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EFFECT OF HOUSEHOLD SIZE ON EDUCATIONAL OUTCOMES IN TANZANIA: A TWO-STAGE LEAST SQUARES (2SLS) APPROACH

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ABSTRACT: *Education achievement is considered the ultimate driver for socio-economic development for the role it plays in developing more human capital in the country. This study examined the effect of household size on education achievement among individuals living in rural and urban areas in Tanzania. The study employed data from the Tanzania National Bureau of Statistics, Household Survey 2020-2021, which consists of a total sample of 1,381 households across 30 regions. To avoid potential endogeneity bias that may exist when variables are endogenous, the study utilized the Two Stage Least Square (2SLS) method to address the problem. The findings posit that the instrumental variables added in the study are strong enough to explain the variations of household size on education achievement in Tanzania. The findings show a significant negative relationship between household size and education achievement in Tanzania with the coefficient of (-0.19926, p-value 0.0010). We, therefore, recommended that the government, through the Ministry of Education, should provide support for larger families, especially those living in rural areas, including financial aid, education subsidies, and access to free or reduced-cost education materials.*

KEYWORDS: Household Size, Education Achievements, Endogeneity, Two-Stage Least Squares (2SLS).

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INTRODUCTION

Educational achievement is one of the conspicuous indicators of how the economy is functioning for the role it plays, especially in human capital development. It acts as a fundamental driver of socioeconomic development in both developing and developed countries (Bykova et al., 2024; Khan & Fauzee, 2025; Pence et al., 2008). In emerging countries like Tanzania, access to education among youth has recently been a standing agenda; however, the socioeconomic factors influencing education outcomes, such as household size, income, consumption, and overall health status, have not been taken into consideration (Kauky et al., 2023; Ajefu & Massacky, 2023).

The government of Tanzania has made milestones in increasing access to education among youth, especially after the implementation of free primary education policies in 2015 (Ndijuye et al., 2024). Despite these efforts, challenges still remain especially in ensuring quality education and equitable outcomes for all students (Pamela & Mwila, 2022). This contributed to the concerns. According to the World Bank (2021), larger households often face resource constraints, which may adversely affect youth's educational achievement. The size of the household in Tanzania varies significantly between urban and rural areas, which is among the reasons for disparities in educational outcomes (National Bureau of Statistics, 2019).

Children are facing significant challenges in their educational journey, and most of these challenges are influenced by some socio-economic factors in the family and systematic issues within the education system (Ndijuye et al., 2024; Pamela & Mwila, 2022). While the government of Tanzania has made significant strides in increasing primary school enrolment, the secondary school counterparts tell a different story. As of the year 2020, the secondary school net enrolment was only about 30.6% (UNICEF, 2021). This low rate is a tell-tale of the hurdles students face transitioning from primary to secondary education. World Bank reports have shown that approximately 32% of students in developing countries drop out before completing their primary education (World Bank, 2019). The drop-out rate is even more alarming at the secondary level, where only 3 out of 10 students complete their studies (Lloyd & Mensch, 2008). According to Mnyawami et al. (2022), statistics show that student dropouts in Tanzanian secondary schools rose from 3.8 percent to 4.2 percent in the year 2019. Factors contributing to high dropout rates include family issues, poverty, early marriages, child labour and household size, to mention a few (Mnyawami et al., 2022; Pezzulo et al., 2022; Twaweza East Africa, 2019). This study is centred on how household size affects the educational outcome of their children.

Previous studies have shown mixed results regarding the impact of household size on education outcomes. While some studies have shown that larger households may benefit from older siblings contributing to the educational environment (Case et al., 2000; Cruise & O'Reilly, 2014; Lindelow, 2008; Dai & Heckman, 2013; Yu & Yan, 2023), others argued that a larger family may struggle with limited resources, leading to poorer educational outcomes (Downey, 1995; Harju-Luukkainen et al., 2020; Munir et al., 2023; Umberson & Thomeer, 2020). Although available evidence support the importance of household-level conditions for education, there remain limited recent Tanzania-specific evidence examining the effect of household size on educational achievement using NPS 2020/21 household survey.

Regardless of the government initiatives and the importance of education among youth in the country, Tanzania still faces challenges in achieving equitable education outcomes (Ndijuye et

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al., 2024). One of the less explored factors, yet it has a significant impact on family educational outcomes, is the household size. Families with a larger number of households in Tanzania often face a significant resource constraint, which may negatively impact the educational attainment of children (Harju-Luukkainen et al., 2020; Karwath et al., 2014; Pence et al., 2008; World Bank, 2019; Yu & Yan, 2023). This problem is compounded by regional disparities, where those living in rural areas experience larger household sizes and fewer education resources compared to those in urban areas (National Bureau of Statistics, 2019; Ndijuye et al., 2024; Pezzulo et al., 2022).

Recent studies are limited and yet have provided contradictory evidence on how the size of households influences education achievement. While some studies suggest the potential benefits of larger household size, such as shared responsibilities and shared support among siblings (Case, Lin & McLanahan, 2000; Cruise & O'Reilly, 2014; Lindelow, 2008; Dai & Heckman, 2013; Yu & Yan, 2023), others have pointed out that, larger households have a negative impact on education outcomes due to resource dilution and limited parental attention (Downey, 1995; Harju-Luukkainen et al., 2020; Karwath et al., 2014; Munir et al., 2023; Tambi & Betrand Ewane, 2019; Umberson & Thomeer, 2020). The prevailing inconsistency in findings, which were mainly contributed by a poor methodological approach, necessitates a more advanced approach to disentangle the causal effect of household size on educational achievement.

Furthermore, other recent studies despite being undertaken in Tanzania (Brandt et al., 2024; Ndijuye et al., 2024; Mugizi, 2025; Mukama & Mgonya, 2026) they focused implicitly on child labour, household enterprises, early learning environments and household headship on education outcome. On the other hand, these studies do not explicitly address potential endogeneity arising from the fact that household size may be jointly determined with unobservable parental preferences, fertility behaviour, household welfare, child labour decisions and intra-household resource allocation. Failing to account for endogeneity may lead to biased and incosistence estimates (Bastardoz et al., 2023).

In the current study, we believed the household's size to be endogenous, as it can be determined by several factors such as health and the characteristics of the head of the family. For this case, a Two Stage Least Squares (2SLS) approach was employed to avoid potential endogeneity bias. As for this case, the approach enabled the mitigation of potential endogeneity issues and provided a more accurate estimation of the causal relationship. Therefore, the main objective of this study is to determine how household size in Tanzania influences educational achievement among citizens living in the country.

LITERATURE REVIEW

The current study was centred on the resource dilution theory proposed by Joshua D. Angrist, who posits that within families, the allocation of parental resources among children significantly impacts educational achievement. As family size increases, available resources such as parental time, attention, and financial support are divided among more children, potentially reducing the individual resources available to each child (Angrist, 1995). Several studies are consistent with this theory, which found that children in larger families often receive less direct interaction with their parents and have less access to educational materials compared to those children in smaller families (Blake, 1989; Munir et al., 2023). According to Blake

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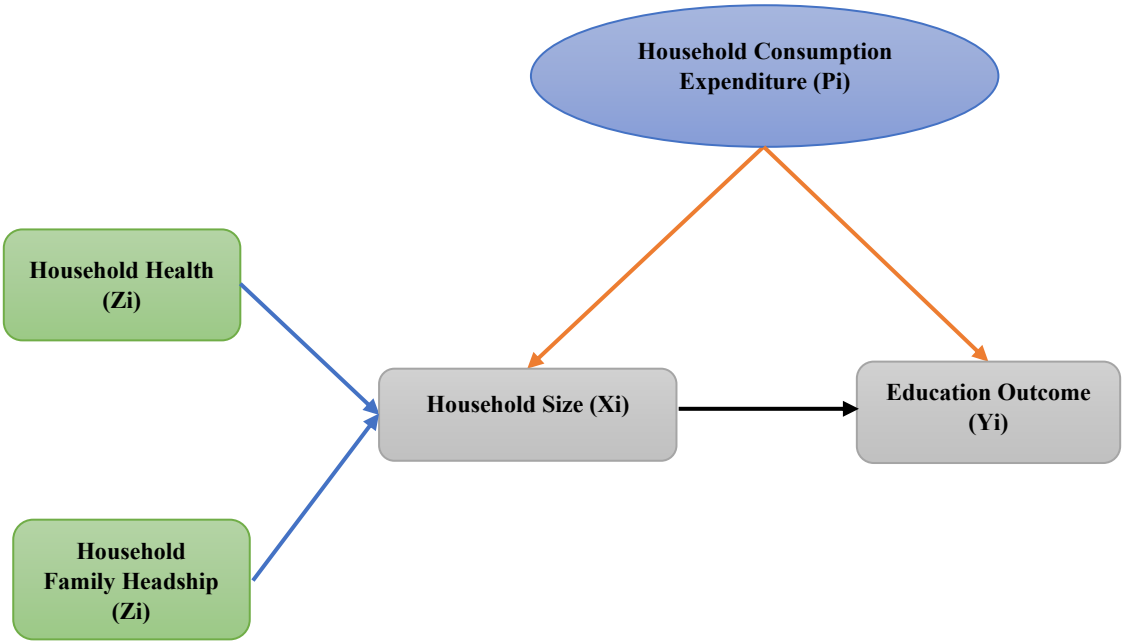
(1989), larger families often struggle to provide equal levels of education support to their children, resulting in inequalities in their education achievements. On the other hand, Downey (1995) and Lawson & Mace (2008) highlighted that larger households face challenges in maintaining a more level of parental involvement in their education journey and access to education resources, which are vital for children's educational outcomes. This slows their cognitive development compared to other children in smaller families. Morduch and Siwicki (2020), when examining the effect of household size on children's educational achievement pointed out that, larger families always struggle to allocate sufficient financial resources as well as parental resources to their children, which results in poor academic outcomes in Indonesia. This again is in hand with the resource dilution theory, which deduces that larger members of the family dilute the available resources per each child and hence affect their educational achievements. This is in line with Black, Devereux (2019), Smith and Haddad (2023), & Alderman and Headey (2024), who posit that larger households are always associated with lower educational achievements.

Notwithstanding the above, Kabubo-Maria et al., (2021) suggested that children from larger families have lower school attendance rates, which is highly linked to child labour to support the family's economic burden, which results in poor education outcomes. Li and Wu (2022) postulated that often larger families have lower education expenditures per child, especially in rural areas where financial resources are already limited, which leads to poor performance in their education journey. Regardless of the contribution provided by the previous studies enumerated above, most of these studies have primarily used traditional econometrics approaches such as Ordinary Least Squares (OLS) regression analysis, which may not fully account for endogeneity bias. This study suggests that the relationship between household size and educational outcomes may still be subject to biases that could be mitigated through the use of Two-Stage Least Squares (2SLS). The current study therefore employed the 2SLS method to address potential endogeneity issues in this relationship. Following the preceding theoretical and empirical perspective, the conceptual framework in Figure 1 below was developed.

Figure 1: Relationship among Variables



Source: *Author's (2026)*

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From Figure 1 above, household size was shown by letter (X), which is considered an endogenous variable and thus may affect a household's educational achievements. The resource delusion theory have been proposed to explain the nature of the relationship between household size and educational achievement. These explanations often encompass economic, socio-psychological, and genetic factors (Conley and Glauber, 2006). As the number of children in a family increases, the financial resources available per child decrease, leading to reduced investment in each child's education, (Lavy & Schlosser, 2010). However, the household size is influenced by a variety of social and economic conditions, including the characteristics of the head of the family, household health, and broader cultural factors, which provide sufficient evidence to qualify as endogenous variables.

Economically, higher income levels and employment stability typically correlate with smaller household sizes, as families with more resources can invest more in each child's education and well-being (Becker, 1960; Black, Devereux, & Salvanes, 2005). Socially, higher educational attainment, especially among mothers, often leads to smaller families due to better access to family planning and a greater emphasis on quality over quantity in child-rearing (Martin, 1995). Health conditions also play a crucial role, with poor health and high child mortality rates often resulting in larger household sizes as a compensatory measure (Schultz, 1997). For this reason, we include the Instrumental Variables (IVs) represented by (Z) in the model, which includes (head of the family and household health) to avoid the endogeneity problem, which may result in inconsistent and unreliable estimates (Wooldridge, 2010).

On the other hand, 'Pi' in Figure 1 is the confounding variable that influences both dependent (Y), educational achievements, and independent variables (X) (Wooldridge, 2010). In this study, we included household consumption expenditure (Pi) as a confounding variable to accurately assess the true relationship among the variables in the study.

METHODOLOGY

Data Source and Variables Measurements

This study uses secondary micro data from the Tanzania National Panel Survey (NPS) 2020/2021 wave 5 from the National Bureau of Statistics (NBS, 2023). The study also used a sample of 1,381 households from 30 regions of Tanzania as provided by NBS with the final sample restricted to observations that contain complete information on all variables used in the study. In the NPS, household and demographic composition were obtained from the household roster; educational information was drawn from the education module, health-related information was drawn from the health module, and welfare information was derived from the food and non-food consumption expenditure sections (NBS, 2023). The dependent variable is household education outcome, which was measured by the average completed years of schooling within the households. This operationalization is consistent with Weng et al. (2019), Mont et al. (2020), Vu and Tran (2021), and Qin et al. (2025). They both measured educational outcomes (education attainment) by years of schooling or completed schooling.

The main explanatory variable in this study is household size, which was measured as a total number of households living in a family, as supported by Ndayishimiye et al. (2024), who applied the same in their study. Since the size of the households is considered to be endogenous, its potential endogeneity necessitates the use of instrumental variables (family headship and

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household health). Regarding the instrument, household health captures the overall health status of the household. Healthier households are likely to have more resources and time to dedicate to their children's education, making this a relevant instrument. Good health can indirectly influence household size through its impact on fertility decisions and child mortality rates. The variable was proxied from NBS health module indicators such as general health status, utilization of health services, and hospitalization financing, from which a composite index was computed. Kauky et al. (2021) provided that household shocks may significantly affect children's schooling, and hence household condition can shape both education and demographic behaviour.

On the other hand, under family headship, the dummy variable was used where 1= when a household head is female and 0 when the household head is male. Several scholars have argued that resource allocation differs between male and female-headed households and that female-headed households in Africa display different patterns of educational investment in children (Bose-Duker *et al.,* 2021; Asiedu et al., 2024; Mukama and Mgonya, 2026). Hence, in this study, household health and household family head were used as first-stage predictors of household size to avoid potential endogeneity problems.

Furthermore, the study includes consumption expenditure as a confounding variable measured from the NPS food and non-food modules (NBS, 2023). The inclusion of household expenditure is supported by the evidence that household economic capacity may affect both education investment and children's schooling (Addai, 2024; Qin et al., 2025; Asiedu et al., 2024). Hence, this variable was included to avoid omitted variable bias in estimating the relationship between household size and educational outcome.

Table 1: Variables and their Measurements

Variable	Variable Type	Measurement	Data Source/Module	Empirical Evidence
Household educational outcome	Dependent variable	Average completed years of schooling within the household	NPS Education Module	Weng et al. (2019); Mont et al. (2020); Vu and Tran (2021); Qin et al. (2025)
Household size	Independent / Endogenous variable	Total number of household members living in the household	NPS Household Roster	Ndayishimiye et al. (2024)
Household health	Instrumental variable	Composite index computed from general health status, utilization of health services, and hospitalization financing indicators	NPS Health Module	Kauky et al. (2021)

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Household headship	Instrumental variable	Dummy variable where 1 = female-is the head of household and 0 = male head of household	NPS Household Roster	Bose-Duker et al. (2021); Asiedu et al. (2024); Mukama and Mgonya (2026)
Household consumption expenditure	Confounding / Control variable	Household food and non-food consumption expenditure	NPS Food and Non-Food Expenditure Modules	Addai (2024); Qin et al. (2025); Asiedu et al. (2024)

Source: *From Literature Reviews (2026)*

Estimation Techniques

To analyse the impact of household size on educational achievement in Tanzania, this study employs a Two-Stage Least Squares (2SLS) approach. The 2SLS method is particularly useful when dealing with potential endogeneity issues, which may arise if household size is correlated with unobserved household factors or characteristics that may also affect educational outcomes. As Weng et al. (2019) argue, the relationship between family size and education should not be interpreted as a simple association because fertility behaviour, parental preferences, and household constraints may determine family size and educational achievements. Similarly, Mont et al. (2020), Vu and Tran (2021), and Xiong et al. (2020) used an instrumental variable frameworks and treated family composition as an identification problem in education models. This study, therefore, used 2SLS to isolate the exogenous component of household size before estimating it effect on household education outcomes.

In the first stage, household size was regressed on the instrumental variables and the confounding variable. The specification of the First Stage Least Square is shown in Equation 1 below.

$$HS_i = \delta_o + \theta_1 HH\_Health_i + \theta_2 FE\_Head_i + \theta_3 Cons\_Exp_i + \varepsilon_i \quad [1]$$

Where:

HS_i	Household Size
H_Health	Household Health
FE_Head_i	Female Head (Binary): 1 when female and 0 when male are the heads.
$Cons\_Exp_i$	Consumption Expenditure

This stage helps to obtain the predicted values of household size that are free from endogeneity. After this estimation, we then estimated the second-stage least squares. In the second stage, household education achievement is regressed on the predicted values of household size and the confounding variable. The study estimated the following model as shown in equation 2 below:

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$$HH\_Educa_i = \alpha_o + \beta_1 \widehat{HS}_i + \beta_2 Cons\_Exp_i + \mu_i \quad [2]$$

Where:

HH_Educa_i	Household Education Achievement
$\widehat{HS}_i$	Household Size (estimated values)
$Cons\_Exp_i$	Consumption Expenditure
α_o,β_1 & β_2	These are coefficients to be estimated by the model.

The 2SLS may provide the causal inferences of the effect of household size on educational achievement and take care of all potential endogeneity bias, as concurred by the similar studies (Weng et al., 2019; Mont et al., 2020; Vu and Tran, 2021; and Xiong et al., 2020). Furthermore, the study employed Partial Least Square Structural Equation Modelling (PLS-SEM) as a supplementary sensitivity analysis to assess whether the direction and relative strength of the relationships between household size and educational outcome remain consistent under the alternative variance-based path-modelling framework. According to Hair and Almer (2022), the PLS-SEM is suitable when the analysis emphasises prediction, or accommodate complex relationships among variables, and remains useful when normality assumptions are not strictly satisfied. Similarly, Sarstedt et al. (2019) and Gudergan et al. (2025) emphasized that PLS-SEM can also be used for robustness checks aimed at assessing the nonlinearities, endogeneity, and unobserved heterogeneity. Hence, it is used as a supplementary analysis to examine if the path coefficient remains consistent.

Model Diagnostic Test

Since the reliability of 2SLS estimator depends on the quality of the instruments used, the study first evaluates the instrument relevance using first-stage regression and its associated F-statistic. Weak instruments can seriously distort inferences; hence, it is recommended to test whether the excluded instruments are sufficiently correlated with the endogenous regressor before interpreting the second stage coefficients (Weng et al., 2019; Mont et al., 2020; Vu & Tran, 2021). The study further assessed the endogeneity of the household size using the Durbin-Wu-Hausman test since the 2SLS is necessary when the null hypothesis of exogeneity is rejected (Khatib, 2025). Furthermore, where the model is over-identified, an over-identification test was performed using an orthogonality test. The aim is to assess whether the excluded instruments are jointly orthogonal to the structural error term and, therefore, satisfy the exogeneity condition required for the valid instrumental variable under 2SLS estimation (Bastardoz, 2023; Keane & Neal, 2023). Hence, these methods were employed to test the assumptions behind the 2SLS estimates.

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FINDINGS AND DISCUSSION

Diagnostic Test

Before estimating the main findings under 2SLS, the diagnostic test was performed to assess the instrument relevance, the endogeneity of household size, and the appropriateness of the instrumental variable specification.

To begin with, we estimated the First Stage Least Squares (1st SLS) to assess the validity of the instrument used in the model. The findings provided in Table 2 below show that there is a statistically significant positive relationship between households' consumption expenditure and household size. The model provides the coefficient of consumption expenditure equal to 0.645675 with a standard error of 0.115163 and a t-ratio of 5.61 ($p < 0.05$). This indicated that higher consumption expenditures are associated with families with larger households. On the other hand, the positive coefficient implies that, as families' consumption expenditures increase, so does their household size, consistently with Rashid et al. (2024) and Bitana (2024). This finding aligns with the idea that higher income or wealth allows families to afford larger homes or accommodate more family members (Bitana, 2024).

On the other hand, as part of the instrument added in the model, the study findings have revealed a negative relationship between household health and household size; however, the relationship is not statistically significant over the study sample. The household health has the coefficient of (θ_1 = -0.06171, SE = 0.05476, and p-value = 0.2600). The negative coefficient for household health suggests that there is a tendency for poorer household health to be associated with smaller household sizes. This interpretation implies that households facing health challenges may have fewer members, possibly due to factors such as higher mortality rates, reduced fertility, or family planning decisions influenced by health concerns. Health shock can alter living arrangements, fertility decisions, and household demographic structure (Bergeot & Fontaine, 2024; Klauky et al., 2021). However, it is insignificantly evident that household health is not a standalone predictor of household size, and that is a reason for their joint significance (with female-headed households) to be statistically significant at 5 percent level as shown by the F-statistic value.

The result further indicated that female-headed households are associated with smaller household size relative to male-headed households as shown by the coefficient of (θ_2 = -1.24928, SE = 171172 and p-value = 0.000). The negative and highly significant relationship (at 5 percent level) is consistent with the recent evidence, which shows that female-headed households have smaller household sizes and distinct household structures (Zhang et al., 2025; Asiedu et al., 2024). This relationship may be attributed to several factors, such as women in developing countries always being protective and left with the task of taking care of their children. In this case, they may be cautious about the burden left to them by their men and opt for smaller family sizes to better manage the available resources and to ensure family care and support for their children. On the other hand, if a family is headed by women, they usually engage themselves in different economic activities to support their families; due to their active participation in economic activities, they may influence family planning decisions, leading to smaller family sizes (Mason & Smith, 2000; UN Women, 2020). On the other hand, the cultural and social norms were given much emphasis in this agenda. In many societies in developing countries, women are assigned traditional gender roles with primary responsibilities for caregiving and household management, which may influence their decisions regarding smaller

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family size (Dykstra & Hagestad; Yabiku, 2005). For this reason, female-headed households may opt for smaller family sizes to balance caregiving obligations with economic activities and aspirations.

Table 2: First Stage Least Square Dep. Household_Size				
	Coef.	**Std. Err.**	**t-ratios**	**P-Values**
Consu_Exp	0.645675	0.115163	5.61	0.0000
HH_Health	-0.061710	0.054766	-1.13	0.2600
Female_Head	-1.24928	0.171172	-7.3	0.0000
_cons	-2.70669	1.614796	-1.68	0.0940
F (3, 1377) = 35.19 Prob > F = 0.0000				

Source: Author's Findings (2026)

Hence, the findings imply that, in this study, the identification is driven more strongly by female-headship in a family as compared to household-health. More importantly, the findings show the joint significant of the model with F (3, 1377) = 35.19 and the p-value > F = 0.000, signifying that all included first-stage predictors are jointly associated with household size; hence, all instruments were kept in the estimation processes.

After estimating the model with the instrumental variable (IV) to address endogeneity, it is necessary to further establish the post-estimation diagnostic tests to evaluate whether the IVs are empirically justified and whether the instruments are sufficiently relevant to support valid inference. Empirical studies emphasized that IV estimations should not be interpreted only from the second stage coefficients; rather, it should be assessed whether endogeneity is present and whether the instruments are strong enough to identify the endogenous regressor adequately (Bastardoz et al., 2023; Khatib, 2025). Moreover, Graf-Vlachy et al. (2024) emphasized that the credibility of IV results depends not only on the existence of instruments but also on evidence that the instruments meaningfully explain the endogenous variable and improve on ordinary least squares estimation. Hence, the study further established the post-2SLS specification tests, and the results are reported in Table 3 below.

Table 3: 2SLS Specification Test

a) **Tests of endogeneity**			b) **Instrumental Validity Test (Wald Test)**				
Ho: Variables are Exogenous			Ho: Instruments are Weak				
Durbin (score) chi2(1)	8.27506	(p = 0.0040)	Minimum Eigen Statistics	27.94			
Wu-Hausman F(1,1377)	8.30083	(p = 0.0040)	2SLS Critical Values	10%	15%	20%	25%
				19.93	11.59	8.75	7.25

Source: Author's Findings (2026)

We first presented an endogeneity test using both Durbin (score) chi-square test and the Wu-Hausman F test. The test compares the result of the IV estimates with the Ordinary Least Squares (OLS) estimates. It tests whether the IV estimates are more efficient and consistent than the OLS estimates, which would support the use of IV regression to address endogeneity.

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In this case, first, the Durbin-Wu-Hausman procedure was used to decide whether an instrumental variable estimator is required instead of least squares. Both tests check for the null hypothesis that variables are exogenous in OLS estimates. A significant Hausman test and Durbin (score) test suggest that the OLS estimates are inconsistent due to endogeneity, validating the use of IV regression. An insignificant test implies that OLS estimates may be sufficient, and there may not be a significant endogeneity problem. The findings have shown that, Durbin (score) chi-square statistic was 8.27506 with a p-value of 0.0040, and the Wu-Hausman F statistic was 8.30083 with a p-value of 0.0040, indicating that the null hypothesis of exogeneity is rejected at 5 percent level of significant (since p-value is below 0.05). This means that household size is endogenous in education outcome equation and OLS estimates would be inconsistent, thereby supporting the use of the 2SLS estimator. It implies that the instrumental variable is empirically warranted in this study, as OLS fails to deliver reliable estimates (Graf-Vlachy et al., 2024).

Furthermore, a weak instrument test was presented based on the minimum eigenvalue statistic, compared against 2SLS critical values as shown in Table 3 above. As provided by Keane and Neal (2023) and Caiumi (2024), instrument strength is central for the reliability of 2SLS as weak instruments may lead to biased point estimates and misleading hypothesis tests. The findings in this study show that the minimum eigenvalue statistic is 27.94, which is greater than the reported critical values, indicating that the instruments are not weak and the first-stage identifying power is adequate for 2SLS estimation. This further validated the inclusion of household-health, despite being individually significant, evidence shows that overall, remain sufficiently strong for identification. As noted by Lewis & Mertens (2025), a weak instrument is fundamentally about whether the first-stage relationship is strong enough to support reliable second-stage inference, not about whether every single instrument is individually significant. In this case again, although household-health appear weak, the minimum eigenvalue statistic suggests that the excluded instruments jointly provide enough explanatory power for household size to proceed with 2SLS estimation, even at the highest critical value (19.93 for 10% size distortion).

In addition to the above, before estimating the main estimates, it is important to assess whether explanatory variables are highly correlated with one another, as multicollinearity may inflate standard errors and make coefficient estimates unstable (Kim, 2019). Hence, VIF is a mostly commonly used diagnostic for detecting multicollinearity, with a higher VIF value exceeding 10, indicating greater inflation in the variance of the estimated coefficient (Kim, 2019). The results for VIF were presented in Table 4 below.

Table 4: Collinearity Statistics: Variance Inflation Factor (VIF)

	VIF
Consumption_expenditure	1.173
Female_head	1.039
Household_health	1.136
Household_size	1.12

Source: *Author's Findings (2026)*

The findings suggested that the estimated coefficients are unlikely to be distorted by serious collinearity among the regressors. As shown in Table 4 above, all explanatory variables have a very low VIF less than 10; hence, multicollinearity is not a serious concern in a model. Hence,

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each explanatory variable contributes distinct information to the model, and the estimated standard errors are not being substantially inflated by overlap among predictors.

The 2SLS Estimation

The findings presented in Table 5 below show that the overall second-stage regression is jointly statistically significant as shown by Wald $\chi^2(2) = 960.35$ Prob > $\chi^2 = 0.0000$, indicating that the explanatory variables included in the structural equation are jointly significant in explaining the variation of household educational outcomes (achievements). Hence, the overall model is statistically significant at 5 percent level. Similarly, the coefficient for household size is -0.199260, indicating a statistically significant negative relationship with educational achievement (p = 0.0010). This suggests that larger household sizes are associated with lower educational achievements within the household. The z-value of -3.28 reinforces the significance of this relationship, indicating that as household size increases, educational achievement tends to decrease.

Table 5: Two-Stage Least Squares Model (2SLS)
Dep. Household_Education_Achievement

Variables	**Coef.**	**Std. Err.**	**z**	**P>z**
$\widehat{Household\_Size}$	-0.199260	0.060838	-3.28	0.0010
Consu_Exp	1.550425	0.064092	24.19	0.0000
_cons	-10.98920	0.777456	-14.13	0.0000
Number of Obs. 1,381	Wald $\chi^2(2) = 960.35$	Prob > $\chi^2 = 0.0000$	R-squared = 0.3497	

Source: *Author's Findings (2026)*

Similarly, these findings comply with the resource delusion theory that, with larger family sizes, the resources available per child always diminish, thus affecting education achievements. This means that larger households face challenges in providing adequate support to their children's academic journey. The findings in Table 5 above further show that consumption expenditure has a positive and highly significant influence on educational outcome (achievements), with a coefficient of 1.550425 and a p-value of 0.000 which is less than 5 percent level of significant. The result implies that stronger household financial capacity in Tanzania enhances the ability to support schooling through the purchase of learning materials, school-related expenses, and a more supportive home environment for education. This complies with Addai (2024), who shows that household expenditure capacity significantly influences formal education expenditure in Ghana.

Robustness Test

To further assess the stability of the coefficient obtained in 2SLS model, PLS-SEM was employed as a sensitivity analysis to examine robustness as to whether the direction of the relationship among the study variables remains consistent under an alternative method. In this study, we employed PLS-SEM to check whether the sign and relative pattern of the structural relationships support the main findings of the study. This is consistent with the main 2SLS findings, where household size also exhibited a strong negative statistically significant effect on education outcome (achievement). Hence, the PLS-SEM supports the directional consistency of the main findings. Similarly, Figure 2 below from PLS-SEM has indicated that,

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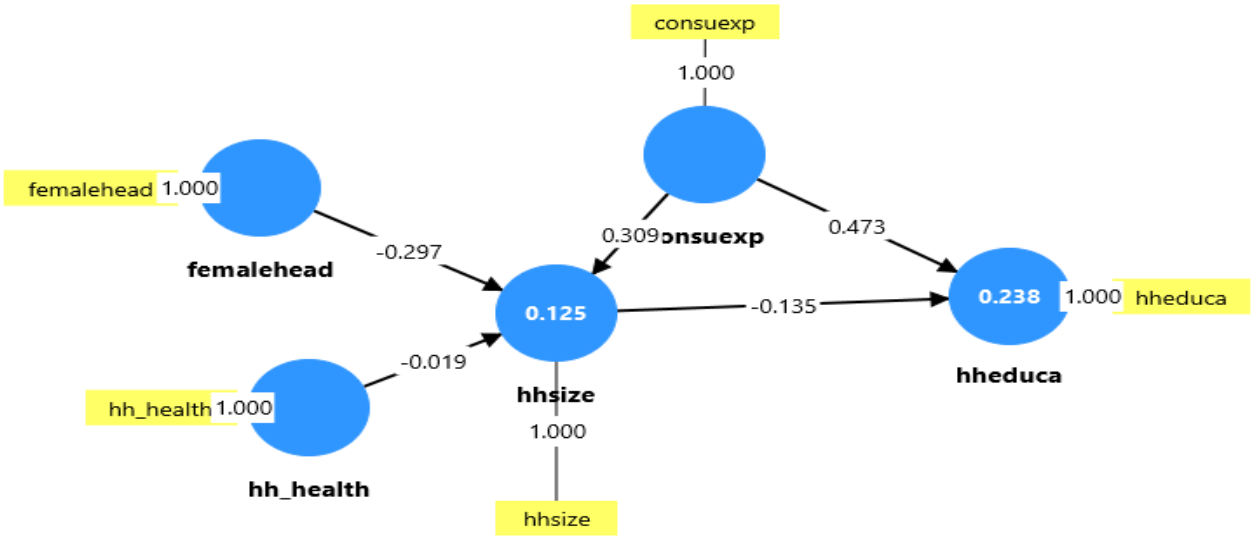
household size has a negative path coefficient on household educational outcome (achievements), with a coefficient of -0.135 indicating that an increase in household size is associated with a decline in educational achievement. The Figure further shows that consumption expenditure has a positive direct effect on educational achievement with a coefficient of 0.473, implying that households with stronger expenditure capacity have a great positive influence on education outcomes. This also complies with the 2SLS findings, where consumption expenditure also has a positive statistically significant effect on education outcome.

Figure 2: PLS-SEM Robustness Test



Moreover, path coefficient also revealed a positive influence of consumption expenditure on household size, with the coefficient of 0.309, suggesting that households with larger expenditure levels may also sustain relatively larger household sizes.

Regarding the instrumental variable, female-headed households had a negative relationship with the household size as shown by the path coefficient of -0.297, suggesting that female-headed households tends to have smaller household sizes, which is also consistent with the findings from first-stage least squares. Household health on the other hand was also found to have a very small negative effect on household size, with a path coefficient of -0.019 suggesting that its contribution in explaining household size is minimal. Which also align with the result from the first-stage regression. Therefore, the robustness of the 2SLS was confirmed where the major coefficient obtained from 2SLS retained the same direction, thereby strengthening confidence in the stability of the main findings of the study.

DISCUSSION OF FINDINGS

The main objective of the study was to assess the effect of household size on educational outcomes in Tanzania using a 2SLS approach. The study findings have indicated that household size has a negative and statistically significant effect on educational outcome, while household consumption expenditure has a positive and statistically significant effect. This means that, after correcting for endogeneity, larger households are associated with lower

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education achievement, whereas households with stronger expenditure capacity tend to achieve a better educational outcome. The findings are consistent with the recent empirical evidence showing that larger family or sibship size tends to depress schooling outcomes, while stronger household socioeconomic conditions support better educational attainment (Weng et al., 2019; Mont et al., 2020; Vu &Tran, 2021; Addai, 2024; Qin et al., 2025).

This phenomenon is also consistent with resource dilution theory, which believes that household resources such as money, parental attention, time, study space, and educational materials are finite, so as family size increases, the amount available per child tends to fall (Angrist, 1995). In larger families, the resources (time, money, attention) available per child are reduced, leading to lower investments in each child's education (Downey, 1995). Empirical evidence further supported this; for instance, Blake (1981) found that children in larger families tend to receive less parental attention and support, resulting in lower academic performance. Hsin and Felfe's (2014) & Booth and Kee's (2009) findings were consistent with this study. These studies provided that, older children in larger families normally assume caregiving roles which in turn affects their educational achievements, on the other hand, larger households have pressure on their financial resources which limits their ability to invest more in education materials, lowering educational achievements.

Furthermore, similar findings were provided in Burundi by Ndayishimiye et al. (2024): larger household size constrains access to education in rural areas. Similarly, Hara et al. (2024) provided that, the trade-off made by the families between child labour and education, has great consequences for the children's education, and that larger family sizes have a positive correlation with child labour and a negative to school attendance. This provides that, in large households, children contribute to household income, at the expense of schooling, and affect their academic journey. Mont et al. (2020) provided that as the number of children rises, households can experience more difficulty sustaining schooling, which is relevant in Tanzania environment, where household conditions remain central to children's schooling. The negative effect of household size reflects a practical pressure that large households place on limited family resources, since the available income, food, study materials, and time must be shared among many members. At the same time, the positive effect of consumption expenditure shows that households with stronger financial capacity are in a better position to support schooling and sustain higher educational achievement. This means that, in Tanzania, education is not determined by school access alone but also by the condition of the household itself.

CONCLUSION AND RECOMMENDATIONS

The study establishes that household conditions matter fundamentally for educational achievement in Tanzania. The empirical evidence shows that the educational outcomes are shaped not only by access to schooling but also by demographic and economic realities of households. The findings imply that household size should be treated as an important structural factor in understanding educational disparities since the pressure created by large family size may weaken the capacity of households to sustain educational progress of their children. Similarly, the positive role of consumption expenditure shows that stronger household welfare can enhance the ability of families to support education and improve educational outcomes. Hence, the study concluded that educational achievement in Tanzania, is linked to the balance between household demographic pressure and household economic capacity. Therefore, any

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effort to improve education outcomes in a country should go beyond the school environment and address the broader context in which learning takes place. Additionally, the analysis suggests that other unobserved factors may adversely affect educational achievement in Tanzania, for this case, we recommend the following. The government, through the Ministry of Education should provide support for larger families, especially those living in rural areas, including financial aid, education subsidies and access to free or reduced-cost education materials. This may assist them in reducing child burden to contribute to family income, cutting off child labour and increasing children's education attainment. Also, they should establish programs to assist parents in resource management and parenting workshops to enhance their ability to support their children in school.

Secondly, Non-governmental Organizations (NGOs) may collaborate with the government in enhancing education financial support for families in need, especially those living in rural areas and establish community-based programs that enhance additional education support. Notwithstanding, the government through the Ministry of Education should leverage the use of technology to provide low-cost educational resources and innovate advanced education delivery methods to ensure quality education to all children living in rural and urban areas. All of these recommendations aimed to enhance educational achievements for all children and foster a more equitable and prosperous society. Irrespective of recommendations, the authors provide a call for further studies to other researchers to develop an infrastructure that may facilitate equal-level education deliveries using advanced technologies to both children living in rural and urban areas. Moreover, researchers may investigate other unobservable factors such as the quality of the local schools, parental education, and income, to observe how this may affect education achievement among male and female children.

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