could have been enhanced by personal efforts or previous practical experiences to learn about the concepts. It could also be linked with the nature of the school being a federally owned and funded institution, their level of exposure in the federal teaching hospital affiliated to their university and their interactions with students from other health professions.

The results of this study also have implications on clinical nursing practices and clinical decisions as nurses must know how and be ready to obtain comprehensive family histories, identify family members at risk for developing a genomic influenced condition and for genomic influenced drug reactions, help people make informed decisions about and understand the results of their genetic/genomic tests and therapies, and refer at-risk people to appropriate and specialized healthcare professionals or agencies, knowledge of which they could acquire in learning institutions.

7. Limitations

The conduct of this study in only one state poses a major limitation to its results' generalizability in Nigeria. Also, the relatively small sample size of the study participants, the non-probability sampling technique used in recruiting the participants and the researchers' inability to access the individual school's training curriculum reduce its objectivity. The selection of only final year nursing

students could have limited the generalization of the results as students from other levels of study might have some level of knowledge about genetics. Also, the involvement of lecturers in data collection could have led to participants' selection bias and voluntariness to participate in the study.

8. Conclusion

The findings of this study correctly accentuate the poor knowledge demonstrated by the respondents in this study. It is also clear that knowledge and institution type influence readiness to practice. Therefore, there is an urgent need for government, nurse educators, educational administrators and policymakers to ensure the training curricula content is adequately reviewed to effectively prepare future nurses to meet the challenges of the highly technological and ever-changing healthcare system, as it could be seen that genomics and genetics are influencing personalized nursing care.

8.1 Recommendation for future studies

The actual evaluation of the school curricula with a checklist instead of reported format should be considered in the future. A qualitative approach for data collection will not be out of place to provide a robust data from mixed method or triangulation approach. The study could also be expanded in the future to accommodate all nursing training institutions in Nigeria to provide room for generalization and inform appropriate policy on curricular review. Future study could also focus on investigating the type of association between interest to learn and level of students' knowledge about genetic nursing

9. Declarations

9.1 Ethical approval and consent to participate

The protocol for research has been approved by Institutional review board (IRB) of the University of Ibadan/University College Hospital, Ibadan (UI/EC/19/0575), after reviewing the study protocol. The institutional administrators also offered permission to collect data. Informed consent and participant authorization were sought from the study participants.

10. Availability of data and material

The study materials and instruments used during the current study are available from the corresponding author on reasonable request.

11. Author contributions

Conceptualization: POA, IOO, IOK

Study design: POA, IOK, IOO

Data collection: IOO, OO, WAT

Data analysis: IOK, IOO

Manuscript writings: All Authors

Critical revisions for important intellectual content**: IOK**

All authors have read and agreed to the published version of the manuscript

Declaration of Conflict of interest

The authors hereby declare no conflict of interest in this study

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References

Abacan, M., Alsubaie, L., Barlow-Stewart, K., Caanen, B., Cordier, C., Courtney, E., . . .Wicklund, C. (2019). The Global State of the Genetic Counseling Profession. Eur J Hum Genet, 27(2), 183-197. doi:10.1038/s41431-018-0252-x

Adejumo, P., Aniagwu, T., Oluwatosin, A., Fagbenle, O., Ajayi, O., Ogungbade, D., . . . Olopade, O. (2018). Knowledge of Genetic Counseling Among Patients With Breast Cancer and Their Relatives at a Nigerian Teaching Hospital. Journal of Global Oncology, 4, 1-8. doi:10.1200/JGO.17.00158

Adeyemo, A.A., Amodu, O.K., Ekure, E.E., Omotade, O.O. (2018) Medical genetics and genomics medicine in Nigeria. Mol Genet Genomic Med. 6:314-321. doi.org/10.1002/mgg3.419

Bashore, L., Daniels, G., Borchers, L., Howington, L., & Cheek, D. (2018). Facilitating faculty

competency to integrate genomics into nursing curriculum within a private US University. Nursing: Research and Reviews, Volume 8, 9-14. doi:10.2147/NRR.S165852

Camak, D. (2016). Increasing Importance of Genetics in Nursing. Nurse Education Today, 44. doi:10.1016/j.nedt.2016.05.018

Chair, S. Y., Waye, M. M. Y., Calzone, K., & Chan, C. W. H. (2019). Genomics education in nursing in Hong Kong, Taiwan and Mainland China. Int Nurs Rev, 66(4), 459-466. doi:10.1111/inr.12537

Collins, C. A., & Stiles, A. S. (2011). Predictors of student outcomes on perceived knowledge and competence of genetic family history risk assessment. J Prof Nurs, 27(2), 101-107. doi:10.1016/j.profnurs.2010.09.007

Consensus Panel on Genetic/Genomic Nursing Competencies. Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines, and Outcome Indicators. 2nd ed. Silver Spring, MD: American Nurses Association; 2009

Donnelly, M. K., Nersesian, P. V., Foronda, C., Jones, E. L., & Belcher, A. E. (2017). Nurse Faculty Knowledge of and Confidence in Teaching Genetics/Genomics: Implications for Faculty Development. Nurse Educ, 42(2), 100-104. doi:10.1097/nne.0000000000000297

Goda, H., Kawasaki, H., Masuoka, Y., Kohama, N., & Rahman, M. M. (2019). Opportunities and challenges of integrating genetics education about human diversity into public health nurses' responsibilities in Japan. BMC Nursing, 18(1), 65. doi:10.1186/s12912-019-0391-

Hsiao CY, Van Riper M, Lee SH, Chen SJ, Lin SC. Taiwanese nursing students' perceived knowledge and clinical comfort with genetics. J Nurs Scholarsh. 2011;43(2):125-132.

IBM Corp April 2020. Statistical Product and Service Solutions version 23.00. Armonk, NY, USA: IBM Corp

Kiray Vural, B., Tomatir, A. G., Kuzu Kurban, N., & Taşpinar, A. (2009). Nursing students' self-reported knowledge of genetics and genetic education. Public health genomics, 12(4), 225-232. doi:10.1159/000197972

Kolb, D. A. (1984). Experiential learning: experience as the source of learning and development. Vol. 1. Englewood Cliffs, NJ: Prentice-Hall

Kolb D.A. (2015). Experiential learning: experience as the source of learning and development. (second ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Lopes-Júnior, L., Bomfim, E., & Flória-Santos, M. (2015). Genomics-Based Health Care: Implications for Nursing. International Journal of Nursing Didactics, 5, 1115.

Lopes-Júnior, L., Carvalho Jr, P., Ferraz, V., Nascimento, L., Riper, M., & Flória-Santos, M. (2017).

Genetic education, knowledge and experiences between nurses and physicians in primary care in Brazil: A cross-sectional study: Genetic education at primary care in Brazil. Nursing & Health Sciences, 19, 66-74. doi:10.1111/nhs.12304

Mikat-Stevens, N. A., Larson, I. A., & Tarini, B. A. (2015). Primary-care providers' perceived barriers to integration of genetics services: a systematic review of the literature. Genet Med, 17(3), 169-176. doi:10.1038/gim.2014.101

Moreno, L., Linossi, C., Esteban, I., Gadea, N., Carrasco, E., Bonache, S. Balmaña, J. (2016). Germline BRCA testing is moving from cancer risk assessment to a predictive biomarker for targeting cancer therapeutics. Clin Transl Oncol, 18(10), 981-987. doi:10.1007/s12094-015-1470-0

Munroe, T., & Loerzel, V. (2016). Assessing Nursing Students' Knowledge of Genomic Concepts and Readiness for Use in Practice. Nurse educator, 41(2), 86-89. doi:10.1097/nne.0000000000000210

Muzoriana, N., Gavi, S., Nembaware, V., Dhoro, M., and Matimba, A. (2017). Knowledge, attitude, and perceptions of pharmacists and pharmacy students towards pharmacogenomics in Zimbabwe. Pharm. (Basel Switzerland) 5, 36. doi: 10.3390/pharmacy5030036

Nembaware, V., A. G. M. T. I., Mulder, N., Abidi, O., Akanle, M., Ali, S. A., . . . Wessels, T.- M. (2019). The African Genomic Medicine Training Initiative (AGMT): Showcasing a Community and Framework Driven Genomic Medicine Training for Nurses in Africa. Frontiers in Genetics, 10(1209). doi:10.3389/fgene.2019.01209

Ngene, S.O., Adedokun, B., Adejumo, P., & Olopade, O. (2018). Breast Cancer Genetics Knowledge and Testing Intentions among Nigerian Professional Women. J Genet Couns, 27(4), 863-873. DOI: 10.1007/s10897-017-0194-4

Ogamba C.F., Roberts A.A. Balogun M.R., Ikwuegbuenyi C.A. (2018) Genetic Diseases and Prenatal Genetic Testing: Knowledge Gaps, Determinants of Uptake and Termination of Pregnancies among Antenatal Clinic Attendees in Lagos, Southwest Nigeria. Ann Med Health Sci Res. 8:143-150

Skirton, H., Lewis, C., Kent, A., & Coviello, D. A. (2010). Genetic education and the challenge of genomic medicine: development of core competences to support preparation of health professionals in Europe. Eur J Hum Genet, 18(9), 972-977. doi:10.1038/ejhg.2010.64

Ward, L. D. (2011). Development of the genomic nursing concept inventory [Doctoral dissertation]. Retrieved from ProQuest Dissertation and Theses. Accession Order No. AAT 3460449.

Whitley, K. V., Tueller, J. A., & Weber, K. S. (2020). Genomics Education in the Era of Personal Genomics: Academic, Professional, and Public Considerations. Int J Mol Sci, 21(3). doi:10.3390/ijms21030768

Wonkam, A., Njamnshi, A. K., & Angwafo, F. F., 3rd. (2006). Knowledge and attitudes concerning medical genetics amongst physicians and medical students in Cameroon (sub-Saharan Africa). Genet Med, 8(6), 331-338. doi:10.1097/01.gim.0000223542.97262.21

Yamane, T. (1967). Statistics: An Introductory Analysis, 2nd Edition. Harper and Row.

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Captions for figures

Captions for Tables

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Table 1

Variables	Frequency (n=136)	Percentage	Mean±SD
Age			24.2±7.06
20-24years	85	62.5	
25-29years	27	19.9	
30-34years	6	4.4	
35-39years	3	2.2	
≥40years	1	0.7	
NR	14	10.3	
Gender			
Male	13	9.6	
Female	116	85.3	
NR	7	5.1	
Ethnic group			
Igbo	23	16.9	
Yoruba	66	48.5	
Hausa	5	3.7	
Others	8	5.9	
NR	34	25.0	
Institution names			
DON, Edo State University, Iyamho	20	14.7	
DON, Igbinedon University, Okada	73	53.7	
DON, UNIBEN	43	31.6	

NR = No Response, DON = Department of Nursing, UNIBEN = University of Benin, Benin-city, Nigeria

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Table 2

Variables	Frequency	%
The amount of DNA contained in a single human cell		
23 pairs of chromosomes	32	23.5
1 million genes	26	19.1
3 billion base pairs	25	18.4
6 billion nucleotides	18	13.2
NR	35	25.8
The percentage of the DNA sequence anticipated to be identical between two unrelated people		
100%	16	11.8
About 99%	10	7.4
About 50%	18	13.2
10 to 20%	32	23.5
NR	60	44.1
Component of genes		
Protein	1	0.7
Amino acids	23	16.9
DNA	45	33.1
RNA	54	39.7
NR	13	9.6
The primary function of a gene		
Determine a particular trait for an individual	17	12.5
Allow cell division	8	5.9
Direct the formation of specific protein(s)	82	60.3
Direct a particular physiologic function	14	10.3
NR	15	13.0
The characteristics of the code contained in gene		
For a specific trait	87	64.0
It has one or more proteins	8	5.9
It has a particular physiologic function	9	6.5
It is for cell division	8	5.9
NR	24	17.7
Description of the flow of genetic information		
Chromosomes contain the code to make genes	33	24.3
Genes contain the code to make DNA	32	23.5
DNA contains the code to make proteins	25	18.4
Proteins contain the code to make genes	5	3.7
NR	41	30.2
The description of DNA "sequence"		
The order of nucleotides	57	41.9
The order of genes	28	20.6
The order of chromosomes	30	22.1
The order of proteins	10	7.4
NR	11	8.1

The relationship between nucleotides, base pairs and genes		
Adjacent base pairs form a gene; nucleotides are located near the gene	22	16.2
Two nucleotides create a base pair, adjacent base pairs form a gene	43	31.6
Multiple base pairs form a nucleotide, and adjacent nucleotides form a gene	40	29.4
Many base pairs form a gene, and genes are organized into nucleotides	18	13.2
NR	13	9.6
The description of a group of genes		
A nucleotide	18	13.2
A protein	56	41.2
A chromosome	20	14.7
An allele	20	14.7
NR	22	16.2
The description of the physical relationship between genes and chromosomes		
Chromosomes are organized into genes	22	16.2
Genes are organized into chromosomes	48	35.3
Both genes and chromosomes are contained on a strand of DNA	38	27.9
Genes and chromosomes are physically distinct	7	5.1
NR	21	15.5
Account of what happens when a gene is expressed		
It is copied to create a new gene (duplicated)	29	21.3
It results in a visible trait or characteristic	34	25.0
It causes a protein to be formed	54	39.7
It initiates cell division	6	4.4
NR	13	9.5
Description of a gene that is expressed		
It is copied to form DNA	29	21.3
It is manifested as a physical trait	41	30.1
It is replicated	6	4.4
It is transcribed and translated into a protein product	49	36.0
NR	11	8.1
The period of gene expression		
It happens constantly, if the gene is dominant	15	11.0
It occurs when a cell is preparing to divide	30	22.1
It occurs when a chemical signal turns the gene on	5	3.7
It happens when the gene senses a need for its product	56	41.2
NR	30	22.1
A laboratory test to determine if a gene is being expressed		
Examines the DNA sequence of the gene	34	25.0
Tests the order of bases within the mRNA	26	19.1
Reveals the quantity of amino acids available for protein building	13	9.6
Shows the amount of mRNA transcribed from the gene	51	37.5
NR	12	8.8
Description of a genotype		
It is a specific type of gene	26	19.1
It is a set of genes that encode a particular trait	33	24.3
It is a set of dominant genes	32	23.5

It is an individual's unique total collection of gene variants	17	12.5
NR	28	20.6
An individual's phenotype for a particular trait matches their genotype for that Trait		
When the trait is influenced by environmental factors	22	16.2
When the trait is determined by one gene pair	29	21.3
When the gene or genes that determine the trait are expressed	39	28.7
When the trait is readily visible	11	8.1
NR	35	25.7
Location of the Insulin gene in the body		
The cells in the liver	36	26.5
The cells in the blood	18	13.2
The cells that utilize glucose	32	23.5
The pancreatic beta cells	36	26.5
NR	14	10.3
Description of an allele		
It is part of a gene	36	26.5
It is a trait	29	21.3
It is the product of a gene	21	15.4
It is a version or alternate form of a gene	37	27.2
NR	13	9.6
The role of insulin gene in maintaining glucose homeostasis		
It directs production of enzymes involved in glucose regulation	49	36.0
It monitors blood glucose levels and signals pancreatic cells to release insulin	29	21.3
It signals pancreatic beta cells to release insulin	23	16.9
It encodes insulin	8	5.9
NR	27	19.8
The purpose of cell transcription and translation		
For division	41	30.1
For the production of new genes	33	24.3
For proteins synthesis	30	22.1
For the production of both DNA and proteins	18	13.2
NR	14	10.3
The description of the relationship between a gene and a protein		
Genes are made of protein	22	16.2
Genes are made by proteins	37	27.2
Genes contain the code to form proteins	53	39.0
Proteins help genes to function	12	8.8
NR	12	8.8
A 54-year-old female who is about to begin treatment for a new diagnosis of atrial fibrillation. Helen is known to be heterozygous for a gene named VKOR.		
It means she has a single copy of the VKOR gene	33	24.3
It means she has two copies of the VKOR gene; one is dominant and one is recessive	23	16.9
It means she has two copies of the VKOR gene that are different in some way	42	30.9
It means she inherited an altered VKOR gene from her mother	23	16.9
NR	15	11.1

The VKOR gene is associated with response to the anticoagulant, warfarin.		
The nurse should note that Helen will most likely be anticoagulated too much with warfarin administration	38	27.9
The nurse should consider that Helen will most likely not be anticoagulated enough	51	37.9
The nurse should be aware of Helen's high risk of developing an allergy to warfarin	26	19.1
The nurse should know that Helen's response to warfarin may be different from Expected	10	7.4
NR	11	8.1
The best explanation for HD in affected individuals		
People with Huntington disease have the HTT gene; unaffected people do not	36	26.5
People with HD have an incorrect number of HTT genes	39	28.7
People with HD have an altered form of the HTT gene	23	16.9
In people with HD, the HTT gene is expressed; in unaffected people it is not expressed	11	8.1
NR	27	19.8
A few genetic diseases are known to be 100% penetrant.		
It means that the affected individuals have the altered gene present in all of their cells	47	34.6
It implies that all offspring of affected individuals will be affected	29	21.3
It indicates that every individual who inherits the altered gene will develop the disease	9	6.6
It means that individuals who are affected will have all signs and symptoms of the Disease	38	27.9
NR		
Explanation for the variation in symptoms between two brothers who both have inherited neurofibromatosis (NF) from their father		
Jake inherited a dominant form of the NF gene and Allen inherited a recessive form	43	31.6
The DNA sequence of the gene associated with NF is different in Jake compared to Allen	20	14.7
Environmental factors were harmful in Jake and protective in Allen	7	5.1
Jake and Allen inherited the same form of the NF gene, but the gene was expressed differently in Jake compared to Allen	36	26.5
NR	30	22.1
The implications of four women who have a positive family history of breast cancer at a community breast cancer screening.		
Freda, whose mother was diagnosed with left breast cancer at age 55 is at least risk to develop hereditary breast cancer	30	22.1
Jane, whose paternal grandmother was diagnosed with bilateral breast cancer at ages 45 and 52 is at least risk to develop hereditary breast cancer	17	12.5
Liz, whose sister was diagnosed with right breast cancer at age 45 is at least risk to develop hereditary breast cancer	22	16.2
Monica, whose maternal aunt was diagnosed with cancer of the right breast at age 68 is at least risk to develop hereditary breast cancer	38	27.9
NR	29	21.3
The cells that contain the breast Cancer (BRCA1) mutation		
Are the breast cells	27	19.9
Are the only tumor cells	46	33.8
Are the adipose cells	12	8.8
Are the cells in patient's breasts and reproductive organs	30	22.1
NR	21	15.5

The description of Anna's risk of passing the BRCA 1 gene to her children		
All her children, regardless of gender, will inherit one copy of the BRCA1 gene from Anna	18	13.2
All her daughters will inherit the BRCA1 gene; her sons will not	21	15.4
Each daughter has a 50% risk to inherit the BRCA1 gene; her sons are not at risk	17	12.5
Each of her children, regardless of gender, has a 50% chance to inherit the BRCA1 Gene	43	31.6
NR	37	27.3
Explanation of the situation where Anna joins a support group of women with BRCA1 mutations.		
The DNA sequence of the BRCA1 genes in these women is most likely identical	25	18.4
The women have identical mutations, although there may be other differences in DNA sequence within their BRCA1 genes	42	30.9
The DNA sequence within the women's BRCA1 genes varies according to whether they have a dominant or recessive form of the gene	23	16.9
The women most likely have unique BRCA1 mutations	13	9.6
NR	33	24.2
The true picture of discrimination based on genetic testing		
Federal law considers genetic testing to be no different from any other type of laboratory testing, although some states have specific laws about genetic testing	39	28.7
Federal law prohibits discrimination in health insurance and employment	13	9.6
Federal law prohibits discrimination in health insurance, employment, and life Insurance	36	26.5
The Health Insurance Portability and Accountability Act (HIPAA) specifically protects against any discrimination based on genetic testing	19	14.0
NR	29	21.2
The cells which have cancer mutations when the patient's breast cancer is not Hereditary		
All her breast cells	41	30.1
Only tumor cells	37	27.2
Her adipose cells	19	14.0
Cells in her breasts and reproductive organs	28	20.6
NR	11	8.1
The description of the dangers in a genetic family history		
The early onset of heart disease	24	17.6
The bilateral breast cancer	40	29.4
The various forms of cancer in multiple family members	24	17.6
A single spontaneous miscarriage	31	22.8
NR	17	12.5
The primary benefit of including common multifactorial OR COMPLEX conditions such as hypertension and diabetes in a genetic family history		
Is to track diseases in families	16	11.8
Is to inform family planning decisions	20	14.7
Is to help establish a diagnosis	28	20.6
Is to predict risk for disease	43	31.6
NR	29	21.3

A disease or health condition is said to be inherited in a dominant pattern		
When a single copy of the altered gene is sufficient to cause disease	28	20.6
When two copies of the altered gene are required to cause disease	34	25.0
When the disease occurs in male offspring more often than female offspring	27	19.9
When all offspring of an affected parent are also affected	21	15.4
NR	26	19.1
A disease or health condition inherited in a dominant pattern		
Affects all offspring of an affected parent	45	33.0
Is transmitted from a parent to offspring of the same sex	25	18.4
Occurs due to several mutations on the same chromosome	16	11.8
Occurs when both genes in a pair are altered	25	18.4
NR	25	18.4
The description of an autosomal disorder		
It is automatically expressed when a single altered copy of a gene is inherited	23	16.9
It results in production of antibodies to one's own tissues	46	33.8
It is inherited equally by male and female offspring	16	11.6
It occurs due to several mutations on the same chromosome	21	15.4
NR	30	22.3
James is diagnosed with cystic fibrosis (CF), an autosomal recessive disorder		
This implies that both his parents must be CF carriers	29	21.3
It means one parent must be affected with CF	50	36.8
It means both parents must be affected with CF	20	14.7
This is an indication that there is insufficient information to make any of the above Inferences	9	6.6
NR	18	20.6
Description of Joe's genotype for the condition		
It is most likely to be homozygous	30	22.1
It is most likely to be heterozygous	20	14.7
It is equally likely to be homozygous or heterozygous	23	16.9
It is most likely to be dominant	32	23.5
NR	31	22.8
The child's risk to have inherited Joe's condition		
It is100%	28	20.6
It is 75%	41	30.1
It is only 50%	24	17.6
It is just 25%	20	14.7
NR	23	16.9
After two years, Joe and Sally's son, Michael, has been diagnosed with the same condition as Joe, and a second son is born. The description of the new baby's chance to carry the same diagnosis as his father and brother		
Is that the new baby is certain to have the condition	50	36.8
He has the same chance as his brother Michael had	38	27.9
His chance is less than 100% but greater than the chance Michael had	9	6.6
He has a lesser chance than Michael had	19	14.0
NR	20	14.7

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Years later, Joe and Sally have had two sons who are both affected with Joe's condition. The prediction of the baby girl they were expecting to also have Joe's conditions.		
Her risk is the same as that of each of her brothers	53	39.0
Her risk is greater than that of her brothers, since both brothers are known to be Affected	18	13.2
Her risk is less than that of her brothers, since both brothers are known to be affected	15	11.0
Her risk is less because she is female	32	23.6
NR	18	13.2
Jacob has Duchenne Muscular Dystrophy (DMD), an X-linked condition. Given that information		
It is likely that his father also has DMD	16	11.8
Either his mother or his father is likely to be a DMD carrier	28	20.6
Both his mother and father are likely to be DMD carriers	27	19.9
His mother is likely to be a DMD carrier	44	32.4
NR	21	15.4
The nurse's consideration of the red flag indicating a possible need for genetic referral when creating a genetic pedigree		
A previous miscarriage	14	10.3
Breast cancer in her mother at age 64	43	31.6
Coronary bypass surgery in her father at age 52	48	35.3
A sister who had twins	13	9.6
NR	18	13.2
Difference between genetics and genomics in healthcare		
Genomics is the application of genetic information to improve health outcomes	29	21.3
Genomics considers effects of multiple genes in addition to environmental effects	53	39.0
Genetics is broader in scope than genomics	8	5.9
Genomics is concerned with molecular activities, and genetics is concerned with clinical outcomes	16	11.8
NR	30	22.1
The description of a genetic disease		
It is apparent at birth	41	30.1
It is caused by the deletion of genetic material	33	24.3
It is caused by one or more genes (unique?) which are present in affected individuals and not present in people without the disorder	8	5.9
It is caused by genetic material that is present in all individuals but altered in affected Individuals	23	16.9
NR	31	22.8
Reason for most genetic diseases		
An alteration in DNA sequence	41	30.1
Missing or extra DNA	22	16.2
An incorrect number of chromosomes	44	32.4
The presence of a gene that is not found in healthy individuals	2	1.5
NR	27	19.8
Description of the role of genetics in cancer		
Cancer is caused by mutations in genes with roles in cell growth and cell division	40	29.4

Most forms of cancer have no genetic basis	29	21.3
Most cancer is directly caused by inherited genetic variations	11	8.1
Most cancer occurs due to genetic predisposition along with environmental triggers	25	18.4
NR	31	22.8
A way by which pharmacogenomics is expected to make the biggest change in Healthcare		
Increase in genetic testing	20	14.7
Personalized prescribing	37	27.2
Better prediction of disease risk	47	34.6
Increased focus on disease prevention	17	12.5
NR	15	11.1
The description of the genetic influence on human drug response		
Genes interact variably with drugs, according to the gene's DNA sequence	39	28.7
Genes cause the immune system to react variably to drugs	40	29.4
Genes change cells to make them more or less responsive to drugs	28	20.6
Genes direct the formation of proteins which interact variably with drugs	18	13.2
NR	11	8.1
Description of a drug receptor		
A Protein	38	27.9
An Enzyme	35	25.7
A Structure or organelle	32	23.5
An Antigen	17	12.5
NR	14	10.3
The implications of hereditary breast cancer test results of two people when Laurie's test was positive for BRCA1 and Carrie's test was negative.		
It means that Laurie's DNA includes a BRCA1 gene; Carrie's DNA lacks that gene	47	34.6
Both sisters have BRCA1 genes but Laurie's is altered	30	22.1
It could be that Laurie has a dominant form of the BRCA1 gene; Carrie has a recessive Form	23	16.9
Both sisters have identical BRCA1 genes, but the gene is expressed only in Laurie	8	5.9
NR	26	20.6
The implication of Laurie's positive BRCA1 test for her health		
She probably has breast cancer now	44	32.4
She needs a biopsy to determine if she has breast cancer	19	14.0
She will develop breast cancer in the future	22	16.1
She has a greater-than-average risk to develop breast cancer	37	27.2
NR	14	10.3
In Africa, the implication of testing positive during every newborn is the screening of every newborn for various genetic diseases.		
The newborn has a genetic disease	12	8.8
He/she may have genetic disease and requires more testing	46	33.8
He/she may develop a genetic disease	20	14.7
The newborn is a carrier for a genetic disease	43	31.6
NR	15	11.0
The primary purpose of a screening test		
To diagnose a specific condition	30	22.1

To identify individuals who are at increased risk to have a specific condition	23
To diagnose a condition before the onset of symptoms	43
To identify carriers in a population	12
NR	30
Location of the breast cancer gene	
It is found only in females	30
It is normally found in all humans, and its alteration increases risk for cancer	47
It is found in all humans but only increases cancer risk in females	33
It is found in male only	13
NR	13
Carrier testing might be done to see if an asymptomatic individual	
Carries a recessive gene that could be passed to offspring	52
Carries either a dominant or recessive gene that could be passed to offspring	18
Carries a pathogen that could be transmitted to others	17
Carries a gene or genes that could cause disease in the future	16
NR	33
The characteristics of the most common mutation.	
It is an alteration in DNA sequence	66
There is an extra or missing gene	22
It is an extra or missing chromosome	27
There is an alteration in gene shape	10
NR	11
The effect of a mutation on health	
It is more likely to be beneficial	25
It is more likely to be harmful	23
It is more likely to be either – mutation effects are random	39
It more likely to result in death	24
NR	25
The most common way that mutations lead to disease	
It causes increased DNA replication	32
It directs the formation of altered proteins or unexpected amounts of proteins	28
It disrupts the function of the cell containing the mutation	49
It evades or weakens the body's immune response	10
NR	17

NR = No Response, Mean±SD = 16.6±8.5, **Total score =** 60, **Range of scores =** <30 =poor knowledge, ≥30 good knowledge

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Table 3

Readiness to practice genomic nursing	**SD** **Fr (%)**	**D** **Fr (%)**	**UD** **Fr (%)**	**A** **Fr (%)**	**SA** **Fr (%)**
I will like to learn about genomic nursing	13(9.6)	17(12.5)	43(31.6)	38(27.9)	25(18.4)
I feel genomics will be difficult to understand	18(13.2)	34(25.0)	49(36.1)	29(21.3)	6(4.4)
The genomics that will be taught in school will be useful in understanding other subjects	8(5.8)	23(16.9)	34(25.0)	53(39.0)	18(13.2)
Understanding genomics will be important in my nursing practice	11(8.1)	11(8.1)	38(28.0)	49(36.0)	27(19.9)
I might decide to do something related to genomic after I leave school	13(9.6)	28(20.6)	55(40.4)	31(22.8)	9(6.6)
I plan to utilize the genomics being taught in school in the care of my patients	12(8.8)	9(6.6)	43(31.6)	54(39.7)	18(13.2)
Genomics knowledge that will be acquired will enhance my client in making informed decision about their care	13(9.6)	17(12.5)	30(22.0)	48(35.3)	28(20.6)
I will avoid the use of genomics in practice even if I were taught in school	27(19.9)	31(22.8)	35(25.7)	30(22.1)	13(9.6)
I feel I will be satisfied practicing genomic nursing	8(5.9)	23(16.9)	50(36.8)	40(29.4)	15(11.0)
I feel practicing genomic is lucrative to venture Into	7(5.1)	21(15.4)	54(39.8)	40(29.4)	14(10.3)

SD= Strongly disagree, D = Disagree, UD = Undecided, A = Agree, SA = Strongly Agree
Mean±SD = 18.5±13.1, **Total score** = 50, **Range of scores =** <25 = Not ready, ≥25 = Ready

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Table 4

Factors	Frequency (n=136)	Percentage
Religious	8	5.9
Cultural	9	6.6
Social	10	7.4
Environmental	11	8.1
Individual lifestyle	8	5.9
Age and life course	9	6.6
Living condition	13	9.6
Poor funding	15	11.0
Lack of trained personnel	14	10.3
Lack of equipment	2	1.5
NR	37	27.1

NR = No Response

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Table 5

	Knowledge of genomic concepts				
Readiness to practice genomic nursing	**Poor**	**Good**	**Chi-square test statistic χ^2**	**df**	**p-value**
Not ready	88(72.7%)	2(13.3%)	21.033	1	0.001
Ready	33(27.3%)	13(86.7%)			

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Table 6-

Socio-demographic variables	**Knowledge of genomic nursing concepts**		**Chi-square test statistic χ^2**	**df**	**p-value**
Age	**Poor**	**Good**			
20-24years	72(59.5%)	13(86.7%)	5.478	5	0.360
25-29years	26(21.5%)	1(6.7%)			
30-34years	5(4.1%)	1(6.7%)			
35-39years	3(2.5%)	0(0.0%)			
≥40years	1(0.8%)	0(0.0%)			
NR	14(11.6%)	0(0.0%)			
Gender			0.199	1	0.656
Male	11{9.6%)	2(13.3%)			
Female	103(90.4%)	13(86.7%)			
Institutions			48.586	2	0.001
School I (State-owned),	9(7.4%)	11(73.3%)			
School II (Privately owned)	73(60.3%)	0(0.0%)			
School III (federally owned)	39(32.2%)	4(26.7%)			

df = degree of freedom, DON = Department of Nursing, UNIBEN = University of Benin

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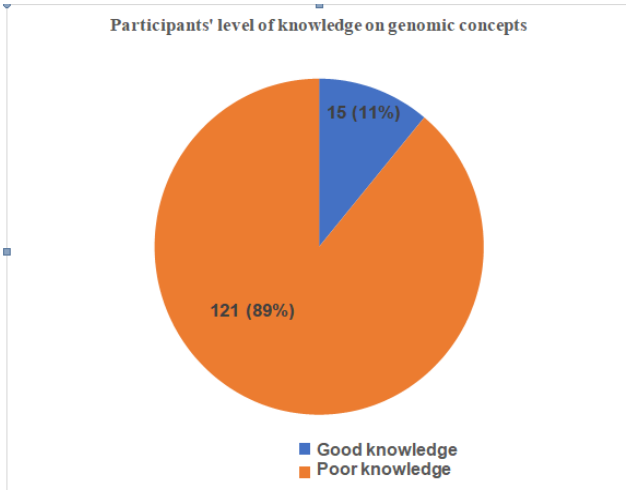
Table 7

Variables (B) Odd	B	S. E.	Wald	df	p-value	Exp ratio	95% C.I for Exp (B) Lower	Upper
Age								
20-24	-3.165	2.388	1.757	1	0.185	0.042	0.000	4.549
25-29	-2.904	2.257	1.656	1	0.198	0.055	0.001	4.568
30-34	-1.477	2.312	0.408	1	0.523	0.228	0.002	21.207
35-39	-22.167	8317.9	0.000	1	0.998	0.000	0.000	0.0000
Institutions								
School I (State owned)	1.871	1.202	2.422	1	0.120	6.495	0.615	68.548
School II (privately owned)	-4695	1.353	12.05	1	0.001	0.009	0.001	0.1290
School III (Federally owned)	2.696	2.747	0.963	1	0.326	14.817	3.190	319.57

S.E.: Standard Error, df: degree of freedom, CI: Confidence Interval

Journal Pre-proofs

Figure 1



Journal Pre-proofs

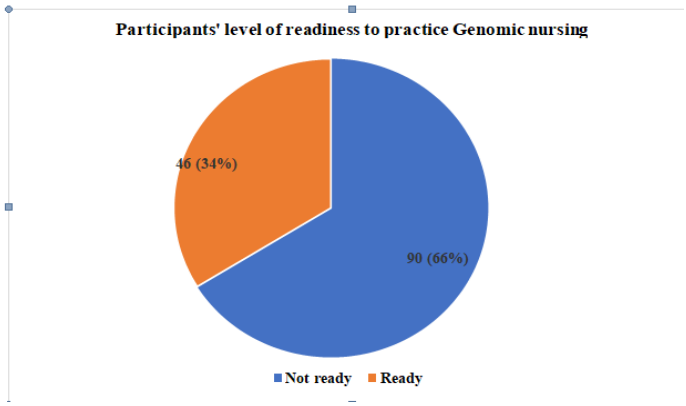


Figure 2:

Journal Pre-proofs