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ECONOMETRIC MODELING OF THE IMPACT OF NON-FORMAL EDUCATION ON THE LIVING STANDARDS OF THE ARMENIAN POPULATION

Abstract: Non-formal education is undergoing a phase of reform and is currently more prominent among the population. In parallel, we do not have a clear statistic on the outcomes of the non-formal edutaion in the Republic of Armenia. There are also no evidence-based assessments of the economic impact of the non-formal education on standards of living in Armenia. Meanwhile, the needs for non-formal and continuing education are growing driven by the ever-increasing employment market development trends.

The study attempts to fill this gap and presents measurable results through models of the impact of non-formal education on the living standards of the population in the RA.

Keywords: non-formal education, standard of living of the population, regression models, impact of continuing education, econometric models.

JEL codes: Q53, I21, I26

Research aims: to assess the impact of expenditures on non-formal education on the indicators of the standard of living of the population.

Research novelty: The interactions between expenditures on non-formal education and components of the standard of living of the population in the Republic of Armenia were assessed through regression models and the corresponding qualitative conclusions were drawn.

Introduction

Non-formal education is currently developing rapidly all over the world. It is gradually becoming attractive both for the acquisition of professional competitive abilities and skills through continuous education, and for the purpose of saving the financial and time resources of the learner (Khachatryan N, Mirzoyan N, Tsughuryan A, Avanesova I, Hakobjanyan A. 2026).

Recognizing the importance of non-formal education, the "Education 2030" Framework of Action calls on countries to ensure "lifelong learning opportunities for youth and adults, including formal, non-formal and informal learning" (Global Education Cooperation Mechanism 2030). According to the results of the survey and research report "Skills Development among Employers in Armenia" of about 1,000 organizations, it is noted that about 50% of large companies in Armenia organize training for employees

annually, medium-sized companies - 44%, small companies - 39%. Moreover, about 92% of the surveyed organizations indicated that they do not provide funding for employee training in their annual financial budgets.

However, in parallel, there have not yet been clear assessments in the Republic of Armenia of how non-formal education affects the living standards of the population (Republican Union of Employers of Armenia, 2021), what interactions are observed between the financing of this form of education and changes in people's well-being (Sahakyan H, 2025). It is also important to examine how people's behaviors are expressed and shaped as a result of non-formal education, especially from the perspective of sustainable development (Khachatryan N., Mirzoyan N., Tshughuryan A., Avanesova I., Hakobjanyan A. 2026).

Research methodology and data

Regression models were estimated to identify and assess the effects between expenditures on non-formal education and living standards indicators. The analysis was performed based on annual time series for the following variables from 2000-2025 published by ArmStat (Statistics yearbook of Armenia): GDP per capita: USD (gdpp), average monthly nominal wage: AMD (wage), poverty rate: % (poverty), unemployment rate: % (unemp), life expectancy: years (life), share of employees with professional education in total employment: % (emp_profeduc), average monthly pension: AMD (pension), internet usage by the population: % (internet), Human Development Index (HDI), share of education expenditure in the budget: % (educ_exp_budg), share of non-formal education in the

state budget: % (nfeduc_st_budg), share of public funding of non-formal education: % (nfeduc_pub_fund), non-formal education in total education expenditure: % (nfeduc_toteduc_exp).

Regression models were performed using EViews v.13 (Nairuhi Jrbashyan, 2013) and ***the models with statistically significant results were included in the article.***

Stationary time series were considered in the models. To test the stationarity of the time series, the Augmented Dickey-Fuller (ADF) unit root test was applied, which tests the null hypothesis "The time series has a unit root" (Magnus Ya.R., Katyshev P.K., Peresetsky A.A. 2004). According to the test, if the ADF test statistic is greater than the test critical value at a given significance level α (1%, 5%, 10%) or Prob>α, where Prob is the probability of being wrong when rejecting the null hypothesis, then the null hypothesis is not rejected at that significance level and the time series is not stationary. The non-stationary series were made stationary by applying first-order sequential difference (Table 1).[1]

Figure 1 shows the graphs of the dependent variables included in the models, which are: average monthly nominal wage (AMD), life expectancy (year), share of employees with professional education in total employment (%), internet usage by the population (%).

[1] *In the variable names, d indicates the first-order difference, ln - the logarithmic value.*

Table 1. Results of the ADF test of the variables in the models

Source: *Authors' own work.*

Variable	ADF test equation	ADF test statistic	5% level critical value	Prob *
ln_educ_exp_budg	Constant, Linear Trend	-3.391837	-3.603202	0.0752
nfeduc_toteduc_exp	Constant, Linear Trend	-3.810475	-3.603202	0.0330
nfeduc_st_budg	Constant, Linear Trend	-5.215619	-3.603202	0.0015
nfeduc_pub_fund	Constant	-4.225193	-2.986225	0.0031
internet	Constant	-0.022204	-2.986225	0.9478
dinternet	Constant	-4.250142	-2.991878	0.0031
ln_hdi	Constant	-2.006732	-2.998064	0.2820
dln_hdi	Constant	-5.385993	-2.998064	0.0002
wage	Constant	2.001606	-2.986226	0.9997
dwage	Constant	-2.966471	-2.991878	0.0526
ln_life	Constant, Linear Trend	-3.551837	-3.238054 (*10% level critical Value*)	0.0553
ln_emp_profeduc	Constant	-1.916250	-2.986225	0.3199
dln_emp_profeduc	Constant	-7.861752	-2.991878	0.0000

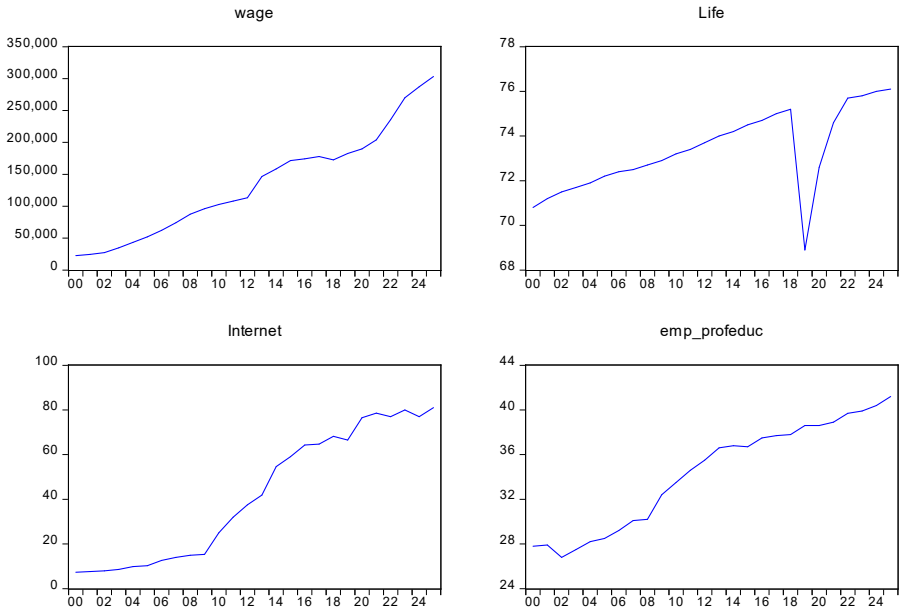

Figure 1. the graphs of the dependent variables included in the models, in 2000-2025.
Source: *[11]*

A linear regression model and log-linear and log-log models were estimated in the article.

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m + \varepsilon,$$

$$\ln(y) = \beta_0 + \beta_1 x + \varepsilon,$$

$$\ln(y) = \beta_0 + \beta_1 \ln(x)\, x + \varepsilon,$$

where β_i $(i = 0,1, \dots m)$ coefficients are the unknown parameters of model, and ε represents the **random error term**. The β_i coefficients were estimated by the least squares method (Christopher Dougherty, 2009). The significance of the β_i

coefficient is assessed to determine if there is a statistically significant linear relationship between the independent variable X_i and the dependent variable y.

The significance of the β_i coefficients were estimated using the Student's t-test. The coefficient β_i is significant at the α significance level (i.e. the null hypothesis H_0: $\beta_i = 0$ is rejected), if the t-statistic is greater in absolute value than the corresponding critical value t_{cr}, where the t_{cr} is determined from the student distribution table. Thus, if $|t| > t_{cr}$ or Prob < α, the independent variable is statisticaly significant at the α significance level, where Prob is the probability of being wrong when rejecting the hypothesis H_0 (Magnus Ya.R., Katyshev P.K., Peresetsky A.A. 2004).

The statistically significance of the model was tested using the F-test. The F-statistic allows to test the presence of a statistically significant relationship between the dependent and independent variables. If $|F| > F_{cr}$ or Prob(F-statistic)< α, then the H_0 hypothesis (H_0: absence of statistically significant relationship) is rejected at the α significance level, and the model is statistically significant. The F_{cr} value is determined from the Fisher distribution table (Magnus Ya.R., Katyshev P.K., Peresetsky A.A. 2004). The coefficient of determination, R-squared was used to measure how well independent variables explain the variance of a dependent variable.

After evaluating the empirical regression equation, it was examined whether the empirical regression parameters are the best estimates of the theoretical parameters in the class of linearly stable estimates. For this, the Gauss-Markov's conditions, which relate to the properties of random errors, were checked. Since the residuals of the empirical regression equation are statistical estimates of the

random errors of the model, the residuals of the empirical regression equation were used to check the specified conditions (Jeffrey M. Wooldridge, 2013; R. Carter Hil, William E. Griffiths, Guay C. Lim, 2011).

According to the Gauss Markov's theorem, the mathematical expectation of the model errors is equal to zero for all observations. The normal distribution of the residuals of the empirical equation was tested using the Jarque-Bera test. The null hypothesis (H_0) is that the data is normally distributed. If the p-value (probability of rejecting the null hypothesis) is less than a given significance level α, the null hypothesis is rejected, indicating the data is not normally distributed (Nairuhi Jrbashyan, 2013).

The absence of first-order autocorrelation in the regression residuals (H_0) was tested using the Breusch-Godfrey Serial Correlation LM Test. If the probability of rejecting the null hypothesis is greater than a given significance level, then the null hypothesis is not rejected, and the residuals are not autocorrelated (Nairuhi Jrbashyan, 2013).

The condition for homoscedasticity of the residuals was tested using the Breusch-Pagan-Godfrey Heteroscedasticity test. The test assumes the null hypothesis that the estimated regression residuals are homoscedastic. The alternative hypothesis is that they are heteroscedastic. If the probability of the Obs*R-Square statistic (Prob. Chi-Square) is greater than a given significance level α, then the null hypothesis is not rejected, and the residuals are homoscedastic (Magnus Ya.R., Katyshev P.K., Peresetsky A.A. 2004).

The correct specification of the estimated model was tested by the Ramsey RESET test (Regression Specification Error Test). The null hypothesis is assumed that the estimated regression specification is the correct form of the dependence of the dependent variable on the explanatory variable. If Probability(F-statistic)>α, the null hypothesis is not rejected, and the model is correctly specified (Nairuhi Jrbashyan, 2013).

Research results

Model 1. The dependence of the average monthly nominal wage on the share of non-formal education in total educational expenditures and the Human Development Index was estimated.

Dependent Variable: DWAGE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NFEDUC_TOTEDUC_EXP(-1)	2564.905	1000.375	2.563944	0.0177
DLN_HDI	255769.8	103679.6	2.466925	0.0219
C	-3932.468	5620.938	-0.699611	0.4915

R-squared	0.318490	Mean dependent var	11217.36
Adjusted R-squared	0.256535	S.D. dependent var	9619.434
S.E. of regression	8294.301	Akaike info criterion	20.99669
Sum squared resid	1.51E+09	Schwarz criterion	21.14296
Log likelihood	-259.4586	Hannan-Quinn criter.	21.03726
F-statistic	5.140637	Durbin-Watson stat	1.695099
Prob(F-statistic)	0.014730		

The model results indicate that the estimated coefficients and the model are statistically significant at the 5% significance level (prob(t-Statistic)<0.05 and prob(F-Statistic)<0.05).

25.7% of the variation in average nominal wage is explained by the share of non-formal education in total educational expenditures

and the Human Development Index (Adjusted R-squared=0.256535).

The residuals of the empirical equation are normally distributed according to the Jarque-Bera test (Jarque-Bera=4.553104, and Prob. Jarque-Bera =0.0.102637>0.05).

The residuals are homoscedastic according to the results of the Breusch-Pagan-Godfrey Heteroscedasticity test. Since in the test F-statistic=0.111176, Prob(F-statistic)=0.8953>0.05 and Obs*R-squared=2.004271, Prob(Chi-Square)=0.3671>0.05, we cannot reject the null hypothesis (Table 2).

The residuals are not autocorrelated according to the results of the Breusch-Godfrey Serial Correlation LM test (F-statistic =0.871584, Prob(F-statistic)=0.4336 and Obs*R-squared=0.250144, Prob(Chi-Square)= 0.8824>0.05).

The correct specification of the estimated model follows from the Ramsey RESET test (F-statistic=3.758060 and Probability(F-statistic)=0.9363>0.05).

According to the results of the VIF test (Variance Inflation Factor), multicollinearity is absent in the regression, since VIF =1.056676<5.

Table 2. Tests of residuals for Model 1
Source: *Authors' own work.*

Breusch-Godfrey Serial Correlation LM Test:	Obs*R-squared	2.004271	Prob. Chi-Square(2)	0.3671
Breusch-Pagan-Godfrey Heteroscedasticity test	Obs*R-squared	0.250144	Prob. Chi-Square(2)	0.8824
Ramsey RESET Test	F-statistic	3.758060	Probability	0.0661

The estimated model is:

$$\mathrm{d}\,(wage)_t = -3932.47 + 2564.91\,(NfEduc\_TotEduc)_{t-1} + 255769.8\,d(\ln(HDI))_t + \varepsilon_t$$

According to the model, a 1% increase in the share of non-formal education expenditures in total educational expenditures in the current year contributes to a 2564.91 AMD increase in the average monthly nominal wage one year later, ceteris paribus. A 1% increase in the Human Development Index leads to 255769*0.01=2557.69 AMD increase in the average monthly nominal wage in the current year, ceteris paribus.

Model 2. The following log-linear regression model of the dependence of life expectancy on the share of non-formal education expenditures in the state budget was estimated:

Dependent Variable: LN_LIFE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NFEDUC_ST_BUDG	0.069923	0.018619	3.755448	0.0010
C	4.253691	0.011708	363.3290	0.0000

R-squared	0.370135	Mean dependent var	4.295106
Adjusted R-squared	0.343890	S.D. dependent var	0.024741
S.E. of regression	0.020040	Akaike info criterion	-4.908374
Sum squared resid	0.009638	Schwarz criterion	-4.811597
Log likelihood	65.80886	Hannan-Quinn criter.	-4.880506
F-statistic	14.10339	Durbin-Watson stat	1.617643
Prob(F-statistic)	0.000975		

The NFEDUC_ST_BUDG variable is statistically significant at the α=0.01 significance level (t-statistic=3.7554>2, Prob=0.001). The model is statistically significant at the 1% significance level (Prob(F-statistic)=0.000975<0.01).

Since R-squared=0.370135, approximately 37% of the variation in the dependent variable, life expectancy, is explained by the independent variable, i.e., the share of non-formal education expenditures in the state budget.

To ensure the reliability of the obtained results, as well as the quality of the model, a test was performed for the absence of autocorrelation and heteroscedasticity of the model residuals (Table 3).

According to the results of the Breusch-Godfrey Serial Correlation LM test Obs*R-squared=0.848683 and Prob.Chi-Square=0.6542>0.05, which suggests that the residuals of the estimated model are not autocorrelated. The results of the residual heteroscedasticity test show that Obs*R-squared=0.90223 and Prob.Chi-Square=0.6369>0.05, so the null hypothesis of homoscedasticity of the residuals is not rejected.

Since the Ramsey RESET test shows F-statistic=0.481480>0.05 and Probability=0.4947, the null hypothesis of correct specification of the model cannot be rejected, and the model is correctly specified.

Table 3. Residual tests for Model 2
Source: *Authors' own work.*

Breusch-Godfrey Serial Correlation LM Test:	Obs*R-squared	0.848683	Prob. Chi-Square(2)	0.6542
Heteroskedasticity Test: White	Obs*R-squared	0.902230	Prob. Chi-Square(2)	0.6369
Ramsey RESET Test	F-statistic	0.481480	Probability	0.4947

Thus, the estimated model is:

$$\ln (life)_t = 4.2537 + 0.0699\ (NfEduc\_st\_Budg)_t + \varepsilon_t$$

According to the model, a 1% increase in the share of non-formal education expenditures in the state budget leads to an increase in life expectancy by about 6.99%.

Model 3. The following log-log model estimates the dependence of the share of employees with vocational education in the total number of employed persons on the share of education expenditures in the state budget.

Dependent Variable: DLN_EMP_PROFEDUC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLN_EDUC_EXP_BUDG	0.079602	0.044301	1.796846	0.0855
C	0.013186	0.003982	3.311161	0.0030

R-squared	0.123096	Mean dependent var	0.015736
Adjusted R-squared	0.084970	S.D. dependent var	0.019450
S.E. of regression	0.018605	Akaike info criterion	-5.054151
Sum squared resid	0.007961	Schwarz criterion	-4.956641
Log likelihood	65.17689	Hannan-Quinn criter.	-5.027106
F-statistic	3.228655	Durbin-Watson stat	1.506845
Prob(F-statistic)	0.085506		

The explanatory variable DLN_EDUC_EXP_BUDG is statistically significant at the 10% significance level (t-statistic=1.796846, Prob=0.0855) and the regression model is also statistically significant at the 10% significance level (Prob(F-statistic)=0.085506).

Since R-squared=0.123096, therefore only 12.3% of the variation in the dependent variable is explained by the independent variable, i.e. the share of education expenditures in the state budget.

All residual diagnostic tests for the model indicate p-values greater than 0.05 (Table 4). The residuals are homoscedastic according to the results of the Breusch-Pagan-Godfrey heteroskedasticity test (Obs*R-squared=0.797701 and Prob.Chi-Square= 0.6711>0.05), not autocorrelated according to the results of the Breusch-Godfrey Serial Correlation LM test (Obs*R-squared=1.345229 and Prob.Chi-Square=0.5104>0.05).

According to the results of the Ramsey RESET test the model is correctly specified (F-statistic=1.536643 and Probability= 0.2282>0.05).

Table 4. Residual tests for Model 3
Source: *Authors' own work.*

Breusch-Godfrey Serial Correlation LM Test:	Obs*R-squared	1.345229	Prob. Chi-Square(2)	0.5104
Heteroskedasticity Test: White	Obs*R-squared	0.797701	Prob. Chi-Square(2)	0.6711
Ramsey RESET Test	F-statistic	1.536643	Probability	0.2282

The estimated model is:

$$d(\ln(Emp\_ProfEduc))_t = 0.013 + 0.0796\, d(\ln(Educ\_Exp\_Budg))_t + \varepsilon_t$$

According to the model, a 1% increase in the share of education expenditures in the state budget in the current year leads to a 0.08% increase in the share of specialists among the employed.

Model 4. The following model estimates the dependence of internet usage by the population (%) on the share of public funding of non-formal education.

Dependent Variable: D(INTERNET)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NFEDUC_PUB_FUND	-0.291234	0.136804	-2.128846	0.0442
C	22.85679	9.379162	2.436975	0.0230

R-squared	0.164608	Mean dependent var	2.948000
Adjusted R-squared	0.128287	S.D. dependent var	3.825845
S.E. of regression	3.572023	Akaike info criterion	5.460760
Sum squared resid	293.4650	Schwarz criterion	5.558270
Log likelihood	-66.25950	Hannan-Quinn criter.	5.487805
F-statistic	4.531986	Durbin-Watson stat	1.998733
Prob(F-statistic)	0.044196		

The model results indicate that the estimated coefficients and the model are statistically significant at the 5% significance level (t-statisticc=-2.128846, Prob=0.0442, Prob(F-statistic)= 0.044196).

Since R-squared=0.164608, therefore, only 16.5% of the change in the dependent variable, the share of Internet users in the population, is explained by the change in the share of public funding of non-formal education.

According to the results of the Breusch-Godfrey Serial Correlation LM test, Obs*R-squared= 1.345229 and Prob.Chi-Square=0.5104>0.05, therefore, the residuals of the estimated model are not autocorrelated. According to the results of the Breusch-Pagan-Godfrey heteroskedasticity test, Obs*R-squared=0.797701 and Prob.Chi-Square=0.6711>0.05, therefore,

the null hypothesis of homoscedasticity of the residuals is not rejected (Table 5).

Since the Ramsey RESET test shows F-statistic=1.536643 and Probability= 0.2282>0.05, therefore the null hypothesis of correct specification of the model cannot be rejected, and the model is correctly specified (Table 5).

Table 5. Tests of residuals for Model 4
Source: *Authors' own work.*

Breusch-Godfrey Serial Correlation LM Test:	Obs*R-squared	1.345229	Prob. Chi-Square(2)	0.5104
Heteroskedasticity Test: White	Obs*R-squared	0.797701	Prob. Chi-Square(2)	0.6711
Ramsey RESET Test	F-statistic	1.536643	Probability	0.2282

The estimated model 4 is:

$$d(internet)_t = 22.8567 - 0.2912\ (Nfeduc\_Pub\_Fund)_t$$

According to the model, a 1% increase in the share of public funding for non-formal education reduces the growth in the share of Internet users by the population by 0.29% compared to the previous year.

Conclusion

According to the research results, expenditures on non-formal education in the Republic of Armenia have a significant impact on some indicators of the standard of living of the population. Analysis of statistical data allows us to conclude that:

a) A one percent increase in the share of non-formal education expenditures in total educational expenditures in the current year contributes to a 2564.91 AMD increase in the average monthly nominal wage one year later, ceteris paribus. A 1% increase in the Human Development Index leads to 255769*0.01=2557.69 AMD increase in the average monthly nominal wage in the current year, ceteris paribus.
b) A one percent increase in the share of non-formal education expenditures in the state budget leads to an increase in life expectancy by about 6.99%.
c) A one percent increase in the share of education expenditures in the state budget in the current year leads to a 0.08% increase in the share of specialists among the employed.
d) A one percent increase in the share of public funding for non-formal education reduces the growth in the share of Internet users by the population by 0.29% compared to the previous year.

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Գայանե Ղուկասյան

Երևանի պետական համալսարան, ֆիզ.-մաթ. գ. թ., դոցենտ

Հասմիկ Սահակյան

«Հաշվապահության Ուսուցման Միջազգային Կենտրոն» կրթական հիմնադրամ, գործադիր տնօրեն

ՀՀ ԲՆԱԿՉՈՒԹՅԱՆ ԿԵՆՍԱՄԱԿԱՐԴԱԿԻ ՎՐԱ ՈՉ ՖՈՐՄԱԼ ԿՐԹՈՒԹՅԱՆ ԱԶԴԵՑՈՒԹՅԱՆ ԷԿՈՆՈՄԵՏՐԻԿ ՄՈԴԵԼԱՎՈՐՈՒՄ

Բանալի բառեր - ոչ ֆորմալ կրթություն, ազգաբնակչության կենսամակարդակ, ռեգրեսիոն մոդելներ, շարունակական կրթության ազդեցություն, էկոնոմետրիկ մոդելներ:

Ոչ ֆորմալ կրթությունը ՀՀ-ում բարեփոխումների փուլ է անցնում և ներկայումս առավել ակնառու է դրսևորվում ազգաբնակչության շրջանում: Սակայն, դրան զուգահեռ, ՀՀ-ում ոչ միայն չի վարվում հստակ վիճակագրություն ոչ ֆորմալ կրթության արդյունքների գծով, այլև չեն տրվում գնահատականներ, թե ի՞նչ ազդեցություն է ունենում ոչ ֆորմալ կրթությունը ազգաբնակչության կենսամակարդակի վրա:

Հետազոտությունում փորձ է արվում լրացնել այդ բացը, և բացահայտել ու գնահատել ՀՀ-ում ոչ ֆորմալ կրթության ծախսերի և ազգաբանակչության կենսամակարդակի տարբեր բաղադրիչների փոխկապակցությունները:

Կառուցված ռեգրեսիոն մոդելներով գնահատվել են ՀՀ-ում ոչ ֆորմալ կրթության ծախսերի և ազգաբնակչության կենսամակարդակի առանձին բաղադիչների փոխազդեցությունները և տրվել են համապատասխան որակական եզրահանգումներ:

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Conflicts of Interest:
The authors declare no ethical issues or conflicts of interest in this research.