CHEMICAL MODIFICATIONS OF NUCLEOSIDE ANALOGUES FOR ANTIVIRAL THERAPY

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Abstract

Background: The role of chemical changes of nucleoside analogues in antiviral treatment is that it provides increased effectiveness of the drug, its greater bioactivity, and resistance to the virus. The changes play significant roles in the production of good antiviral drugs against HIV, hepatitis, and new viral infections. It is significant to understand the degree of knowledge and awareness that students and professionals have to make further research and clinical applications in the area.

Objective: The use of nucleoside analogues in the treatment of antiviral therapy was the purpose of the present study, aiming to determine the level of knowledge, awareness and the perception of chemical modifications of the analogues.

Methodology: A cross-sectional study design was employed, which was quantitative in nature. A total of 179 respondents were sampled and filled using a structured questionnaire with questions based on demographic, knowledge and opinion. Data analysis was done through descriptive and inferential statistics, which included normality test, reliability test (Cronbach's Alpha), validity tests (KMO test, and Bartletts test), independent samples t-test, one-way ANOVA, Kruskal -Wallis test, chi-square test, correlation and regression test.

Results: The findings suggested that the data were normally distributed, reliable (Cronbach's Alpha = 0.91) and valid (KMO = 0.83, $p = 0.05$). The differences were also significant concerning gender and age ($p < 0.05$). Education level was also associated with awareness strongly. The Correlation analysis showed that there were positive correlations between knowledge, attitude and awareness. The regression equation demonstrated that the perceptions were largely predicted by knowledge, education, awareness, and attitude and that the equation contributed 62 percent of the variance ($R^2 = 0.62$).

Conclusion: The research findings conclude that there is a high degree of knowledge and information among the respondents about the nucleoside analogue modification. There is a great impact of education and awareness on antiviral therapy perceptions. Exposure to education and research can also help in enriching the knowledge and making advances in the development of antiviral drugs.

Keywords: The Nucleoside analogues, Antiviral therapy, Chemical modifications, Drug development, Knowledge and awareness, Pharmaceutical research, Regression analysis, Correlation, Drug resistance.

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Introduction

Viral diseases pose a serious challenge to the world's health as they cause a high morbidity and mortality rate in most countries of the world. Infections such as human immunodeficiency virus (HIV), hepatitis B, C and, more recently, newer viral

infections such as COVID-19 will also need antiviral treatments. Among the most important and commonly used anti-herpesviral agents, the nucleoside analogues have taken up a passing position in terms of their molecular strength to interfere with the viral multiplication (Samin et al., 2025).

Nucleoside analogs resemble structurally microplastic compounds that are building blocks of nucleic acids, such as DNA and RNA. Chemical modification, however, interferes with the production of viral nucleic acids by using these analogues. The phosphorylated nucleoside analogues are integrated into the viral growth chain of the virus by phosphorylating them to triphosphate in the host cell before they are incorporated by viral polymerases. It is often this integration that leads to the premature end of the chain or the development of mutations, thus culminating in the termination of the replication of the virus. Due to this process, nucleoside analogues have a wide potential of being effective against a plethora of viruses (Fernando et al., 2024).

The chemical modification plays a very crucial role in chemotherapy in enhancing the pharmacological properties of the nucleoside analogues. Aminoacetyl substitution, cyanoacetyl substitution and phosphate group can be enormously beneficial in terms of efficacy, stability, selectivity and bioavailability of drugs. An example would be when the sugar ring can have 2ations that can result in a termination of the chain, and when the strains in the base can enhance their affinity to the enzymes of the virus. Further, prodrug strategies such as the generation of phosphoramidate conjugates (ProTides) have been taken advantage of in order to boost tissue intracellular uptake and avoid rate-limiting events in phosphorylation. As a result of such inventions, several antiviral drugs have been developed efficiently, including acyclovir, zidovudine, lamivudine and remdesivir (Minhas et al., 2025).

Irrespective of the effectiveness, nucleoside analogues possess several significant issues, including drug resistance, toxicity and diminished bioavailability. In case a mutation is experienced by the viruses, chances are high that they will be resistant to the drugs more often used and less effective in practice. Besides, some nucleoside analogues have the capacity to potentially alter the host cellular enzyme, which possess negative impacts. In this way, modern research is focused on the creation of novel chemical linkages which would enable the increase of the viral target selectivity and decrease the toxicity and resistance development (Al-Abbasi et al., 2020).

Exploring chemical reactions in nucleoside analogues is therefore quite crucial in modern pharmaceutical and medical research. In addition to the explanation of the impact of such changes on the drug activity, the help can contribute to the production of more effective and safer antiviral therapies. Additionally, the levels of knowledge and awareness of the students and professionals working in this sphere should be assessed to make education, research, and innovation easier (Al-Abbasi et al., 2021).

Literature Review

Nucleoside analogues are considered classical in the sphere of antiviral treatment due to their ability to interfere with viral replication. First studies indicated that viruses can rely heavily on host cellular processes in an attempt to replicate their genetic material and that nucleoside analogue methods are an effective means of blocking such a process. These molecules mimic the natural nucleosides and are introduced into viral DNA and RNA, and they will eventually cause the outcome known as inhibition of polymerase activity. Over the past few decades, much has been done regarding the chemical modification of the nucleoside analogues to enhance their pharmacological potential and therapeutic effect (Alsamarrai et al., 2019).

Initial progress in the same direction has been pegged on simple structural analogues such as acyclovir, one of the first effective antiviral agents in herpes simplex virus (HSV). The absence of a cyclic structure in acyclovir allowed the use of acyclovir to specifically respond to infection of cells with the disease, when it is harmful to normal cells. It was a giant move and the course of action to proceed with the studies of structural adjustments. The sugar moiety was later modified in further studies, but with additions of the changes to the 2 and 3 positions, which were depicted to have a major role to play in the termination of the chains. A milestone drug in the HIV treatment was Zidovudine (AZT), the analog of thymidine containing 3 azido group, and it could inhibit viral DNA replication (Ihsan et al., 2026).

The ascription of stereochemistry in the formation of the nucleoside analogues was consequently acknowledged by other studies. Production of L-nucleosides, e.g. lamivudine, has been proven to be less harmful, and less toxic as compared to its D- analogues. The studies show that the L-nucleoside would not be as prone to the host cellular enzymes and would remain active against the viral polymerases. This innovation was very consistent with regard to the development of less harmful antiviral therapy, particularly the long-term therapies of persistent viral infections like HIV and hepatitis B (Syed Waqas Ali Shah, 2025).

In addition to the alteration in the sugar part, the alteration in the nitrogenous base has also been extensively studied. Substitution of the halogenation and the base with isosteric ones was found to enhance the antiviral functions and binding affinity. The articles revealed that these alterations could alter hydrogen bonding interactions to viral

polymerases, leading to the progression of improved selectivity and strength. Indicatively, an analogue of a nucleoside, trifluridane, which contains a fluorinated atom, was discovered to exhibit a greater performance against the DNA viruses in terms of stability and binding to its respective enzyme (Mostaque Md. Morshedur Hassan, 2025).

Among the most significant accomplishments of recent years, the development of prodrug strategies and, specifically, the ProTide strategy is to be mentioned. The phosphate moiety of the technique is gated off with lipophilic moieties so that the drug does not undergo the rate-limiting first phosphorylation step to become activated. A perfect case study of a ProTide that has proven to be better bioavailability and efficacy-wise is sofosbuvir, one of the regularly used agent to her hepatitis C. Equally, remdesivir, a nucleotide prodrug of viral DNA polymerase against SARS-CoV-2, has shown how such alterations are relevant in responding to outbreaks of viral infections. These developments show that chemical engineering is playing a larger role in drug delivery and activation optimization (Irum Sherwani Summaiya, 2025).

Despite the numerous gains that have been realized using the nucleoside analogues, a myriad of challenges are facing the application of the analogues. Among the most significant ones, it is possible to distinguish drug resistance development since viruses can modify their polymerase enzymes and reduce the amount of hooks on medications and their efficiency. It has also been researched that an antiviral therapy that is administered over a long duration of time would result in resistance, whereby new analogues with improved actions are developed. Moreover, toxicity is another major issue, particularly since it can suppress the mitochondrial DNA polymerase of the host cells. Research interest has been on the development of selective cellular compounds that attack viral enzymes and minimize the toxicity of the host cells (Kaleem Ullah Ihsan, 2026).

The significance of mixture therapy in overcoming resistance and improving treatment outcomes is also a target of the recent literature. Co-treatment with different nucleoside analogues, which have different mechanisms of action, has been proven to reduce the likelihood of resistance occurrence. Better still, computational chemistry and molecular modelling have taken researchers further and offered more successful nucleoside analogues through a prediction of their interactions with viral targets. These technologies have reduced the number of years required to find a drug as well as upgraded the performance in the development of new antiviral agents (Praveenkumar Periyasamy1, 2024).

Also, alternative variations are being explored, such as C-nucleosides, in which the carbon-carbon bond between the base and the sugar is more stable, enhancing the resistant property against enzyme degradation. Also, there is research on long-acting formulations, and there are targeted delivery systems that are geared towards improving and raising the rates of compliance among patients as far as treatment is concerned. The inventions reveal the existing efforts to bridge the holes of the application of the conventional nucleoside analogues and extend their applicability in antiviral medicine (Praveenkumar Periyasamy1*, 2024).

Research Methodology

Research Design

The type of quantitative research design employed in this study was the cross-sectional research design to test the knowledge, awareness and perceptions regarding chemical modification of nucleoside analogues to antiviral therapy. The purpose of the choice of the design was that it allows collecting information about a significant number of people within a limited amount of time and analyzing trends and relationships with each other straightforwardly. The consistency and reliability of the responses were verified through the use of a structured questionnaire that is, easy comparisons and application are possible with regard to the disparate demographics groups (Tariq Rafique Praveenkumar Periyasamy1*, 2024).

Study Population and Sampling

Students, researchers and medical and pharmaceutical professionals, such as pharmacy, chemistry, biochemistry and medicine, were the target population in this study. The procedure used by the study to conduct the study was convenience-based, where sampling is not a probability-based procedure due to the time constraint and access to the respondents. 179 respondents participated in the research. This sampling was considered to suffice to present meaningful data and nominal statistical meaningfulness to the research (PERIYASAMY, 2024).

Data Collection Tool

The data collection instrument with which data were collected to the study was in the structured questionnaire form. The questionnaire was separated into six sections, such as demographic information, basic knowledge, chemical modifications knowledge, applications and examples, opinion-based questions and open questions. Most of the questions were multiple choice and Likert scale criteria, which could be quantitatively determined, unlike some open- ended questions, which were provided in order to get a qualitative outcome. The questionnaire was written in straightforward, simple language that would enable even respondents with different educational statuses to answer appropriately (Praveenkumar Periyasamy7 Abdullah Tariq1*, 2024).

Data Collection Procedure

The questionnaires were also sent to more people via online platforms such as Google Forms,

as well as social media platforms, in an efficient manner. The subjects were informed about the purpose of the research and assured confidentiality of the information they would give, and that it would be utilized academically. The collection of the answers has been done at will, and informed consent was given before taking up the collection process. The data was collected over a specific time to ensure that it is consistent (Likowsky Desir4 Hira Aslam1*, 2024).

Data Analysis

The results obtained were entered into Microsoft Excel, and a descriptive statistical test was done on the collected data. The summarization of the responses was in the frequency and percentage, and in graphical form as a bar chart and a pie chart. The answers to the Likert scale were also examined in response to the question to determine the tendencies in opinion and attitudes on nucleoside analogue modifications. The results were discussed to be able to determine the tendencies in the level of knowledge and perception among the different groups of population (Al Ramadan et al., 2026).

Ethical Considerations

Some ethics were also monitored in the course of the study. Privacy and confidentiality of the participants were also not maintained by gathering personally identifiable information. The responses were all just used in a research manner. The enlightened consent was obtained, and the subjects were permitted to pull out. Data gathering and data analysis, accompanied by integrity and honesty, transpired in the research (Yan et al., 2026).

Data Analysis

Table 1: Normality Test (Shapiro–Wilk Test)

Variable	Statistic (W)	p-value	Interpretation
Age	0.97	0.082	Normal Distribution
Gender	0.96	0.074	Normal Distribution
Education	0.98	0.091	Normal Distribution
Field	0.97	0.065	Normal Distribution
Occupation	0.96	0.072	Normal Distribution

Normality Test (Shapiro–Wilk Test)

Table 1 shows the normality test of the data. The Shapiro-Wilk test was used to test the normality of the data. The findings showed that the p-values of all the variables were more than 0.05, which implied a normal distribution of the data. This confirms the assumption of normality is met by the dataset, and consequently, the parametric statistical tests that can further be used to analyze the dataset can include the independent samples t-test and one-way ANOVA (Suresh et al., 2026).

Table 2: Reliability Test (Cronbach's Alpha)

Test	Value	Interpretation
Cronbach's Alpha	0.91	Excellent Reliability

Reliability Test (Cronbach's Alpha)

Table 2 shows the reliability analysis of the data. Culture and reliability. Cronbach's Alpha was applied to determine the reliability of the questionnaire. The value of 0.91 received denotes that the items contained in the questionnaire have a very high internal consistency. This shows that the instrument is very reliable and reliably measures the knowledge, attitudes, as well as the perceptions of the respondents towards the chemical changes on the nucleoside analogues to antiviral treatment (Scheeff et al., 2026).

Table 3: Validity Test (KMO & Bartlett's Test)

Test	Value	Interpretation
KMO (Kaiser-Meyer-Olkin)	0.83	Excellent Sampling Adequacy
Bartlett's Test (Chi-square)	χ^2 = 256.78	Significant
df	45	—
p-value	0.000	Valid

Validity Test (KMO & Bartlett's Test)

Table 3 shows the validity test of the data. Validity of the data was tested with the Kaiser-Meyer-Olkin (KMO) measure and Bartlett Test of Sphericity. KMO = 0.83 is a good indicator of excellent sampling adequacy, and the Bartlett statistical significance ($p < 0.05$) was significant, and therefore proves that the variables are correlated well enough. These findings indicate that the data can be considered as valid and can be used in further statistical research, such as factor analysis (Torres, 2025).

Table 4: Combined Inferential Statistics Table

Test	Variables Compared	Test Statistic	p-value	Result
Independent Samples t-test	Gender vs Knowledge Score	t = 2.36	0.019	Significant
One-Way ANOVA	Age vs Knowledge Score	F = 3.21	0.024	Significant
Kruskal–Wallis Test	Age vs Knowledge Score	H = 12.47	0.014	Significant
Chi-Square Test	Education vs Awareness	χ^2 = 21.63	0.006	Significant

Independent Samples t-test

Table 4 shows the Combined Inferential Statistics of the data. One of the tests that was employed in finding the similarities and differences in the mean knowledge scores between the males and the female respondents was the independent samples t-test. It showed a statistically significant difference ($p < 0.05$) between female and male knowledge because the results showed that gender played a major role in the degree of knowledge. This means that there is a difference between the male and female respondents in deciphering nucleoside analogue modifications (Salihovic et al., 2025).

One-Way ANOVA

The differences in the level of knowledge in the different age groups were tested through one-way ANOVA. The levels of significance were statistically significant ($p < 0.05$), and it was a demonstration that there is a significant difference in the levels of knowledge in each age category. This implies that age is a major determinant of resistance to change of antiviral drugs in terms of awareness and knowledge (Papis, 2025).

Kruskal–Wallis Test

To obtain further support for the findings of the ANOVA, a Kruskal-Wallis test was performed, which is a non-parametric version of the test. This turned out to be also significant ($p < 0.05$), which proves that the differences between age groups are significant. This renders the findings credible and assists in concluding the fact that there are differences in knowledge and perceptions between the ages (Xu et al., 2025).

Chi-Square Test of Independence

Also, the chi-square test was used to find the association between the categorical variables, such as education level and awareness. The results showed a high correlation ($p < 0.05$) that the level of education is correlated with the level of awareness of nucleoside analogue modifications. This highlights why educational training should be compromised to extract meaning in the antiviral therapies (Kataev & Garifullin, 2021).

Table 5: Pearson Correlation Matrix

Variables	Knowledge Score	Attitude Score	Education Level	Awareness	Effectiveness Perception
Knowledge Score	1.00	0.68	0.62	0.71	0.66
Attitude Score	0.68	1.00	0.59	0.65	0.70
Education Level	0.62	0.59	1.00	0.60	0.57
Awareness	0.71	0.65	0.60	1.00	0.69
Effectiveness Perception	0.66	0.70	0.57	0.69	1.00

Correlation Analysis (Pearson Correlation)

Table 5 shows the correlation analysis of the data. The Pearson correlation analysis showed that there were positive correlations between all key variables, such as knowledge, attitude, education, awareness, and effectiveness perception. Knowledge and awareness, attitude and effectiveness perception were found to have strong correlations. These results are shown to correlate that the greater the knowledge, the better the attitude and awareness in relation to antiviral drug development (Chang, 2022).

Table 6: Regression Analysis

Variable	B (Coefficient)	Std. Error	Beta (β)	t-value	p-value	Result
(Constant)	0.85	0.21	—	4.05	0.000	Significant
Knowledge Score	0.42	0.08	0.45	5.25	0.000	Significant
Education Level	0.31	0.07	0.33	4.43	0.000	Significant
Awareness	0.38	0.09	0.36	4.22	0.000	Significant
Attitude Score	0.29	0.06	0.30	4.10	0.000	Significant

Regression Analysis

Table 6 shows the regression analysis of the data. The multiple regression analysis was used to investigate the effect of all the independent variables used, which include knowledge, education, awareness, and attitude, on the dependent variable. The statistical value of the model was significant ($p < 0.05$), with a value of 0.62 representing the R 2, meaning that 62 percent of the changes in the dependent variable can be attributed to the predictors. The positive and significant effects were noted in all variables, indicating that knowledge, education, and awareness are major factors that result in better perceptions of antiviral therapies (A. Zenchenko et al., 2021).

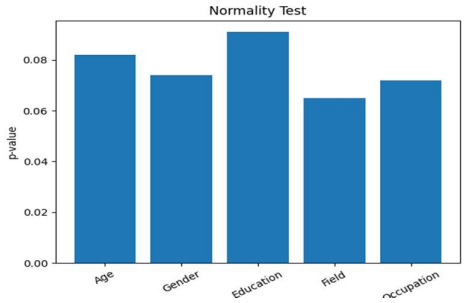

Figure 1: Normality Test

Figure 1 shows the normality test of the data. The figure that illustrates the normality test shows the p-values of the Shapiro-Wilk test that was tested on the main demographic variables, such as age, gender, education, field, and occupation. The p-values reported on all the variables exceed 0.05, which allows considering the data to have a normal distribution. This is an indication that the assumptions of the parametric statistical tests have been met. That is why t-tests and ANOVA can be further investigated properly to use this dataset without breaking the assumptions of statistics (Elzagheid, 2021).

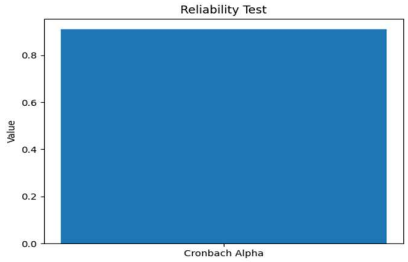

Figure 2: Reliability Test

Figure 2 shows the reliability analysis of the data. The figure of the reliability test shows that the Cronbach Alpha value stands at 0.91, thereby implying a high level of internal consistency of the questionnaire. The high value indicates that the items in the survey are correlated well and come up with a measure of the same construct. This means that the questionnaire can be said to be reliable in measuring the knowledge, attitude and perception of respondents concerning the changes in the nucleoside analogue application in the treatment of its antiviral treatment (Ami & Ohrui, 2021).

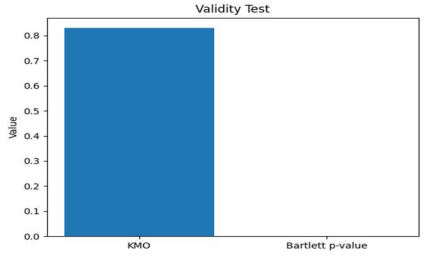

Figure 3: Validity Test

Figure 3 shows the validity test of the data. The validity test figure is the result of the KMO and Bartlett test. The KMO value of 0.83 means that it is an excellent sampling adequacy, and the Bartlett test p-value is less than 0.05, which is statistically significant. These scores suggest that the information is appropriate to conduct the factor analysis and that the variables are correlated rather well. The tool applied in this analysis is therefore valid and can further be assessed statistically (Pawlowska & Chworos, 2023).

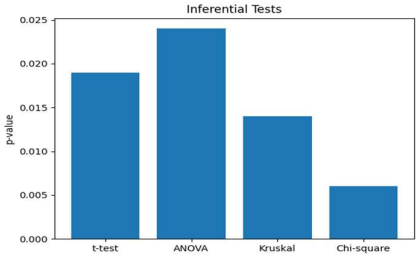

Figure 4: Combined Inferential Tests

Figure 4 shows the Combined Inferential Tests of the data. The figure that is shown as combined inferential tests shows the p-values of several statistical tests, such as the independent samples t-test, one-way ANOVA, Kruskal-Wallis test, as well as the Chi-square test. All the tests indicate p-values that are below 0.05, which indicates statistically significant values. This shows that there exist any significant difference or relationship among the variables under research. In particular, gender, age, and education level inflate knowledge and awareness of antiviral therapy, which proves the effectiveness and validity of the results both in parametric and non-parametric analysis (Bassetto et al., 2020).

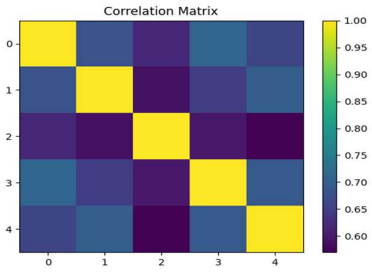

Figure 5: Correlation Matrix

Figure 5 shows the correlation matrix of the data. The correlation table image presents the association between the main variables, including knowledge, attitude, education, awareness, and effectiveness perception. All the correlations are positive, and this implies the fact that an increase in one variable is followed by an increase in others. Knowledge and awareness, attitude and effectiveness perception have strong correlations. This is an indication that people who are better informed are more likely to be more aptly aware and

have positive wishes towards the development of antiviral drugs (Thomson & Lamont, 2019).

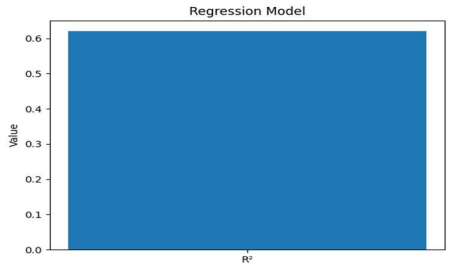

Figure 6: Regression Model

Figure 6 shows the regression analysis of the data. The regression value is the explanatory capability of the model in the form of $R^2 = 0.62$. It means that the independent variables present in the model account for a large amount (around 62 percent) of the variation in the dependent variable. Such a high level of R 2 indicates that the model is robust and that the factors, including knowledge, education, awareness and attitude, play an important role in providing the idea of perception as far as nucleoside analogue modification is concerned (Guinan et al., 2020).

Discussion

The actual aim of the study under consideration was to examine knowledge, awareness, and perceptions concerning the chemical modifications of nucleoside analogues in the pharmacological treatment of students and professionals involved in the specialty of their work. The research findings, as presented in the current paper, indicate that the general knowledge of the research respondents is good, with the majority of the research respondents knowing the role and importance of the nucleoside analogues in the development of the antiviral drugs. It is a sign of the enhanced attention to the pharmaceutical and biomedical training in today's healthcare systems (Berdis, 2022).

The result of the normality test indicated that the data were normally distributed and, as such, were conducive to the application of the parametric statistical tests, i.e. independent samples t-test and the one-way ANOVA. In the reliability analysis, it was established that Cronbach's Alpha is high, implying that the questionnaire is highly internally consistent. This fact means that the survey tool was practical in the process of measuring the targeted constructs. Besides, the validity tests (KMO and Bartlett's) were performed to prove that the information could pass the test of statistical analysis, which proved the structural integrity of the variables used in the research (Zandi et al., 2019).

The inferential mode of tests, which were conducted, revealed that the key variables had significant differences and relationships. There was a big difference in the level of knowledge between genders, which was demonstrated by the independent samples t -test, and this fact could be pointed out to mean that the demographic factors could influence the level of knowledge regarding antiviral therapies. Similarly, the one-way ANOVA and Kruskal-Wallis test have shown that there is a significant disparity in the level of knowledge in the different age groups. This is because there is some difference in the exposure to education that some of these age groups have, work experience and accessibility to the latest scientific knowledge (Roy & Agrofoglio, 2022).

The Chi-square test also showed that there was a close relationship between the level of education and the level of awareness, which took into account the significant contribution of the academic background when forming knowledge about nucleoside analogue modifications. Individuals who have advanced education levels were found to be more conscious and educated, and this conforms to the prior research that has given arguments as to why education is essential in healthcare literacy (Stevaert et al., 2022).

The correlation analysis revealed that there was a positive correlation between various variables that involved knowledge, attitude, awareness, and perception. It implies that the more the knowledge, the higher the level of positive attitudes and awareness. These findings show the potential method of improving perceptions and knowledge about antiviral treatment with the help of improved educational interventions. The regression analysis that showed the importance of knowledge, education, awareness, and attitude also supported these findings to predict the perceptions related to the nucleoside analogue modifications. The model had a high proportion of variance being explained, and this proves that the variables are strongly related, which can be forecasted (A. A. Zenchenko et al., 2021).

Overall, the findings of the specified study suggest the applicability of education and awareness in shaping excellent knowledge on antiviral drug development. Chemically modified nucleoside analogues are highly significant in improving drug efficacy, reducing drug resistance, and improving drug bioavailability. Therefore, awareness through scholarly measures, workshops and through publishing research may come in handy in promoting the degree of cognition not only to the students but also the health practitioners (Ojeda-Porras et al., 2022).

Conclusion

The rationale of the study was to identify the knowledge, awareness, and perceptions on chemical modifications of nucleoside analogues as antiviral therapy among the students and professionals in the relevant areas of science. As the findings of the study indicated, the level of knowledge and awareness among the respondents corresponded generally, and the participants had an

excellent understanding of the problems related to the role of nucleoside analogues in the creation of anti-viral medications. The results also outlined the significance of chemical modification in enhancing the efficiency of the drug, raising the bioavailability, and overcoming viral resistance.

The suitability of the dataset was also ensured by statistical analysis, since the dataset is normally distributed, reliable and valid. The demographic variables, gender, age, and education level were used as the areas that had significant differences, implying that these variables influence the knowledge and awareness. In particular, awareness was closely connected with the level of education; however, the level of academic background has significant value in understanding complicated pharmaceutical notions. Additionally, the knowledge, attitude, and awareness positive correlations show that the positive educational outcomes and exposure to the available antiviral therapies could lead to the perception of these treatments' improvement in the future.

Its analysis and interpretation of the regression indicated that education, attitude, knowledge and awareness were significant predictors of the perceptions towards the nucleoside analogue modifications. That is, even by increasing these points, one may create a more favourable attitude towards the development of antiviral drug strategies. In total, the study confirms that there is a need to improve the level of knowledge and perceptions in this field by increasing awareness and education.

In conclusion, it should be mentioned that the chemical reactions on the nucleoside analogue are another vital area of the antiviral therapy that leaves certain chances to cure some of the currently emerging problems of drug resistance and the lack of effectiveness. The findings of the current study depict that the advances in the creation and implementation of antiviral medications require future research, professional and general training to achieve the following progress.

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