**Full title: Awareness and Knowledge of Pharmacists Toward Biosimilar Medicines**

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**ABSTRACT**

**Aims**

Pharmacistsin all clinical settingsare recognized drug expertsand integral educators of biosimilar medicines. Therefore, the objective of this study was to assess pharmacists' knowledge, predictors of knowledge and views toward biosimilar medicines in Jordan.

**Methods**

A cross-sectional questionnaire was conducted in Jordan using an internet-based self-administrated questionnaire via *Google Forms*. A descriptive statistical analysis was performed to summarize the data for the total sample as counts (percentage).

**Results**

A total of 502 pharmacists answered the survey. 52.6% were knowledgeable about biosimilar medicines and the mean number of correct answers was 6.47 ± 1.62 (range 2–10). Multivariate analysis identified that respondents who had heard about biosimilars before (OR = 1.942, 95% CI = 1.231-3.063, p <0.05) were more likely to be knowledgeable. Respondents who had not taken course or post-graduating training course about biosimilars were less likely to be knowledgeable (OR = 0.548, 95% CI =0.357-0.839, p < 0.05). A positive response was noted in pharmacist’s view regarding the implementation of biosimilar medicines in healthcare setting, biosimilar medicine prescription related to decreased costs, self-study about biosimilar medicine, and incorporating biosimilar education program at the pharmacy school curriculum universities level.

**Conclusions**

Pharmacists’ views and knowledge vary regarding the particularities and key issues on biosimilar medicines in Jordan. There is a need to improve communication between physicians and pharmacists and pledge educational initiatives to ensure safe and optimal use of biosimilar medicines. Incorporating biosimilar course in pharmacy school curriculum could improve their acceptance for future pharmacy jobs.

**Keywords:** pharmacists, biosimilar medicines, knowledge, views, predictors

**What is already known about this subject**

* Biosimilar is a biological product that has a version of the active substance of an already approved original biological medicine.
* Several surveys assessing knowledge and awareness, perspectives and attitudes of community and hospital pharmacists toward biosimilar medicines have been conducted in different countries.
* Most of pharmacists are informed about the biosimilar medicines. However, there is a lack of understanding of the application of that knowledge.

**What this study adds**

* This study identifies some predictors for biosimilar knowledge among participated pharmacists.
* This research highlights the importance to pledge educational activities for pharmacists about biosimilar medicines to ensure their safe and optimal use which is necessary to control log-term costs of biologics.
* This study reveals a positive trend towards incorporating biosimilar drug course in pharmacy school curriculum among respondents, as this could be reflected in improving their acceptance for future pharmacy jobs.
* The findings of this study support the need for conducting further studies of biosimilar-specific education topics to alleviate existing misunderstandings and bridge knowledge gaps altogether about biosimilar medicines among pharmacists.

1. **INTRODUCTION**

Biosimilar is a biological product that has a version of the active substance of an already approved original biological medicine (known as the originator or licensed reference medicine). It is designed to be very similar to their originators in terms of quality, safety, efficacy, immunogenicity and clinical properties 1-4. However, the generics of biological medicines are not possible which means making the exact copy by manufacturer is not feasible because biological substances are heterogeneous and complex in nature, high molecular weight, and batch to-batch variability 5. The approval process of biosimilar medicines is more complex, compared to generic medicines, and it requires extensive investigation to obtain a marketing authorization, including Phase 1 and Phase 3 preclinical studies 6-8. The regulatory framework for biosimilar medicines is well-defined by both European Medicines Agency (EMA) and the Food and Drug Administration (FDA) 2,4,6,9-12. Biosimilars development costs in comparison to their reference medicines (originator biologic) is low, allowing for potential cost savings of expenditure of pharmaceutical and healthcare systems 1,4,13. Biological and biosimilar medicines have specific pharmacovigilance considerations such as immunogenicity, manufacturing variability and stability 14,15. Therefore, ongoing pharmacovigilance activities should be maintained after approval to ensure their safety, through reporting of adverse reactions 16.

Importantly, pharmacists, being the drug experts, must ensure their accurate understanding of this new category of drugs to assure the safe and optimal use of biosimilars. They must educate themselves and update their knowledge by keeping aware of current medical literature 17. As biosimilars now are becoming more widely available, pharmacists working in community and hospital settings may need to advise their patients about biosimilars, thus assessing the awareness of pharmacists toward biosimilars is highly important 2. Several surveys assessing knowledge and awareness, perspectives and attitudes of community and hospital pharmacists toward biosimilar medicines have been conducted in different countries among the world 12,18-20. The biosimilar medicines are becoming available in Jordan, however, up to our knowledge no previous studies have been performed before on assessing the knowledge and practice of pharmacists towards biosimilar medicines. Therefore, the main objective of this study was to evaluate the knowledge of pharmacists toward biosimilar medicines and predictors that could influence their knowledge in Jordan. This will help to optimize effective treatment of these new category of drugs to patients. A secondary objective was to explore the views of pharmacists about biosimilar medicines.

# **METHODS**

## Design and Data Collection

A cross-sectional design was conducted to meet the study objectives. Data collection was performed between the periods October-December 2020 using an internet-based self-administrated questionnaire which was created using *Google Forms*. The participants in our study were recruited through social media platforms. The questionnaire was distributed across several Facebook and WhatsApp groups of pharmacists among different areas in Jordan. These social media groups were created as a tool for general communication within the pharmacist’s community. Informed consent was obtained from the participants as a pre-request to proceed in participation.

## Sample size

The sample size was calculated based on 95% confidence level, and 5% confidence interval, and total pharmacists in Jordan is 20.000. The sample size calculation revealed the need for at least 378 pharmacists. However, for the purpose of enhancing the generalizability of the results, a minimum sample of 500 pharmacists was intended.

## Ethical consideration

The study was approved by Institutional Review Board at the Hashemite University in Jordan (Reference number: 2021/2020/4/3).

## Development of the survey questionnaire

## A self-administered questionnaire was created especially for the purpose of this study. Most of the questions related to the knowledge, and views were selected from the literatures 12,21,22. Face validity was revised by a group of experts in the field and was constituted of 5 pharmacologists. The questionnaire is composed of three sections. The first section consisted of eight questions about demographic data including gender, age, area of residence, bachelor’s degree (pharmacy or Pharm D), holding a postgraduate degree, professional specialty, length of service in professional specialty, and the university of graduation. In addition, it had a question whether the pharmacists had taken a biosimilar course or post-graduating biosimilar training course. The second section was about the pharmacists’ knowledge related to biosimilar medicines which consisted of 10 questions 12. The respondent pharmacists were asked to indicate whether some statements about biosimilar medicines were accurate or not (yes/no). The total knowledge score ranging from ‘’0’’ (No knowledge) to ‘’10’’ (high knowledge). The third section consisted of 13 statements exploring the pharmacists’ views about biosimilar medicines 12,21,22. The participating pharmacists were requested to point out their views and agreements about each statement using agree/disagree 5-point Likert scale. The questionnaire was pretested for reliability through the pilot study. The views scale was calculated and showed an excellent reliability with a Cronbach’s alpha of 0.885. Piloting of the questionnaire was performed to assess the comprehension and accuracy of the questions in relation to the research topic, identify possible redundancy among the 32 questions, and ensure the usability of the data-collection method.

## Data analysis

Statistical Package for Social Sciences (SPSS) version 24.0 (SPSS Inc., Chicago, IL, USA) was used for analysis of the data. Descriptive statistical analyses were performed to summarize the data for the total sample as counts (percentage). Univariate analysis was performed using a Chi square (χ2) (categorical variables), t-test analysis and One-way ANOVA (continuous variables) as appropriate. A multivariate analysis was conducted to determine predictors of knowledge using binary logistic regression (knowledge) including all variables with p<0.20 on univariate analysis. Statistical significance was set at p value < 0.05. Odds ratio (OR) values and their 95% confidence intervals (95% CI) were calculated for the predictors of pharmacist’s knowledge. Knowledge was dichotomized as knowledgeable and non-knowledgeable. For this purpose, the answers to 10 different questions of knowledge for each participant were labelled as categorical variables using a cut-off point for cumulative scores of correct answers. A participant was categorized as knowledgeable if the sum of the scores was >6 (out of 10) and non-knowledgeable if the sum of the scores was ≤6 (out of 10).

# **RESULTS**

## Demographics

A total of 502 responses to the study questionnaire were collected and included in the analysis. The demographic characteristics of the participating pharmacists are summarized in **Table 1**.

The majority of respondents (77.9%) aged between 21-30 years and most of them were female (n=379, 75.5%). More than half of the respondents’ area of the residence was from the capital of Jordan, Amman (n= 265, 52.8%). The vast majority of participants have a bachelor’s degree in pharmacy (n=456, 90.8%) and only 28.7% of the respondent pharmacists have postgraduate certificate. Close to the half of the respondents worked at community pharmacies (46.2%). Most of the respondents (79.1%) have heard about biosimilars before. However, almost the quarter of the respondents (26.1%) had taken course or post-graduating training course about biosimilars. More details about the demographics of the respondents are presented in **Table 1**.

## Pharmacists’ knowledge level about biosimilar medicines

Approximately, a half of pharmacists (52.6%, 264/502) were knowledgeable and the mean number of correct answers was 6.47 ± 1.62 (range 2–10). Only 1% (5/502) of respondents answered all questions correctly and none of the respondents reported knowing nothing at all about biosimilars. The respondents’ answers to each of the 10 statements proposed are shown in **Table 2**. The adequacy of pharmacists’ answers to the statements about biosimilar medicines in the questionnaire vary from one statement to another. A minimum percentage of adequate answers obtained was 38.4% (95% CI [34.1-42.7]) for the statement “if biosimilar medicine is structurally identical to its reference medicinal product”. A maximum percentage of adequate answers obtained was up to 76.3% (95% CI, [72.6-80.0]) for the statement “if a drug is for which marketing authorization is granted on the sole investigation of pharmacokinetic bioequivalence with its reference medicinal product”.

## Predictors of pharmacist’s knowledge

As shown in **Table 3**, the results of univariate analysis indicated that participants’ gender, length of service in professional specialty, hearing about biosimilars before, had taken course or post-graduating training course about biosimilars were associated with the pharmacist’s knowledge with p values of <0.20 in the univariate analysis. So, these variables were investigated as predictors for knowledge and included in the multivariate analysis. The results of multivariate analysis identified that respondents who had heard about biosimilars before (OR = 1.942, 95% CI = 1.231-3.063, p=0.004) were more likely to be knowledgeable. On the other hand, respondents who had not taken course or post-graduating training course about biosimilars were less likely to be knowledgeable (OR = 0.548, 95% CI =0.357-0.839, p=0.006).

## Pharmacist’s views about biosimilar medicines

The level of pharmacists’ views agreement varied from one statement to another as indicated in **Table 4**. The highest frequency of answers for all statements was supportive (including agree and strongly agree) and ranged from 45.7% to 74.5%. Out of 502 respondents, 41.8% of pharmacists agreed with the implementation of biosimilar medicines in healthcare setting. In addition, 46.8% of pharmacists agreed to trying and testing biosimilar medicines in terms of efficacy and safety. 42.4% of respondents agreed that biosimilar medicines are not only pharmacist’s concern, while 6.6% strongly disagreed. The pharmacists’ responses for the approval substitution of a reference biological medicinal product to its biosimilar product by a pharmacist were between 45.7% (strongly agree/agree) and 32.1% (neutral). More than 60% of pharmacists strongly agreed/agreed that biosimilar medicines prescription allows reducing healthcare costs. The highest percentage of agreement (74.5%) was for the statement “I prefer to work in a pharmacy that has biosimilar medicines”.

# **4. DISCUSSION**

The present study has assessed the pharmacists’ knowledge level and views about biosimilar medicines in Jordan, and to explore the predictors which could influence their knowledge. Few surveys have been conducted to assess pharmacists’ knowledge and attitude toward biosimilars in Middle East countries 23,24, and up to our knowledge this is the first questionnaire survey that has been conducted in Jordan.

The current study highlighted gaps in biosimilar knowledge and understanding among pharmacists. Our results showed that percentage of community pharmacists participated in this study is approximately half of all participated pharmacists. This might be due to the large number of pharmacists who worked in the community pharmacies compared to those who worked in hospital. Consistent with the literature, this research found that community pharmacists were less knowledgeable about biosimilar medicines compared to hospital pharmacists 20. This lack of awareness could be due to the decreased biosimilar prescriptions in outpatient clinics and limited availability of biosimilar medicines in community pharmacies 3,12. In agreement with our findings another study by Pasina et al (2016) indicated low percentage of pharmacists who having complete knowledge about biosimilars 25.

Notably, 61.4 % of our respondents lack the knowledge that biosimilar medicine is not structurally identical to its reference medicinal product. This could be explained that similarity between biosimilar medicine and its reference medicinal product does not mean they have both identical structure 1-4. The FDA defines a biosimilar product as highly similar but not identical to an already licensed biologic product (also termed reference product or bio-originator) in terms of quality, safety, and efficacy 26,27. Therefore, it is important to educate pharmacists accurately and promptly by shedding light on some of the confusion differences between biosimilars and their reference biologics 28. In addition, 61.4% of pharmacists in the present study knew that biosimilar medicine has the same dosage and route of administration compared to its reference medicinal product. This finding could be partly explained by knowing that biosimilars are still considered new drugs and that there is a lack of educational initiatives 2,3. In fact, limited reports indicated what specific biosimilar factors contribute to the reluctance and uncertainty of pharmacists to accept biosimilars as equal to the reference product 29-31. However, awareness of the similarities and differences between reference product and its biosimilar, and impact on their efficacy and safety, is imperative 32. Approximately, more than 60% of respondent pharmacists in the present study were knowledgeable with the fact that the biosimilar medicine has no meaningful differences from a reference medicinal products in term of quality, safety, and efficacy 33,34. Notably, this statement about biosimilar medicines was confirmed by evidence-based information obtained from various clinical trials 35,36. Moreover, the most obvious finding to emerge from the analysis is that pharmacists supported the indication extrapolation that refers to the approval of a biosimilar for indications held by the bio-originator but that were not directly evaluated during the biosimilars’ clinical trials 3. This outcome is contrary to that of Adé et al. (2017) who found that 64% of pharmacists opposed indication extrapolation as they have doubted biosimilar safety and efficacy in extrapolated indications 21. This discrepancy could be due to differences in the study populations, the pharmacy curricula, market availability of biosimilars, and the resources of biosimilars among these studies 37,38.

Data regarding pharmacists’ view showed that almost two-thirds of our participants (64%) agreed that biosimilar medicines prescription allows for reducing healthcare costs. Noteworthy, the high cost of reference biological medicinal products is the rational for the development of biosimilar medications, as they mitigate rising drug costs in biologics and have significant cost-saving advantages over biological medicinal products 3. Considering this environment, the availability of biosimilar as alternatives versions of reference biological medicinal products, is critical for containing the health care expenses 39-45.

Another important aspect about biosimilar medicine is its interchangeability with reference product. According to definition of biosimilar, an interchangeable biosimilar must be highly similar to reference product and produces the same clinical result in any given patient 3,46. It is important to know that the biosimilar substitution policy is not the same among different counties in the world 47,48. Our surveyed pharmacists indicated neutral to positive attitudes about interchangeability. These findings match with what was reported by Danese et al. (2016) 49,50. Notably, interchangeability between biosimilars and reference medicines has numerous debates and are still ongoing because it is associated with a potential to induce immunogenicity, which in turn could affect the efficacy and cause toxicity 1. Therefore, it is imperative that healthcare professionals who are involved in the use of biosimilar medicines are informed of the considerations related to their prescribing practices, traceability, and interchangeability 51.

Moreover, more than 70% of respondents believed that pharmacists are the main source of information to educate physicians and patients about the appropriate medication use of these products and the differences between biosimilar and their reference biologics. This finding is expected as the pharmacists are considered the experts in pharmacotherapy, so they play a vital role in evaluating the benefit versus the risk for medications 6,28. These results also are in agreement with O’Callaghan’s (2017) findings 19. Additionally, the introduction of biosimilar agents into the Jordan market in 2015 52, opened the space to pharmacists in Jordan to acquire the necessary knowledge and awareness on the principle aspects surrounding the biosimilar medicines 21.

Furthermore, data showed that the majority of respondent pharmacists in favor to educate themselves about biosimilars and encouraged to take courses to enrich their knowledge about biosimilars. In addition, they are in favor with the implementation of biosimilars in healthcare settings. These results corroborate the findings of previous studies in France s 12 and Pakistan 53. Over half of our participants encouraged pharmacy students and pharmacists to take courses in biosimilar medicines to enrich their knowledge and improve their clinical practice which is parallel with other reports 3,34. Moreover, our results indicated low percentage of pharmacists (26.1%) who had taken biosimilars course or post-graduating training course about biosimilar medicines, albeit, the exact educational activities in our study were not defined, similar to other study 50. The learning educational means of biosimilar education include training courses, self-study, independent guideline and/or journal article colleague discussion, continuous education, and consulting promotional manufacturer materials 19,20,22,54-56. A positive trend towards incorporating biosimilar drug course in pharmacy school curriculum has been noted among respondents. In addition, respondent pharmacists believed that a beneficial impact of biosimilars course at universities would be reflected in improving the acceptance for future pharmacy jobs. these findings are in agreement with a previous study in Karachi 53. The positive trend of our participants toward working in a pharmacy that has biosimilar medicines is in accord with two studies 50,57.

Most importantly, our results suggested knowledge level was significantly positively associated with having heard about biosimilar before or taking course or post-graduating training course about biosimilars before. These relationships support previous research 55. Murphy et al. (2020) presented results demonstrating a structured biosimilar educational program’s ability to improve provider biosimilar confidence 58. Taken together, biosimilar education not only improves provider understanding and confidence but also elicits actual prescribing changes and increases biosimilar use 3.

**Limitation of the study**

The survey was undertaken during COVID-19 pandemic, and the attitudes of pharmacists may evolve and change over time. It will be valuable to repeat a similar study in different timepoint and then evaluate whether awareness has changed. The detailed information about biosimilar-specific education topics was not obtained. Therefore, further studies of biosimilar-specific education topics are recommended to alleviate existing misunderstandings and bridge knowledge gaps altogether.

**5. CONCLUSIONS**

The findings of this study indicate important implications for pharmacist’s knowledge regarding key issues of biosimilar medicines in Jordan. The present study shows that most pharmacists in Jordan are knowledgeable with biosimilar medicines. In addition, this study highlights the impact of biosimilar education in increasing the familiarity with biosimilar medicines. As well as, it identifies the optimistic willingness of pharmacists in Jordan toward educating themselves about biosimilar and support educational program incorporation in the curriculum of university pharmacy school. That may have a great impact on increasing the awareness and knowledge of pharmacists and other health care providers toward biosimilar medicines and their safe and effective use. In addition, they could contribute to strengthen biosimilar market penetration in Jordan market and on the subsequent cost savings. Future research to evaluate the knowledge and views of different health care providers (physicians, nurses) and patients in Jordan about biosimilar medicine are encouraged. This has the potential to ensure safe and effective use of biosimilar medicines and to assess perceived biosimilar educational needs.

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**CONTRIBUTORS**

Muna Oqal designed the study, performed statistical analysis, interpreted the data and wrote the manuscript. Bushra Hijazi performed statistical analysis. Abdelrahim Alqudah help in desining the study and reviewing the manuscript. Ahmad Al-Smadi interpreted the raw data. b, Basima A Almomani critically reviewed the manuscript. Roaa Alnajjar, Majd Abo Gonaim, Mohammad Irshaid, and Aroob Husam help in collecting the data from respondents. All authors approved the final version of the manuscript.

**CONFLICT OF INTEREST**

The authors declare no conflicts of interest. This article has not been submitted elsewhere.

**Data availability statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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# **Table 1: Demographic data of pharmacists’ respondents (n =502)**

|  |  |  |
| --- | --- | --- |
| **Demographic data of pharmacist’s respondent (n =502)** | | |
| **Pharmacist’s demographics** | **Frequency**  **(n)** | **Percentage**  **(%)** |
| **Gender** | | |
| Male | 123 | 24.5 |
| Female | 379 | 75.5 |
| **Age** | | |
| 21-30 | 391 | 77.9 |
| 31-40 | 76 | 15.1 |
| above 40 | 35 | 7 |
| **Area of residence** | | |
| Amman | 265 | 52.8 |
| Other than Amman | 237 | 47.2 |
| **BSc degree type** | | |
| Pharmacy | 456 | 90.8 |
| Pharm D | 46 | 9.2 |
| **Postgraduate certificate** | | |
| Bachelor | 358 | 71.3 |
| Postgraduate | 144 | 28.7 |
| **Professional specialty** | | |
| Community pharmacist | 232 | 46.2 |
| Other (medical representative, academia, hospital pharmacist, pharmacologist…) | 270 | 53.8 |
| **Length of service in professional specialty** | | |
| < 1 year | 200 | 39.8 |
| 1-3 years | 138 | 27.5 |
| 4-10 years | 106 | 21.1 |
| >10 years | 58 | 11.6 |
| **Type of graduate university** | | |
| Public | 358 | 71.3 |
| Private | 144 | 28.7 |
| **Hearing about biosimilars before** | | |
| Yes | 397 | 79.1 |
| No | 105 | 20.9 |
| **Taking biosimilars course or post-graduating training course** | | |
| Yes | 131 | 26.1 |
| No | 371 | 73.9 |

# **Table 2. Pharmacists’ knowledge about biosimilar medicines (n = 502).**

|  |  |  |
| --- | --- | --- |
| **In your opinion, which statements about biosimilar medicines are accurate? A biosimilar medicine:** | **Adequate answer** | **Number of adequate answers** |
| **n (%)** |
| is structurally identical to its reference medicinal product | No | 139 (38.4) |
| is similar to a reference medicinal product that has gone off-patent | Yes | 383 (67.3) |
| has no meaningful differences from a reference medicinal product in terms of quality | Yes | 323 (64.3) |
| has no meaningful differences from a reference medicinal product in terms of safety | Yes | 359 (71.5) |
| has no meaningful differences from a reference medicinal product in terms of efficacy | Yes | 348 (69.3) |
| has the same dosage and route of administration compared to its reference medicinal product | Yes | 194 (38.6) |
| is a drug for which marketing authorization is granted on the sole investigation of pharmacokinetic bioequivalence with its reference medicinal product | No | 383 (76.3) |
| is a drug for which assessment of biosimilarity requires more comprehensive data compared to generic drugs | Yes | 386 (76.9) |
| [requires preclinical and clinical studies | Yes | 378 (75.3) |
| extrapolation of indications is the authorization of a biosimilar in indications of the reference biologic in the absence of specific clinical trial/data for the biosimilar in those indications | Yes | 345 (68.7) |

# **Table 3. Univariate and multivariate analysis of factors affecting the pharmacists’ knowledge**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **All participants** | **Univariate analysis** | | | **Multivariate analysis** | |
| Not Knowledgeable | Knowledgeable | P value | OR (95%CI) | P value |
| **Gender**   * Female * Male | 186 (78.2)  52 (21.8)  186 (78.2) | 193 (73.1)  71 (26.9) | **0.189** | Ref  1.202 (0.778-1.859) | 0.407 |
| **Age**  21-30  31-40  above 40 | 183 (76.9)  36 (15.1)  19 (8.0) | 208 (78.8)  40 (15.2)  16 (6.1) | 0.697 |  |  |
| **Area of residence**  Amman  Other than Amman | 125 (52.5)  113 (47.5) | 140 (53.0)  124 (47.0) | 0.909 |  |  |
| **BSc degree type**  Pharmacy  Pharm D | 219 (92)  19 (8) | 237 (89.8)  27 (10.2) | 0.384 |  |  |
| **Professional specialty**  Community pharmacist  Others | 104 (43.7)  134 (56.3) | 128 (48.5)  136 (51.5) | 0.283 |  |  |
| **Length of service as in professional specialty**  >10 years  < 1 year  1-3 years  4-10 years | 26 (10.9)  90 (37.8)  77 (32.4)  45 (18.9) | 32 (12.1)  110 (41.7)  61 (23.1)  61 (23.1) | **0.135** | Ref  0.945 (0.510-1.750)  0.64 (0.338-1.213)  1.196 (0.617-2.317) | 0.708 |
| **Type of graduate university**  Public  Private | 168 (70.6)  70 (29.4) | 190 (72.0)  74 (28.0) | 0.733 |  |  |
| **Hearing about biosimilars**  No  Yes | 65 (27.3)  173 (72.7) | 40 (15.2)  224 (84.8) | **0.001** | Ref  1.942 (1.231-3.063) | **0.004** |
| **Biosimilars course or post-graduating training course**  Yes  No | 46 (19.3)  192 (80.7) | 85 (32.2)  179 (67.8) | **0.001** | Ref  0.548 (0.357-0.839) | **0.006** |

# **Table 4. Pharmacist’s view levels about biosimilar medicines (n = 502).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **To what extent do you agree or disagree with the following statements?** | **Strongly disagree**  **n (%)** | **Disagree**  **n (%)** | **Neutral**  **n (%)** | **Agree**  **n (%)** | **Strongly agree**  **n (%)** |
| I am in favor with the implementation of biosimilar medicines in healthcare setting | 23 (4.6) | 20 (4) | 173 (34.5) | 210 (41.8) | 76 (15.1) |
| Biosimilar medicines are tried and tested in terms of efficacy and safety | 27 (5.4) | 19 (3.8) | 94 (18.7) | 235 (46.8) | 127 (25.3) |
| Biosimilar medicines are not only pharmacist’s concern | 33 (6.6) | 44 (8.8) | 116 (23.1) | 213 (42.4) | 96 (19.1) |
| I approve the substitution by a pharmacist of a reference biological medicinal product to its biosimilar product | 28 (5.6) | 84 (16.7) | 161 (32.1) | 169 (33.7) | 60 (12) |
| Biosimilar medicines prescription allows for reducing healthcare costs | 21 (4.2) | 34 (6.8) | 126 (25.1) | 210 (41.8) | 111 (22.1) |
| I intend to educate myself about biosimilar medicines in clinical practice to improve patient safety | 170 (33.9) | 17 (3.4) | 15 (3) | 196 (39) | 104 (20.7) |
| I encourage pharmacy students and pharmacists to take courses in biosimilar medicines to enrich their knowledge and improve their clinical practice | 188 (37.5) | 11 (2.2) | 18 (3.6) | 198 (39.4) | 87 (17.3) |
| I prefer to work in a pharmacy that has biosimilar medicines | 96 (19.1) | 11 (2.2) | 21 (4.2) | 198 (39.4) | 176 (35.1) |
| Pharmacists are the main source of information to educate physicians, other clinicians and patients about the appropriate medication use of these products and the differences between biosimilar and their reference biologics | 156 (31.3) | 13 (2.6) | 25 (5) | 203 (40.4) | 105 (20.9) |
| Biosimilar course may benefit the pharmacy profession | 161 (32.1) | 10 (2) | 13 (2.6) | 237 (47.2) | 81 (16.1) |
| Incorporating biosimilar course in pharmacy school curriculum will be important to pharmacist future career | 153 (30.5) | 15 (3) | 12 (2.4) | 240 (47.8) | 82 (16.3) |
| Teaching Biologics and biosimilar drugs course to undergraduate pharmacy students will be important to patient safety | 144 (28.7) | 14 (2.8) | 12 (2.4) | 237 (47.2) | 95 (18.9) |
| Incorporating biologics and biosimilar drugs course in the pharmacy college curriculum is important in improving future pharmacy graduates’ acceptance of future jobs | 154 (30.7) | 14 (2.8) | 15 (3) | 212 (42.2) | 107 (21.3) |