



Exploring the Attitudes, Beliefs and Perceptions of Undergraduate and Graduate Students in Bangladesh towards Precision Medicine and Pharmacogenomics Practice: A Qualitative Study

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Abstract:

The aim of this study is to investigate the attitude, beliefs, and perceptions among undergraduate and graduate students toward precision medicine (PM) and pharmacogenomics (PGx) practice. A cross-sectional survey is conducted amongst students from different universities in Bangladesh. The results of the survey showed that the majority of students had a positive attitude towards precision medicine and pharmacogenomics, perceiving it as a means to improve diagnosis and treatment accuracy. Furthermore, many students also expressed a willingness to learn more about precision medicine and pharmacogenomics, suggesting that there is potential for these practices to be utilized in Bangladesh. Particularly in this study, 337 students from life science and relevant programs participated. From this study, it is shown that 84% of graduate students and 74% of undergraduate students thought PM is a promising healthcare model. In addition, 39% of students are highly encouraged to pursue their post-graduation in the subject areas of PGx and PM to support patients. The majority (62%) thought that patient privacy was the ethical concern most closely related to pharmacogenomic testing, while 19% of respondents thought that data confidentiality was the key issue. The results provide insight into the potential of precision medicine and pharmacogenomics in Bangladesh and suggest that further research into the attitudes of healthcare professionals should be conducted in order to take full advantage of the potential of these practices.

INTRODUCTION

Precision medicine is a novel approach to medical care that considers a person's genetic background, lifestyle, and environmental circumstances. It has

gained popularity in recent years (1, 2). It is a strategy that is made significant by molecular diagnostics and contradicts the conventional method of treating all patients in the same state with the same medication and

dosage (3). However, personalized medicine uses data about a person's particular genes or proteins to treat disease (4). It has the ability to shape various aspects of clinical practice and enhance early diagnosis to the treatment of disease (5). The study of numerous genes or gene patterns and simultaneous examination of their structure and expression are required for pharmacogenomics practice (6). It is also important to investigate how variations in the human genome affect an individual's response to particular drugs. In twenty centuries, the human genome project (HGP) reported that humans have approximately 20,500 genes and that 99.5 percent of the genes are analogous, only 0.5 percent of the genes have differences that are accountable for the specific groups and cause-specific diseases (7, 8). Therefore, the emphasis has shifted to using genetic techniques to identify markers for therapeutic response.

The number of SNPs linked to medication reactions will increase at a never-before-seen rate during the coming years. The task is to sort through the pertinent SNPs and show the clinical validity and efficacy of these SNPs as Pharmacogenomics indicators (9). In the human genome NSP is the most prevalent type of DNA sequence variation (10). Approximately 11 million SNPs in the human genome which an average one SNPs found in 1300 base pairs. It is act as a biological markers and determine an individual's response to certain drugs and risk of developing diseases (11, 12).

Adverse drug reactions (ADRs) are the fourth major cause of mortality in the United States, and it is thought that 2.74 million ADRs and 128,000 fatalities are caused each year by prescription medications (13). As a result, one out of every five wounds or deaths among hospitalized patients are caused by ADRs, which have an annual cost of \$136 billion greater than the combined expenditures of treating diabetes and cardiovascular disease (13). The goal of PGx discoveries is to maximize the advantages of drugs while minimizing any negative effects and healthcare expenses (12).

According to the recent pharmacogenomics report, the Food and Drug Administration's (US-FDA) collection of medications that have been labeled before use currently includes more than 350 drugs (14). These drugs are often referring to multiple pharmacogene, resulting in ~15% of all approved drugs having pharmacogenomics information on their labels (8, 15) In order that pharmacogenomics and personalized medicine approach played a crucial role in preventing genetic disorder. However, the concern arises with genetic testing that must satisfy specific requirements with respect to their clinical utility, clinical validity, and analytical validity before use in clinical context (16, 17). In addition, concerns about the security and privacy of a patient's pharmacogenomics data are also

raised by personalized medicine approaches (18).

The public's awareness of the molecular uses and characterization of PGx and PM during the COVID-19 outbreak in Bangladesh has increased because to the advancement of genome sequencing research. (19, 20, 21, 22). Surprisingly, there are presently no local studies that address the public's knowledge and perceptions about PM, PGx, and genetic testing, and there is no educational program at the undergraduate and graduate levels. Information regarding PM, PGx and its testing are very low, but few studies are available from Asia (2, 4). The majority of the report arrived from USA and Europe (23, 24). On the other hand, knowledge and awareness of these are crucial since they could be used as a guide when developing national policy and curriculum.

This research article explores the attitudes, beliefs, and perceptions of undergraduate and graduate students in Bangladesh towards precision medicine and pharmacogenomics practice. A qualitative approach was employed in order to gain insight into the participants' perspectives. The focus of this survey was to analysis insight into the views and opinions of students in Bangladesh towards precision medicine and pharmacogenomics practice, and to provide a foundation for future research on the topic. This study is significant as it provides valuable insight on the views of the student population towards precision medicine and pharmacogenomics practice, which in turn can be used to provide a better understanding of the general population's perspective, can also be used to inform future research on the topic, as well as provide a platform for further discussion on the implications of precision medicine and pharmacogenomics practice (25, 26).

METHODOLOGY

Study Design

Cross-sectional research was carried out over the course of four months, from July 1 to October 25, 2022. The purpose of this population-based cross-sectional study was to examine the understanding, attitudes, and application of pharmacogenomics and personalized medicine. A combination of qualitative and quantitative data was used to conduct the study. Current students from a number of Bangladeshi universities qualified as participants. The total number of 337 graduate and undergraduate students contributing to the survey were from life science backgrounds, as well as those with backgrounds in various fields outside of molecular life science and health science. They could communicate in English, ranged in age from 18 to 60, and were citizens of Bangladesh with various socioeconomic backgrounds and educational institutions. On the basis of a question from the Mahmutovic et al. study, an online questionnaire was made and updated and

given to participants to answer in order to learn how undergrads studying molecular life sciences and health felt about PGx and PM (3). Each and every participant was fully informed of the study's purpose prior to the data collection.

Sampling and Data collection

The 39 questions in the survey were separated into three groups as follows: Part 1 consists of demographic information, including ages, gender, and educational attainment. About 15-20 question related to pharmacogenomics and personalized medicine included in part 2 and was concerned through knowledge and awareness related questionnaire. Part-3 of the survey included five to seven multiple-choice questions about respondents' opinions about pharmacogenomics and the practice of personalized medicine. Definition of pharmacogenomics/Pharmacokinetics test were given to the respondents which were included in the introduction of the survey. In this survey these question answers where yes/no/I don't know (not sure). The survey also included multiple-choice questions and a Likert scale for rating of agreement with various statements like agree, disagree, no opinion, neutral. The aim and objectives of this study were described in the introductory cover page attached to the questionnaire

and invited students to participate in it.

STATISTICAL ANALYSIS

All categorical variables were presented as frequencies and percentages, including participant professional information, demographics and response to question concerning participants' opinions of PGx and PM. Data analysis was conducted using Microsoft excel and SPSS software. In order to calculate proportions, descriptive statistics were utilized. Chi-square test were used to determine the relationship between demographic factors and response and understanding, perception, and practice of pharmacogenomics and precision medicine. The p values were determined via appropriate statistical test. All statistical tests were performed with a significance threshold of 5%, and the odd ratio (OR) and correspondence 95% confidence intervals (CI) were computed.

RESULT

Participants' demographics

Table 1 summarizes the student's demographic information as well as their employment history. The current study included 337 students who consented to fill out the questionnaire. Most of the students

Table 1. Student's demographic characteristics and professional information.

	Total	Undergraduate student	Graduate student	* MLS & HS	**Non-MLS & HS	P value
Gander						
Male	157	111	46	131	26	0.025
Female	180	146	34	166	14	
Age						
<19	7	7	0	3	4	P<1
19-26	262	234	27	234	28	
27-40	67	16	51	60	7	
41-50	2	0	2	1	1	
51-60	0	0	0	0	0	
>60	0	0	0	0	0	
Number of family member						
<4	61	40	21	50	11	0.094
4-6	227	177	50	200	27	
6-10	31	27	4	29	2	
>10	18	13	5	18	0	
Family income						
<25000 TK	89	72	17	81	8	0.546
25000-50000 TK	147	107	40	132	15	
50000-100000 TK	82	63	19	66	16	
>100000 TK	19	15	4	18	1	
Level of education						
HSC	26	26	0	23	3	P<1
BSc	231	231	0	207	27	
MSc	77	0	77	67	10	
MPhil	0	0	0	0	0	
PhD	3	0	3	3	0	
*MLS & HS= Molecular Life Science & Health Science, this area includes Biochemistry & Molecular Biology, Genetics and Biotechnology, Medicine, Health Studies, Microbiology, Pharmaceutical Sciences. **Non-MLS & HS= Non- Molecular Life Science & Health Science, it includes Computer Science, Electrical and Electronic Engineering, Journalism, Anthropology, BBA						

were aged between 19–26 years. Among the 337 participants, 257 were undergraduates and 80 were graduates. Among them, 180 (53%) were female and 157 (47%) were male.

Students' attitudes towards pharmacokinetics practice and personalized medicine

Various question and responses used to assess pharmacogenomics knowledge were shown in table 2.

Table 2. Students' attitudes towards pharmacogenetics practice and personalized medicine

	Total	Undergraduate student	Graduate student	*MLS & HS	Non-MLS & HS	P value
Do you know some genetic disease transmitted by inheritance from one generation to another?						
Yes	284	219	65	259	25	0.678
No	32	22	10	23	9	
Don't know	10	7	3	9	1	
Not sure	11	9	2	6	5	
Do you think; Genetic Counselor can help you to refer to the right doctor about genetic disease related issues?						
Yes	284	212	72	254	30	0.175
No	13	9	4	11	2	
Don't know	18	16	2	16	2	
Not sure	22	20	2	16	6	
Do you know; action of drugs can vary person to person. For this reason, personalized medicine is very important.						
Yes	303	230	73	268	35	0.024
No	12	6	6	12	0	
Don't know	9	8	1	9	0	
Not sure	13	13	0	8	5	
Do you know about 'companion diagnostics'?						
Yes	115	84	31	110	5	0.078
No	161	127	34	136	25	
Don't know	33	21	12	29	4	
Not sure	28	25	3	22	6	
Have you heard about personal genome testing companies?						
Yes	152	104	48	136	13	0.009
No	136	116	20	120	22	
Don't know	30	22	8	24	4	
Not sure	19	15	4	18	1	
Have you ever had an adverse drug reactions?						
Yes	106	73	33	95	11	0.155
No	167	131	36	147	20	
Don't know	44	36	8	38	6	
I have never taken any medication	20	17	3	17	3	
Have you ever found that a particular drug not work for you?						
Yes	137	103	34	126	11	0.697
No	123	92	31	113	10	
Don't know	56	44	12	42	14	
I have never taken any medication	21	18	3	16	5	
To what extend do you think that genes influence your health?						
Completely	127	81	46	120	7	0.0001
Moderately	129	110	19	113	16	
Not at all	19	18	1	14	5	
Don't know	62	48	14	50	12	
Would you consider having a genetic test done to find out what illness you might develop in the future?						
Yes	248	183	65	224	24	0.080
No	43	33	10	35	8	
Don't know	46	41	5	38	8	
I have never taken any medication	56	44	12	42	14	
Do you agree that personalized medicine represents a new and promising healthcare model?						
Yes	262	195	67	239	23	0.334
No	17	14	3	12	5	
Don't know	58	48	10	46	12	
I have never taken any medication	21	18	3	16	5	
Would you consider contacting a personal genome testing company and ordering a pharmacogenomic test for yourself?						
Yes	157	106	51	150	7	0.0002
No	68	50	18	56	12	
Not sure	77	70	7	62	15	
Don't know	35	31	4	29	6	

Continue the table 2. Students' attitudes towards pharmacogenetics practice and personalized medicine

If a pharmacogenomics test revealed that a prescribed drug would either be ineffective or cause severe side effect, would you take the drug anyway?						
Take the drug anyway	19	16	3	14	5	0.108
Accept the test result, and not take the drug	143	100	43	133	10	
Accept the test result and take the drug only if the disease might be life-threatening	127	104	23	110	17	
Not sure	48	37	11	40	8	
To what extent do you think that genes influence your health?						
Completely	134	87	47	126	8	0.001
Moderately	123	104	19	106	17	
Not at all	18	14	4	14	4	
Don't know	62	52	10	51	11	
If you know your genetic tendency to develop a disease, would you be ready to make necessary changes in your lifestyle, to reduce disease risk?						
Yes	289	217	72	259	30	0.463
No	13	12	1	9	4	
Not sure	18	15	3	15	3	
Don't know	17	13	4	14	3	
Do you agree that personalized medicine represents a new and promising healthcare model?						
Yes	263	195	68	240	22	0.179
No	18	14	4	12	6	
Don't know	56	48	8	44	12	
*MLS & HS= Molecular Life Science & Health Science						

Replies to all questions regarding their awareness and attitude related to genetic testing, pharmacogenomics, and personalized medicine are also shown here. Among the participants from the field of medicine, pharmacy, health science, genetics, and bioengineering roughly 40% did not work for a particular drug, while 31% of these students had an unfavorable medicine response.

Significance of pharmacogenomics education

The findings in Table 3 and Table 4 show that medical, pharmacy and health studies students have similar perspectives on their education program and upcoming diplomacies for PGx. Overall, 84% of graduates and 76% of undergraduates believed that PM is promising healthcare model. The majority of undergraduates, 82% (212/257) agreed that PGx should be relevant to their curriculum, and 42% (108/257) thought their program were well organized for PGx. The curriculum wasn't well-designed for PGx, according to 31% of respondents (81/257) and 39% (100/257) want to running their next learning degree (masters, PhD, specializations) in the area of personalized medicine. According to our findings, students' opinions toward their course of study and their desire to pursue postgraduate research in the field of personalized medicine are both highly influenced by the subject of study. When compare to other responders, it seems that more Biochemistry and Molecular biology students would like to pursue postgraduate study in this area. Additionally, our findings imply that students are more likely to pursue postgraduate studies related the field of

personalized medicine if the program is well designed to provide them a sufficient understanding of PG.

In their future practices, more than 70% of undergraduates and recent graduates feel that they are able to identify patients who might get advantage from genomic identification, in addition they can address patients' inquiries about PG and PM and recognize medications that call for pharmacogenomics testing before being administered to the patient.

Students' awareness about the ethical, legal and social implications

In this survey study it is seen that 54% of the students are conscious about ethical issues related to genetic testing and 60% of those are believe that privacy of the patients is heights' concerning issue associated with pharmacokinetic testing, whereas just 19% thought that the main issue is the confidentiality of data protection. The racial issue, non-incident findings, and stigma possess 5%, 7%, and 5% of the other ethical issue. Our findings indicate that 74% of students seem that disclosing of PGx test results might be an unlawful practice. This concern was echoed by students in all faculties. Furthermore, 53% of students trust that revealing an unfavorable test result would be a disadvantage at the workplace or in job-searching and are also worried that they would feel "helpless" or "pessimistic".

DISCUSSION

One of our study's unique features is that it is the

Table 3. Students opinion regarding the study curriculum and their future plans in pharmacogenomics

	Total	Undergraduate student	Graduate student	*MLS & HS	Non-MLS & HS	P value
Pharmacogenomics should be an important part of my study curriculum.						
Agree	283	212	71	264	19	0.029
Disagree	1	1	0	0	1	
Neutral	39	36	3	24	15	
No opinion	14	8	6	9	5	
Do you think that the curriculum of your study program is well designed for understanding pharmacogenomics?						
Yes	158	108	50	148	10	0.010
No	100	81	19	82	18	
Don't know	36	32	4	29	7	
Not sure	43	36	7	38	5	
Would you like to continue your postgraduate education (Masters, PhD, specialization) in the field of personalized medicine?						
Yes	150	100	50	148	2	0.001
sure	102	83	19	89	13	
Don't know	40	36	4	30	10	
No	45	38	7	30	15	

*MLS & HS= Molecular Life Science & Health Science

Table4. Students attitudes towards continued education in pharmacogenomics

	Total	Undergraduate student	Graduate student	*MLS & HS	Non-MLS & HS	P value
In my future practice, I should be able to identify patients that could benefit from genetic testing.						
Agree	251	191	60	231	20	0.0002
Disagree	5	0	5	5	0	
Neutral	41	36	5	29	12	
No opinion	40	30	10	32	8	
In my future practice, I should be able to answer patient's questions regarding pharmacogenomics and personalized medicine.						
Agree	250	189	61	228	22	0.862
Disagree	6	5	1	3	3	
Neutral	46	37	9	40	6	
No opinion	35	26	9	26	9	
In my future practice, I should be able to identify drugs that would require pharmacogenomics testing prior to their administration to the patient.						
Agree	228	170	58	212	16	0.559
Disagree	16	12	4	14	2	
Neutral	48	37	11	38	10	
No opinion	45	38	7	33	12	

*MLS & HS= Molecular Life Science & Health Science

first study to examine graduate and undergraduate students from multiple different universities in Bangladesh about their knowledge of and attitudes on the part of pharmacogenomics and precision medicine. Our findings indicated that participants from life science and health science are typically conscious for pharmacogenomics test & have a basic understanding of personal genome testing companies. Students in non-molecular life sciences, as opposed to, are fewer conscious for this medicine and not concerned in using PM may a good healthcare model than students in molecular life science. Here, we also established that most of the graduate and undergraduate students think that PGx should play a significant role in their academic program and higher than 50% of these students would like to acquire there next study program related to the field of personalized medicine (27, 28). Most of the

faculties may not have PGx-related courses included in their curriculum, as just one-third of all students who took part in our survey believed that their study curriculum is properly prepared to understand PGx.

In a recent survey, it was discovered that the vast majority of the students in California's eight pharmacy schools were knowledgeable about pharmacogenomics, concurred that pharmacogenomics is significant for future pharmacists, and expressed interest in following a PGx residency, fellowship, or career. However, Latif(29) noted that only a basic understanding of PGx was being taught in the USA by 2005, emphasizing the requirement to include PGx in the pharmacy curriculum.

In recent year Direct-to-consumer Genetic Testing (DTCGT) companies have risen, offering substitute information on genetic testing (GT) and personalized

Table 5. Students awareness and opinion regarding the ethical, legal, and social implication

	Total	Undergraduate student	Graduate student	*MLS & HS	Non-MLS & HS	P value
Are you aware of different ethical aspects of genetic testing?						
Yes	182	135	47	167	15	0.015
No	84	69	15	70	14	
Not sure	36	32	4	29	7	
Don't know	35	21	14	31	4	
What ethical issues do you believe might be related to genetic or pharmacogenomics testing?						
Patient privacy	210	147	63	186	24	0.001
Racial issues	16	16	0	14	2	
Non-incident findings	23	21	2	22	1	
Data confidentiality	64	49	15	56	8	
Stigma	18	18	0	15	3	
Other	6	6	0	4	2	
Are you worried about the possibility that the result of a pharmacogenomics test may be passed to unauthorized persons?						
Very worried	135	86	49	124	11	0.0001
Not worried	29	25	4	26	3	
Slightly worried	113	98	15	99	14	
I don't know	60	48	12	48	12	
In case of any unfavorable test result should be disclosed, do you believe that you would be disadvantages at work or job-seeking?						
Yes	177	123	54	161	16	0.007
No	51	41	10	44	7	
No opinion	109	93	16	92	17	
In case of an unfavorable test results, do you believe that you would feel "helpless" or "pessimistic"?						
Yes	178	126	52	158	20	0.003
No	73	54	19	65	8	
No opinion	86	77	9	74	12	
In case of an unfavorable test result, do you believe that you would feel "different" or "inadequate"?						
Yes	182	129	53	164	18	0.014
No	64	49	15	56	8	
No opinion	91	79	12	77	14	

*MLS & HS= Molecular Life Science & Health Science

medicine (PM), while highlighting the remarkable benefits of genomic medicine for specific healthcare management. Although students' knowledge about genetic testing, precision medicine, and pharmacogenomics may be largely based on information and advertisements from the direct-to-consumer genetic testing (DTCGT) industry, which may contain inaccuracies and overstatements, rather than more accurate information acquired from their academic curriculum. (30, 31). As seen, few numbers of students expecting to continue their doctoral lessons in PM, undergraduates find it challenging to acquire a great interest in future consideration of such subjects without a thorough knowledge of PM, PGx, and GT. So, by focusing more attention and resources on academic study and profession development in PM and PGx, there is a high chance that genomic medicine will be promoted thanks to a strong base of knowledge and widespread support.

According to our finding, 76% of undergraduate students believed PM is an encouraging healthcare model, and 54% said they would think about getting

a genetic test. Initial instruction in genetics and genomics starts in high school in Bangladesh, but it does so in kindergarten through primary school in other western nations like the United States. Kindergarten students in the USA are exposed to the fundamental ideas of genetic inheritance through the application of relatable cases, such as cats giving birth to kittens with distinct markings, to show how features can vary. Due to this, the educational system in the USA provided evidence that genomic education could be implemented and a solid foundation in genetics could be built at an early learning stage (32, 33). In recent years' inadequate education and talent progress in PM and PGx practice may be exaggerated due to slow local progress of its practice. The practice of PGx in Bangladesh is still in primary level compared to other countries.

Negative attitude toward genetic testing results due to ethical, legal and social implications

It has been established that students who took

Table 6. Students awareness toward diagnosis of diseases and treatment option

	Total	Undergraduate student	Graduate student	*MLS & HS	Non-MLS & HS	P value
Have you been diagnosed with any of the following diseases? You can choose multiple options.						
Cardiovascular (heart problems, atherosclerosis, hypertension)	19	16	3	17	2	0.700
Psychiatry (depression, anxiety)	48	38	10	41	7	
Oncology (any type of cancer)	4	3	1	4	0	
Metabolic diseases (diabetes, metabolic syndrome)	23	20	3	22	1	
No	232	172	60	203	29	
Other	11	8	3	10	1	
Did you ever take a drug that is used to treat any of the following diseases? You can choose multiple options.						
Cardiovascular	14	13	1	14	0	0.160
Psychiatry	16	14	2	12	4	
Metabolic disease (Diabetes)	13	11	2	12	1	
Oncology	2	1	1	2	0	
I do not take drugs	266	195	71	235	31	
Other	26	23	3	22	4	
How much money are you willing to spend to examine the effectiveness of a specific drug in your body using a pharmacogenomic test?						
<5000 TK	160	110	50	145	15	0.027
5000-8000 TK	33	25	8	27	6	
8000-12000 TK	11	9	2	11	0	
>12000 TK	10	8	2	10	0	
Not sure	123	105	18	104	19	
Do you think, cost of Precision Medicine & Pharmacogenomics testing will be reduced in the near future like general diagnostics screening?						
Yes	176	137	39	155	21	0.018
No	41	24	17	41	0	
Don't know	65	49	16	56	9	
Not sure	55	47	8	45	10	
Do you believe that in the future pressure may be exerted on patients to agree to perform a pharmacogenomics test?						
Yes	201	141	60	182	19	0.004
No	51	42	9	43	8	
No opinion	85	74	11	72	13	

*MLS & HS= Molecular Life Science & Health Science

part in our survey are aware of the various ethical issues surrounding genetic issue and its testing. However, from our survey it is showed that most of the students seems to be concerned about parents' secrecy and data privacy. More than 40% of Bangladeshi undergraduates demonstrated a negative outlook in the event of a poor GT result, including feelings of "helplessness or pessimism," "different or inadequate," and "disadvantaged" job seeking, with students older than the age of 19 more inclined to agree with this statement(34).

Typically, Asians are more pessimistic than other ethnic groups, indicates that the propensity of pessimism among local undergraduates are more pessimistic. According to a research by Chang et al., Asians Americans are generally extra doubtful

than Caucasian Americans (35). Similarly, results were found in another study by Lee et al., which showed that Caucasia American students and Chinese American students both had higher levels of pessimism than mainland Chinese students and Chinese American students, respectively (36). Although the tendency of pessimism about poor GT results is particularly pronounced and widespread among Bangladeshi undergraduates, the highlighting causes of pessimism and potential solutions to reverse the trend should be thought and carefully addressed. Surprisingly, our study showed that nearly half of all respondents were concerned that PGx test results would be disclosed to unauthorized parties. Students who are concerned that PGx testing show further hazard issues for

former illness would equally feel “different” and “inadequate” in the event of negative test results. Otherwise, numerous participants claimed that they wouldn’t feel “helpless,” “pessimistic,” “different,” or “inadequate.” This means that every person would respond to the genetic test results differently.

Patients are thought to need sufficient counseling in order to understand the significance of the test results in relation to their particular health.(37, 38). One of the most significant findings of our study is for the national health service it is necessary to recruit a diverse group of students in three different settings like medicine, pharmacy, and health studies. Students from genetics and other non-molecular life science and non-health science departments are also important. Our findings were further strengthened by the comparison of the thoughts and attitudes of students who had taken the PGx course and those who had not. Our survey accelerates students’ interest for learning more about PGx.

CONCLUSION

This study provides evidence of how undergraduate and graduate students in Bangladesh perceive PM and PGx. Our findings show that, with the exception of graduate students from Bangladesh, the majority of undergraduate students who participated in our survey are enrolled in life science programs. However, they believe PM is a promising healthcare model but their knowledge, understanding, technologies used for testing, its applications are very poor. However, the majority of students who are studying molecular life and health science want to learn more about this program. This fact suggests that study programs in this field should be developed in order to ensure better service regarding personalized medicine. Therefore, it is necessary to improve coordination between universities, healthcare organizations, and governing bodies in order to include more training and continuing education themes about pharmacogenomics and personalized medicine. In order to ensure the widespread clinical adoption of personalized medicine, it is crucial to expand the pharmacogenomic path of biological education. Also, this study is significant as it provides valuable insight into the views of precision medicine and pharmacogenomics practice, which can be used better understand the general population’s perspective, and can also be used to inform future research on the topic.

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Author Contributions

The main conceptual ideas, technical details and questioner are made by Md Monirul Islam. All authors are participating in data collection, analysis, reading and processing of the manuscript. All authors read, edition and approved for the publication.

Conflict of Interest

The authors announce that there is no conflict of interest for disclosing and publication of this paper.

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