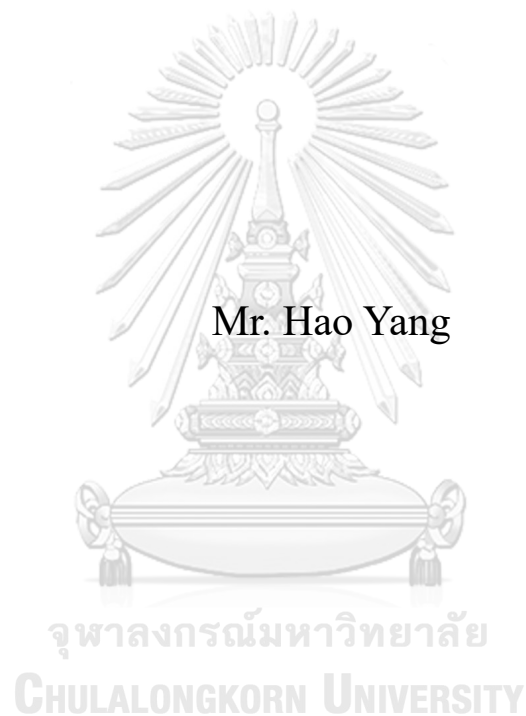


The Relationship between Single-Parent Families and Academic Performance



An Independent Study Submitted in Partial Fulfillment of the
Requirements
for the Degree of Master of Arts in Applied Economics
Field of Study of Applied Economics
FACULTY OF ECONOMICS
Chulalongkorn University
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ความสัมพันธ์ระหว่างครอบครัวเลี้ยงเดียวกับผลการเรียน



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Abstract:

The impact of family structure on children's academic performance has been one of the great interests to researchers. Single-parent families have received particular attention because of the unique challenges they might face in providing adequate educational support and resources for their children, especially for single mothers Downey (1994). In this paper, we try to examine the relationship between students who live in single-parent families and academic performance, with a particular focus on Taiwan. In this paper, we investigate the relationship between family types and academic performance among students in Taiwan using Ordinary Least Squares (OLS) regression analysis. By analyzing data from the Comprehensive Ability Test, this study examines how different family structures influence students' academic outcomes, considering various family types such as single dad, single mom, skipped family, and living with others, along with control variables like student gender, number of siblings, suburban or rural location, private school attendance, parent drinking problems, and family finance issues. The results reveal significant differences in academic performance between students from complete families and those from non-traditional family types. Students from single-parent families, both single dad and single mom, tend to exhibit lower academic performance compared to their counterparts from complete families. Moreover, students living with only one parent, without other family members, show even larger negative associations with academic performance. The study also highlights the significant impact of students who live without parents and grandparents on academic performance, with this family type showing the lowest academic achievement, possibly due to lack of stability and support, limited access to educational resources, and emotional or psychological

implications. In conclusion, the paper emphasizes the importance of addressing the unique challenges faced by students in non-traditional family types, contributing valuable insights to understand how family types influence academic outcomes and underscoring the need for inclusive educational practices that cater to the diverse needs of students from various family backgrounds. Through these insights, the study aims to contribute to the development of more effective and targeted interventions that positively impact the educational journey of students from non-traditional family types.



Introduction:

Family structure and dynamics have changed dramatically in recent decades, with the number of children in single-parent households increasing. Single-parent families often face additional or lower family socioeconomic status and emotional pressures Pan and Lin (2012) that can affect children's education experience and results Tobishima (2018). Understanding the relationship between single-parent families and educational outcomes is critical to designing effective policies and interventions to support this vulnerable population.

According to Figure 1, from 2006 to 2021, single parent households have increased from 630,555 to 963,986. Furthermore, from Figure 2, the proportion of single-parent families in Taiwan rose from 8.63 % to 10.81 %, which shows that the proportion of single-parent families in Taiwan has gradually rising trend. This also shows that the influence of single-parent families on Taiwanese society is increasing, which is a notable prevalence of non-traditional family structures, with a high percentage of children not living with both parents Chen (2016).

From Table 1, we can see a notable trend of increasing percentages of single-parent households over the years. From 2006 to 2021, there has been a steady rise in the proportion of single-parent households, reflecting evolving family structures and dynamics. The table shows a gradual upward trajectory, with the percentage starting at 8.63% in 2006 and reaching a peak of 10.81% in 2021. This upward trend suggests a significant shift in family composition and highlights the growing prevalence of single-parent households within the population. The consistent increase over the years indicates the need for a deeper understanding of the challenges and implications

associated with single-parenting and the potential impact on individuals, families, and society.

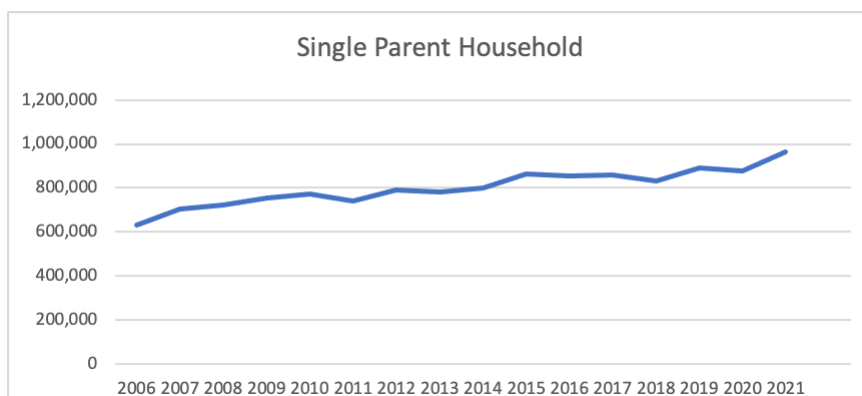


Figure 1 Single Parent Household. Source: Taiwan Department of Civil Affairs of the Ministry of the Interior

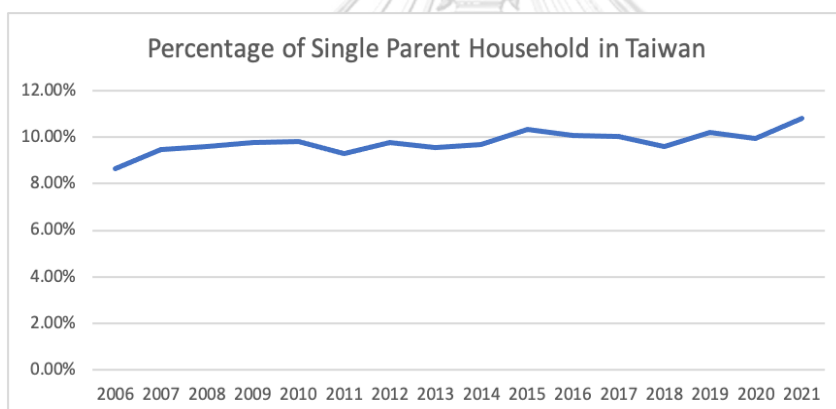


Figure 2 Percentage of Single Parent Household in Taiwan. Source: Taiwan Department of Civil Affairs of the Ministry of the Interior

Year	Percentage of Single Parent Household	Single Parent Household
2006	8.63 %	630,555
2007	9.47 %	702,348
2008	9.59 %	723,694
2009	9.78 %	751,916
2010	9.82 %	769,765
2011	9.31 %	741,091
2012	9.76 %	788,576
2013	9.55 %	782,617
2014	9.67 %	801,614
2015	10.32 %	865,369

2016	10.09 %	853,461
2017	10.04 %	859,111
2018	9.61 %	830,683
2019	10.21 %	891,757
2020	9.94 %	877,698
2021	10.81 %	963,983

Table 1 Percentage of Single Parent Household & Single Parent Household. Source: Taiwan Department of Civil Affairs of the Ministry of the Interior

As one of the fastest growing countries in East Asia, Taiwan is not immune to the rise of single-parent families and the associated challenges. Taiwan's education system has long been viewed as highly competitive, with a strong emphasis on academic achievement. Consequently, it is important to observe how children from single-parent families fare in this context and to assess the effectiveness of Taiwan's education budget in promoting equal opportunities for educational success.

During the seven-year period, Taiwan experienced a sharp rise in public and private education funds. From 2015 to 2021, as can be seen from Figure 3, public education funding increased from 856,766,171 NTD to 978,069,341 NTD. With the exchange rate of 27.9 Taiwanese Dollar to 1 US\$, in 2021, these figures are equivalent to 30,662,306.6 USD in 2015 to 35,003,555.2 USD.

The continuous increase in education funding indicates that the government acknowledges the importance of investment in education for social development and human capital formation. These funds play an important role in supporting education policy development, improving teaching, learning, and ensuring equitable access to education for all students. The analysis of trends in public and private education funds provides valuable insights into the priorities of financing and the strategies adopted by Taiwanese government and private institutions to support the education sector.

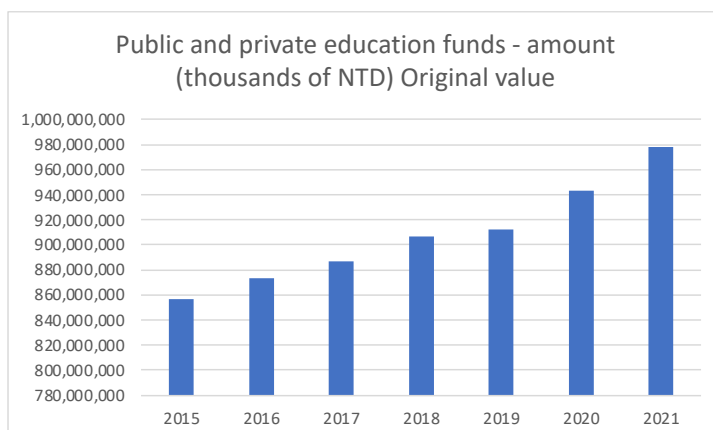


Figure 3 Public and Private Education Funds as Original Value of the National Budget of Taiwan (Fiscal Years 2015-2021). Source: National Statistics, R.O.C (Taiwan)

During the seven-year period, the ratio of public and private education funds to GNI (Gross National Income) in Taiwan gradually decreased from 2015 to 2021, as can be seen in Figure 4.

The decrease in the ratio of education funding to GNI indicates a possible change in the country's priorities or a change in Taiwan's economic situation. It is important that the changes in this ratio can possibly be affected by a variety of factors, such as changes in government policies, changes in economic conditions, or other growing sectors in the economy.

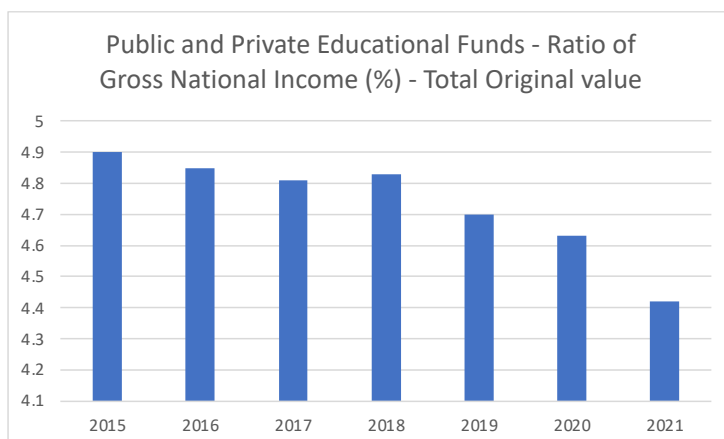


Figure 4 Public and Private education funds as Percentage of Gross National Income in Taiwan. Source: National Statistics, R.O.C (Taiwan)

Figure 5 presents the education spending as a percentage of South Korea Education GDP, to use as a comparison with Taiwan's situation. Figure 6 depicts Singapore's Education spending, as a percentage of GDP. Compared with South Korea and Singapore, Taiwan's education expenditure ratio of national Gross Income is declining overtime.

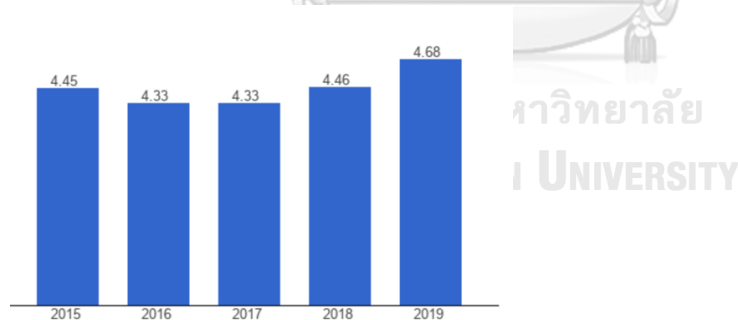


Figure 5 South Korea Education spending, percent of GDP. Source: TheGlobalEconomy.com, UNESCO

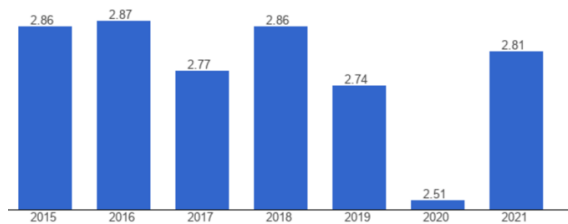


Figure 6 Singapore Education spending, percent of GDP. Source: TheGlobalEconomy.com, UNESCO

From Figure 7, Singapore consistently outperformed Taiwan and South Korea in all three categories of mathematics, science and reading in the PISA 2015 survey. Singapore's strong performance can be attributed to its emphasis on high quality education, strong curriculum, well-trained teachers and effective teaching practices. On the other hand, Taiwan showed commendable performance in mathematics and science, indicating a strong educational foundation in these disciplines. However, further improvements in reading comprehension can possibly be made.

South Korea showed strong skills in mathematics and science, cementing its status as a high-growth nation. Although its reading score was slightly lower than Singapore, it still showed strong performance in general. A comparative analysis of PISA's 2015 math, science and reading scores between Singapore, Taiwan and South Korea shows strengths and areas to improve in each country's education system. Singapore stands out as a top performer in all sectors, demonstrating its commitment to continued excellence in education. On the other hand, Taiwan and South Korea show strong growth in mathematics and science. However, there is still room for improvement in reading scores.

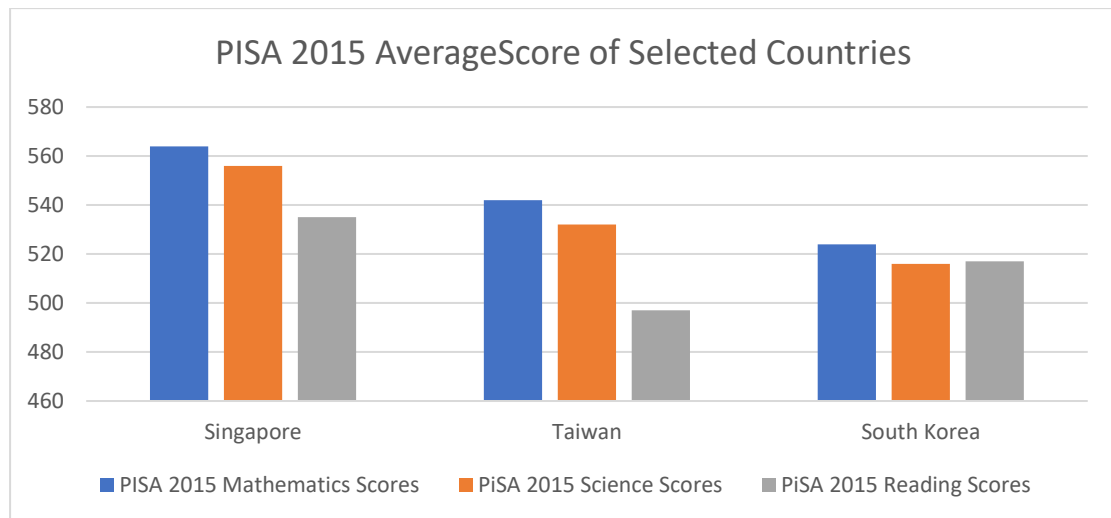


Figure 7 PISA 2015 Average Score of Selected Countries. Source: www.oecd.org/pisa

Single parenthood is on the rise in modern society, and children are increasingly being raised in single-parent homes. Chen (2016). The role of parents as primary teachers and their influence on their children's learning is widely recognized. Over the years, researchers have tried to examine the determinants of children's academic achievement. Notably, single parenthood has consistently emerged as an important determinant of children's educational outcome Tobishima (2018). Several studies have emphasized the impact of parental noncooperation on student academic achievement. Taylor, Hinton et al. (1995), Sui-Chu and Willms (1996), Jones and Prinz (2005)

The aim of this paper is to investigate the impact of single parenthood on the academic performance of children in Taiwan. Specifically, we focus on how parenting in a single-parent home affects children's academic performance. Different dimensions of family types will be examined to identify specific factors that significantly affect children's academic achievement. The results of this study are expected to provide valuable insights into the factors influencing the academic

performance of children particularly for single-parent households in Taiwan. Furthermore, understanding the relationship between different family types and academic achievement may provide important information about how parents can best support their children's education in such situations. In addition, educators can benefit from the findings of this study to develop targeted interventions and support strategies to improve learning results.



2. Literature Review

2.1 Measure of academic performance

According to Mrinde (2014) that studies on the challenges faced by single-parenting students in attaining secondary school education in Kinondoni Municipal, Dar-es-Salaam, it became evident that single parenting has a significant negative effect on students' academic performance. The findings of this research shed light on the specific hurdles encountered by students raised in single-parent households, such as limited financial resources, reduced parental availability, inadequate emotional support and a lack of effective guidance.

The academic performance of the participants was measured using a combination of research techniques. The data collection process involved the use of interview schedules, focus group discussions, and documentary review.

In the study, primary data, which refers to firsthand information collected directly from the participants, was obtained through interviews and focus group discussions. Interviews were conducted in a face-to-face setting between the researcher and the respondents. Semi-structured interviews were used to gather qualitative data, focusing on the challenges faced by single-parented secondary school students and their impact on education. Secondary data, on the other hand, refers to information that has already been collected and compiled for other purposes. In this study, secondary data sources included students' school records, statistics and examination results. These secondary data sources were collected through documentary review, providing additional information to supplement the primary data.

The study underscores that these factors lead to lower levels of academic engagement, weaker study habits, and a diminished sense of educational value among

students from single-parent families, ultimately impacting their overall academic performance (Mrinde 2014).

Another study shows the impact of family structure on children's academic performance, with studies focusing on its impact on educational achievement regularly Tobishima (2018). According to the study, it examined the relationship between family structure and children's academic achievement in Japan, using quantile regression method. The study specifically uses students' mathematics scores as a measure of their academic achievement. Since the study relies on data from the PISA 2012 assessment, which focused on mathematical literacy, the mathematics score is considered as an indicator of academic achievement.

Research findings have shown that family structure plays an important role in children's academic success. Specifically, children in single-parent households showed lower academic performance compared to children from double-parenting families. When the study identified factors such as lack of financial resources, reduced parental absenteeism and increased stress in single-parent households as potential contributors to these disparities, the findings occurred highlighting the importance of parental involvement and support as mitigating factors.

PISA (Programme for International Student Assessment) is used as a reference for assessing academic performance as a standardized assessment for comparisons of student performance. This holistic approach provides a comprehensive understanding of students' academic abilities beyond rote memorization, which is also more suitable for multi-different educational systems and cultural backgrounds.

In this study, we will incorporate the Comprehensive Ability Test from TEPS (Taiwan Education Panel Survey) as a measure of academic performance. The

students' academic performance was assessed based on the number of correct answers on the test, providing a comprehensive evaluation of students' academic abilities and their performance across different domains. This multi-dimensional approach will allow for a more nuanced understanding of the impact of family structure on students' academic achievements.

The Comprehensive Analytical Abilities Test was determined that the test should reflect students' learning achievements and growth, with a focus on assessing their problem-solving abilities rather than their general subject knowledge. The test consisted of different sections for high school, and vocational school students. The duration of the test was approximately 100 minutes. The high school and vocational school sections included subtests on general analytical abilities, English, mathematics, Chinese, and natural science. Table 2 shows different components of the test with a total score of 73 points.

General analytical abilities:	25 questions
English:	6 questions
Mathematics:	20 questions
Chinese:	10 questions
Natural science:	12 questions
Total:	73 questions

Table 2 Comprehensive Analytical Abilities Test. Source: Taiwan Education Panel Survey

Scoring for all questions followed a one-point-per-correct-answer system without negative marking. During the administration of the test, proctors explicitly instructed students not to guess answers in order to reach the accuracy of the test results.

2.2 Measure of family structure

From the study using a combined sample of PISA Hong Kong 2009 and 2012 to examine the relationships among single parenthood, family socioeconomic conditions, parental involvement, and academic test scores Cheung and Park (2016), the main independent variable in the study was family structure, which was categorized into four groups: two-parent families, single-father families, single-mother families, and others. The "others" category was included in the regression analysis but omitted from the tables. The study acknowledged the limitation of not being able to further distinguish single-parent families by reasons such as divorce, widowhood, or other causes. The main dependent variables were students' scores on reading, mathematics, and science literacy tests. Item Response Theory was used to generate five plausible values for each test score. The study analyzed the scores separately for reading, math, and science from the PISA (Programme for International Student Assessment) Hongkong 2009 and 2012 surveys.

Furthermore, in the study "Growing Up in Single-Parent Families: An Illustration from Taiwanese Families" by Pan and Lin (2012), the paper examines the family structure and its impact on the well-being of Asian youth in single-parent families. The research investigates the development of young adults who were raised by single parents in Taiwan, considering both parental death and parental divorce as factors contributing to different types of single-parent families. The study explores the influence of family socioeconomic status and family relations as potential mediators

of the negative effects of single-parent families on children. The type of single-parent family, whether resulting from parental death or divorce, predicts negative correlated outcomes for children as they transition into young adulthood. Economic disadvantages were more likely for children from families where a parent had died, while those with divorced parents reported lower levels of psychological well-being. The study also highlights the importance of positive family relations, as measured by parental conflict and family satisfaction, in mediating the associations between parental divorce and young adults' psychological outcomes Pan and Lin (2012).

In this paper, we aim to investigate the impact of different family structures on the academic performance of students. Specifically, we will examine the academic performance of students growing up in single-parent families, distinguishing between those raised by single fathers and those raised by single mothers. Additionally, we will include a separate category for students who are raised by their grandparents, thus capturing the influence of skipped-generation families and the students who are living with others (living without both parents or grandparents). We will also consider the variable of financial status as a potential factor affecting academic performance. By comparing the academic performance of students from single-parent families, skipped-generation families, double-parent families, and others, our study aims to provide insights into the relationship between family structure and academic performance.

2.3 Impact of family structure on academic performance

Numerous studies have investigated the impact of family structure on academic performance, particularly comparing double parenting (biological mother and father co-parenting) and single parenting family types. Children from double parenting

families tend to exhibit better academic performance compared to those from single parenting families. The presence of both parents in a household provides a potential advantage for children, as they benefit from the combined support, resources, and involvement of two caregivers. The stability and nurturing environment typically associated with double parenting families may contribute to a more conducive learning atmosphere, facilitating children's educational development. In contrast, single parenting households, often facing additional challenges and responsibilities, may have limited resources and time available for supporting their children's academic pursuits Park (2007).

In the study Cheung and Park (2016), the negative effect was found to be partially mediated by socioeconomic background and parental involvement. The study shows that the absence of a mother figure in single father households, along with potential socioeconomic challenges and variations in parental involvement, contribute to the observed academic disadvantages.

Furthermore, Hampden-Thompson (2013) further supports the notion that children in two-parent families tend to exhibit better literacy achievement compared to their peers in single-mother households across various countries. This association persists even after accounting for student background characteristics, indicating that family structure plays a crucial role in shaping academic outcomes. The analysis revealed that a substantial portion of the literacy gap between the double-parenting family can be attributed to disparities in family economic resources and parental time investments. These findings highlight the importance of considering not only the

presence of both parents but also the socioeconomic factors and parental involvement that accompany different family structures.

2.4 Other factors that affect academic performance.

Examining students gender differences in single-parent households is important to understand the impact on children's academic achievement, especially in the Taiwanese context. Students gender may play a role in the effects of single parenting on academic achievement. Male students in households with single mothers are at greater risk for poor academic performance, which may be due to economic hardship and lack of male role models, whereas girls in single-parent families experienced interpersonal communication difficulties, which could lead to lower academic achievement McLanahan and Beck (2010). These findings highlight the importance of considering gender dynamics when examining the relationship between single parenthood and academic performance. In the research in Taiwan, it is reasonable to expect similar gender differences in academic achievement in single-parent families, taking into account the different circumstances faced by boys and girls.

2.5 Methodology

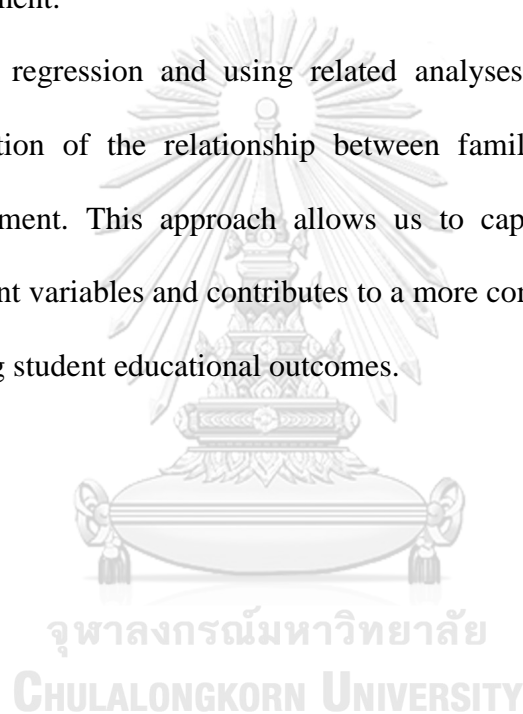
In this study, we are using ordinary least squares (OLS) regression analysis, a standardized composite ability test used as a measure of academic achievement. OLS regression is a statistical technique widely used in social science research.

Several studies have used OLS regression to examine the relationship between family structure and academic achievement. Brand, Moore et al. (2019) used OLS regression to examine the effect of parental divorce on children's educational attainment. The findings indicated a negative association between divorce and

academic achievement, emphasizing the importance of using OLS regression to examine the effect of family structure on academic achievement.

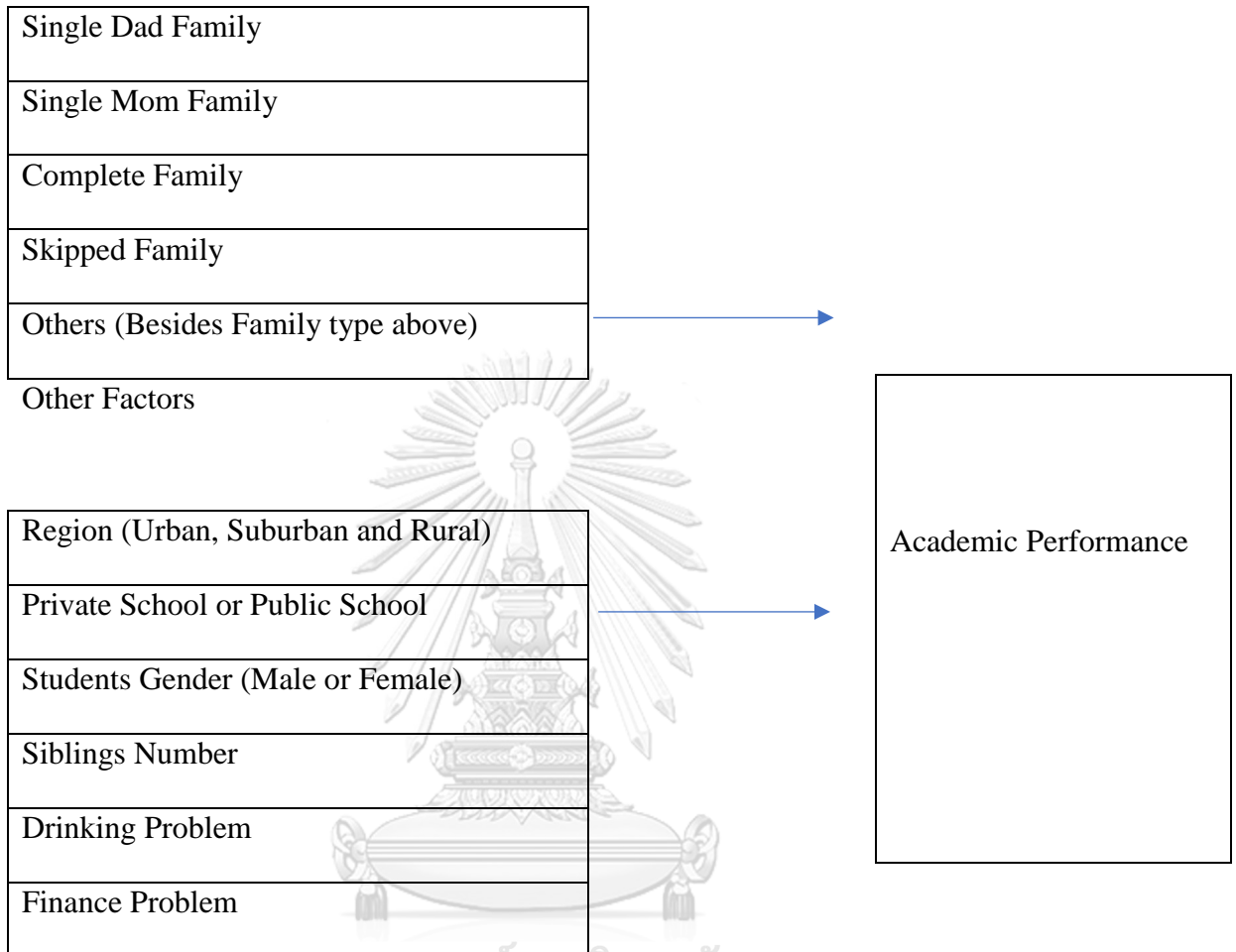
Furthermore, Tobishima (2018) examines the academic achievement gap between children in single-mother and two-parent families, as well as between children in single-father and two-parent families. The paper utilizes OLS regression analysis to estimate the effects of single motherhood and single fatherhood on children's academic achievement.

By using OLS regression and using related analyses, our approach ensures a rigorous examination of the relationship between family structure variables and academic achievement. This approach allows us to capture the subtle effects of various independent variables and contributes to a more comprehensive understanding of factors affecting student educational outcomes.



3. Conceptual Framework

Family type



The conceptual framework presented above highlights the importance of family types in terms of academic performance. The extent of family type is said to play an important role in determining a child's academic performance. Complete family can positively influence students' academic achievement by fostering positive effects toward education and developing effective study habits.

In this study, we will focus on family types, sibling numbers, parent divorcement or separation and other factors as indicators on academic performance. In addition, we will also consider socioeconomic and demographic factors that may affect a child's

academic performance. It is important to examine how these variables interact and contribute to a broader understanding of the factors affecting academic performance. By examining the relationships between family types, sibling numbers, parent divorce or separation and other factors, including region, private or public schools, financial status and parents drinking issues, we can gain insight into the impact of these factors on academic performance.



4. Data

The participants in this study were derived from the "Taiwan Education Panel Survey" (TEPS), a comprehensive long-term survey project jointly planned by the Academia Sinica, the Ministry of Education, the National Academy of Education, and the National Science Council.

This paper aims to investigate the influence of single-parent families on academic achievement using data from the Taiwan Education Panel Survey (TEPS). The study focuses on high school and vocational school students born in 1984/5 (the academic year 2002 in Taiwan) and utilizes a stratified random sampling method based on the geographical distribution, public and private school differences, and educational system (high school, vocational school, and five-year junior college). The sampling process involves selecting schools, classes, and students within the selected classes. On average, three classes were selected per school, and 15 students were sampled from each class. Additional students were randomly selected to supplement the sample. Furthermore, for the sampled five-year junior colleges due to their reduced quantity, a complete class survey was conducted after selecting the class. From September 1, 2001, to March 1, 2002, trained interviewers visited the schools and conducted class testing during regular class hours. The students were first administered a standardized comprehensive analytical abilities test, followed by self-administered questionnaires, which were collected after taking standardized comprehensive analytical abilities test. For the public version, a random sample of 70% was drawn from the total sample, resulting in 13,319 observations.

The dataset includes the "Comprehensive Analytical Abilities Test," which uses Item Response Theory analysis to measure students' learning achievements and growth. The test comprises comprehensive analytical abilities, general analytical abilities, and mathematical analytical abilities.

In the regression analysis, the comprehensive analytical abilities test will serve as the dependent variable, as known as academic performance, while the independent variables will include single-parent families, skipped-generation families, other family types, and other relevant factors.



5. Variables

According to Table 3, the study aims to investigate the relationship between different family types and Comprehensive Ability Test, while controlling for several variables. The dependent variable is the "Comprehensive Ability Test " score, representing the academic performance of students. The independent variables include "Single dad," "Single mom," "Live with dad alone," "Live with mom alone," "Single dad with family members," "Single mom with family members," "Skipped Family," and "Living with Others," which are dummy variables indicating the presence or absence of specific family types.

Based on prior researches and theoretical assumptions, it is hypothesized that students from single-parent families and other non-traditional family types may experience additional challenges that could potentially hinder their academic achievement. Therefore, it is expected that these variables will have a negative relationship with academic performance.

Additionally, several control variables are included in the regression model. The "Student gender" variable is a dummy variable where 1 represents male and 0 represents female. It is expected to have possibly positive or negative relationships with academic performance, as gender differences can influence educational outcomes. The "Suburban" and "Rural" variables are dummy variables comparing students living in suburban and rural areas to those in urban areas, respectively. It is anticipated that these variables will have negative relationships with academic performance, indicating potential urban-rural educational disparities.

Furthermore, the "Parents drinking problem" and "Family financial problem" variables are dummy variables indicating the presence or absence of such issues in the students' families. It is hypothesized that both variables will have negative relationships with academic performance, as they can significantly impact students' well-being and ability to focus on their studies.

Variable type	Variable	Variable in accounting and statistics	Measurement	Excepted positive / negative relationship
Dependent variable	Comprehensive Ability Test	Score results	Number	
Independent variable	Single dad (In Model 1)	Single father=1, otherwise=0	Dummy	(-)
Independent variable	Single mom (In Model 1)	Single mother=1, otherwise=0	Dummy	(-)
Independent variable	Single dad with other members (In Model 2)	Single father with other family member=1, otherwise=0	Dummy	(-)
Independent variable	Single mom with other members (In Model 2)	Single mother with other family member=1, otherwise=0	Dummy	(-)
Independent variable	Live with dad alone (In Model 2)	Dad alone without other family member=1, otherwise=0	Dummy	(-)
Independent variable	Live with mom alone (In Model 2)	Mom alone without other family member=1, otherwise=0	Dummy	(-)
Independent variable	Skipped family	Skipped family=1, otherwise=0	Dummy	(-)
Independent variable	Living with others	Living with others=1, otherwise=0	Dummy	(-)
Control	Student gender	Male=1, Female=0	Dummy	(+ / -)
Control	Suburban	Suburban=1, others=0	Dummy	(-)
Control	Rural	Rural=1, Others=0	Dummy	(-)
Control	Sibling number	How many siblings does student have	Number	(-)
Control	Parents Drinking Problem	Children whose parent has drinking problem=1, no=0	Dummy	(-)
Control	Family Financial Problem	Children whose family has financial problem=1, no=0	Dummy	(-)

Table 3 Variable type, variable, variable in accounting and statistics, measurement and excepted positive / negative relationship

6. Regression Model

This study considers two regression models as follows:

Model1: Comprehensive Ability Test = $\beta_0 + \beta_1 * \text{Single dad} + \beta_2 * \text{Single mom} + \beta_3 * \text{Skipped family} + \beta_4 * \text{Living with others} + \beta_5 * \text{Students gender} + \beta_6 * \text{Suburban} + \beta_7 * \text{Rural} + \beta_8 * \text{Private school} + \beta_9 * \text{Sibling number} + \beta_{10} * \text{Parent drinking problem} + \beta_{11} * \text{Family finance problem} + \varepsilon$

Model 2: Comprehensive Ability Test = $\beta_0 + \beta_1 * \text{Live with dad alone} + \beta_2 * \text{Live with mom alone} + \beta_3 * \text{Single dad with family members} + \beta_4 * \text{Single mom with family members} + \beta_5 * \text{Skipped family} + \beta_6 * \text{Living with others} + \beta_7 * \text{Students gender} + \beta_8 * \text{Suburban} + \beta_9 * \text{Rural} + \beta_{10} * \text{Private school} + \beta_{11} * \text{Sibling number} + \beta_{12} * \text{Parent drinking problem} + \beta_{13} * \text{family finance problem} + \varepsilon$

These equations represent as multiple linear regression models, where Comprehensive Ability Test captures as academic performance, which is the dependent variable, student gender, single dad family, single mom family or live with dad alone, live with mom alone, single dad with family members, single mom with family members, skipped family, living with others. Control variables are student gender, suburban, rural, private school, parent drinking problem and family finance problem are independent variables.

These regression models will compare each family type to the omitted variable, "Complete family" (students who live with biological dad and mom), to determine the differences in Comprehensive Ability Test score between different family types and complete family. The control variables will help to account for potential confounding factors and provide a more accurate understanding of the relationship between family types and academic performance. Model 1 considers children in single dad and single

mom family whether there are other family presented or not. On the other hand, Model 2 separate single dad and single mom family further into those with other family members presented and those that are with single dad and single mom alone.

By conducting an Ordinary Least Squares (OLS) regression analysis with these variables, the study aims to identify the unique contribution of each family type while considering the influence of control variables. The results of the regression analysis will provide insights into the extent to which different family types and control variables influence comprehensive analytical abilities and contribute to academic achievement.



7. Results

According to Table 4, it provides average academic performance of the students for different family types in the Comprehensive Ability Test. Students who live in complete families, there are 11,185 observations. The mean score for students from complete families was 44.829, with a standard deviation of 11.142. The minimum score observed was 12, and the maximum score was 72.

In single dad family, there were 514 observations in this group. The mean score for students from single dad families was 42.197, with a standard deviation of 11.479. The minimum score observed was 11, and the maximum score was 69.

On the other hand, students who live in single mom families, there were 1,019 observations in this group. The mean score for students from single mom families was 43.822, with a standard deviation of 11.09. The minimum score observed was 14, and the maximum score was 69.

Moreover, for students who live with their grandparents without parents. There were 224 observations in this group. The mean score for students from skipped families was 40.46, with a standard deviation of 12.535. The minimum score observed was 13, and the maximum score was 66.

For the students who live without parents or grandparents, they might live with other relatives or guardians. There were 293 observations in this group. The mean score for students living with others was 38.24573, with a standard deviation of 12.52208. The minimum score observed was 8, and the maximum score was 65.

The table provides insights into the academic performance of students from different family types. It shows that students from complete families tend to have higher mean scores compared to those from single dad, single mom, skipped family, and living with others family types. These students achieved a mean score of 44.82924, indicating a relatively strong performance. On the other hand, the family type with the lowest mean score is the "Living with others" category, comprising students who live without parents or grandparents. These students obtained a mean score of 38.24573, reflecting comparatively lower academic performance. The discrepancy in scores between these family types suggests that the presence of both parents in a household contribute positively to a student's academic development.

	Observations	Mean	SD	Min.	Max.
Complete Family	11,185	44.82924	11.14193	12	72
Single dad	514	42.1965	11.4787	11	69
Single mom	1,019	43.82237	11.0904	14	69
Skipped family	224	40.45982	12.53545	13	66
Living with others	293	38.24573	12.52208	8	65

Table 4 Family types and test results

According to Table 5, it provides a distribution of the results from the Comprehensive Ability Test, where students' academic performance is measured by the scores they achieved. The table presents the frequency and percentage distribution of the correct answers among the participants. The table shows a wide range of performance levels, with the lowest score being 8 and the highest being 72.

The majority of students fell within the middle range of performance, with higher frequencies observed for correct answers between 35 and 52. Specifically, the most common range of correct answers was between 41 and 52, with over 57% of total

students falling within this range. From Figure 8, as the number of correct answers increases, the frequency gradually decreases, indicating a decline in the number of students achieving higher levels of academic performance.

Correct Ans.	Freq.	Percent	Cum.	Correct Ans.	Freq.	Percent	Cum.
8	1	0.01	0.01	42	429	3.24	42.23
11	1	0.01	0.02	43	379	2.86	45.09
12	3	0.02	0.04	44	434	3.28	48.37
13	10	0.08	0.11	45	424	3.2	51.57
14	8	0.06	0.17	46	427	3.22	54.79
15	11	0.08	0.26	47	429	3.24	58.03
16	22	0.17	0.42	48	403	3.04	61.07
17	25	0.19	0.61	49	407	3.07	64.14
18	42	0.32	0.93	50	408	3.08	67.22
19	54	0.41	1.34	51	404	3.05	70.27
20	71	0.54	1.87	52	431	3.25	73.52
21	63	0.48	2.35	53	392	2.96	76.48
22	75	0.57	2.91	54	356	2.69	79.16
23	102	0.77	3.68	55	371	2.8	81.96
24	126	0.95	4.63	56	339	2.56	84.52
25	135	1.02	5.65	57	342	2.58	87.1
26	145	1.09	6.75	58	293	2.21	89.31
27	173	1.31	8.05	59	262	1.98	91.29
28	190	1.43	9.49	60	238	1.8	93.09
29	209	1.58	11.06	61	202	1.52	94.61
30	232	1.75	12.81	62	178	1.34	95.96
31	237	1.79	14.6	63	150	1.13	97.09
32	256	1.93	16.53	64	113	0.85	97.94
33	235	1.77	18.31	65	85	0.64	98.58
34	291	2.2	20.5	66	74	0.56	99.14
35	287	2.17	22.67	67	40	0.3	99.44
36	345	2.6	25.27	68	32	0.24	99.68
37	314	2.37	27.64	69	25	0.19	99.87
38	360	2.72	30.36	70	11	0.08	99.95
39	354	2.67	33.03	71	4	0.03	99.98
40	368	2.78	35.81	72	2	0.02	100
41	422	3.18	38.99				
				Total	13,251	100	

Table 5 Comprehensive Analytical Abilities Test results

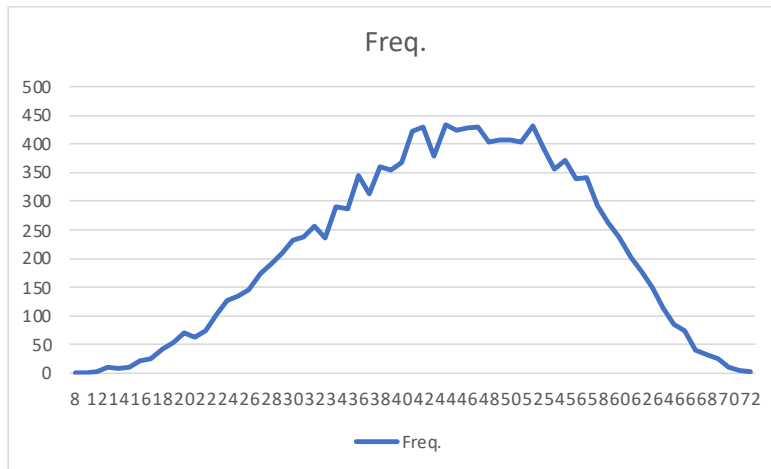


Figure 8 Distribution of Comprehensive Ability Test result

Table 6 presents the results of the regression analysis examining the relationship between various factors and academic performance, as measured by the "Comprehensive Ability Test" score. The analysis includes a range of independent variables representing different family types, control variables, and the corresponding coefficients, standard errors (SE), and significance levels (denoted by asterisks). There are two different models: Model 1 and Model 2 on the table.

The findings indicate that students from single dad families show a negative relationship with academic performance ($\beta = -1.994$, $SE = 4.32$, $p < 0.01$), suggesting that students in this family type tend to have -1.994 lower score in comprehensive ability test compared to students from complete families. Similarly, single mom families show a negative association with academic performance ($\beta = -0.6$, $SE = 1.81$, $p < 0.1$); however, the coefficient is not significant.

Students from skipped families also demonstrate lower academic performance ($\beta = -2.421$, $SE = 3.55$, $p < 0.01$), indicating the potential impact of living with grandparents on comprehensive analytical abilities. Moreover, living with others,

which refers to students living with others without parents or grandparents, is associated with even lower academic performance, as having the lowest score students among all the family types. ($\beta = -4.944$, $SE = 8.21$, $p < 0.01$). This implies children living with others on average achieve lower score by 4.94 points comparing to children in complete family.

The number of siblings is also negatively correlated with academic performance ($\beta = -1.412$, $SE = 15.98$, $p < 0.01$), suggesting that more siblings may pose challenges to academic achievement, possibly with limited resources to each child in the family.

Among the control variables, residing in suburban areas shows a negative relationship with academic performance ($\beta = -4.087$, $SE = 22.56$, $p < 0.01$), while living in rural areas demonstrates an even stronger negative association ($\beta = -7.45$, $SE = 17.78$, $p < 0.01$). Attending a private school is also linked with lower academic performance ($\beta = -8.123$, $SE = 45.85$, $p < 0.01$). One possible explanation for this finding could be related to the lower standard of applying to private schools in Taiwan. Public schools in the country may have more stringent admission criteria and higher academic standards for enrollment. As a result, students who are academically stronger and more motivated may opt for public schools, leading to a higher average academic performance in these institutions.

Regarding gender, being male is associated with slightly higher academic performance ($\beta = 1.546$, $SE = 8.79$, $p < 0.01$). In general, this observation aligns with broader trends seen in education worldwide, especially in Chinese culture, where there have been historical gender disparities favoring male students in certain subjects or learning areas. Chinese related family are known to be more willing to investing in

boys' education rather than girls' education. This result seems to hold for students in Taiwan.

The presence of a parent with a drinking problem negatively impacts academic performance ($\beta = -2.172$, $SE = 6.04$, $p < 0.01$). Similarly, family financial problems show a negative relationship with academic performance ($\beta = -0.895$, $SE = 4.11$, $p < 0.01$).

The R-squared value of 0.22 indicates that approximately 22% of the total variation in academic performance can be explained by the variables included in the model.

In conclusion, the results suggest that different family types and various socio-economic factors significantly influence academic performance. Students from single-parent families, skipped families, those living with others, and larger sibling numbers tend to exhibit lower Comprehensive Ability Test score. Furthermore, factors such as residential location, private school, parent drinking problem, and family financial issues also contribute to variations in academic performance. These findings provide insights into the complexities of the relationship between family structure and academic outcomes, highlighting the importance of considering socio-economic factors when addressing educational disparities.

Additionally, by looking in details into single dad and single mom family types (i.e., Model 2) with living with dad and mom alone, or living with single dad and mom with the presence of other family members, we found out that there are significant associations between different family types and academic performance. Students who live with their dad alone demonstrate a negative impact on academic performance, with a coefficient of -3.372. Similarly, students living with their mom alone also show a negative influence on academic performance, with a coefficient of -1.613.

Furthermore, students in skipped families and those living with others experience lower academic performance, with coefficients of -2.421 and -4.946, respectively. Furthermore, the results show that students in single dad families with other family members have a coefficient of -1.498, indicating a negative impact on academic performance. Similarly, students in single mom families with other family members have a coefficient of -0.322, although this coefficient is smaller in magnitude.

These findings suggest that the presence of additional family members in single dad or single mom households may still have some influence on academic performance, albeit to a lesser extent compared to living alone with the respective parent. It is possible that having other family members in the household could introduce additional dynamics and complexities that can affect a student's educational outcomes.

Comparing Model 1 to Model 2, we can observe some similarities and differences in the results. Both results include variables related to family structure. In both cases, non-traditional family types show a negative impact on academic performance, although the magnitude of the coefficients varies.

In terms of other variables, we see consistency in their effects across the two tables. Factors such as skipped family, living with others, sibling number, suburban area, rural area, private school, parent drinking problem, and finance problem all show negative coefficients, indicating a detrimental influence on academic performance.

One notable difference between the two models is the inclusion of single dad and single mom with family members as separate categories in the second model. The coefficients for these categories are less negative, suggesting that having additional

family members in single-parent households may be beneficial for the academic performance of children compared to those that living alone with a single dad or single mom. These differences suggest that the inclusion or exclusion of other family members in the living arrangement can affect the magnitude of the association between single-parent families and academic performance. When considering only students living with their father or mother alone, without any other family members, the negative impact on academic performance appears to be more pronounced.

Living with a single dad or single mom alone, without any other family members, may have a detrimental impact on academic performance for several reasons. Firstly, the absence of the other parent or additional family members may result in reduced social and emotional support, potentially leading to feelings of loneliness and impacting academic performance. Secondly, single parents living alone with their child often face increased responsibilities and demands, such as working harder to provide for the family and managing parenting duties on their own. These added responsibilities may leave less time and energy for parental involvement in a child's education, potentially affecting their academic performance. Additionally, single-parent households, particularly those living alone, may face financial constraints and limited access to resources, which can impact educational opportunities and access to educational support. Moreover, single parents living alone with their child may experience higher levels of stress due to the multiple demands they face, which can affect parental well-being and the parent-child relationship, potentially influencing academic success. Lastly, the absence of siblings or other family members in the household can limit opportunities for peer interactions and social support, which are important for social development, motivation, and academic engagement.

These factors collectively suggest that the living arrangements of single dad or single mom alone without other family members may contribute to poorer academic performance.¹

Model1.

	Academic performance
Single dad	-1.994
SE	(4.32)**
Single mom	-0.6
SE	-1.81
Skipped family	-2.421
SE	(3.55)**
Living with others	-4.944
SE	(8.21)**
Siblings number	-1.412
SE	(15.98)**
Suburban	-4.087
SE	(22.56)**
Rural area	-7.45
SE	(17.78)**
Private school	-8.123
SE	(45.85)**
Students gender	1.546
SE	(8.79)**
Parent drinking problem	-2.172
SE	(6.04)**
Finance problem	-0.895
SE	(4.11)**
_cons	52.493
SE	(232.99)**
R2	0.22
N	13,008
	* p<0.05; ** p<0.01

Model2.

	Academic performance
Live with dad alone	-3.372
SE	(3.83)**
Live with mom alone	-1.613
SE	(2.35)*
Single dad with family members	-1.498
SE	(2.80)**
Single mom with family members	-0.322
SE	-0.87
Skipped family	-2.421
SE	(3.55)**
Living with others	-4.946
SE	(8.22)**
Siblings number	-1.418
SE	(16.04)**
Suburban	-4.087
SE	(22.57)**
Rural area	-7.436
SE	(17.75)**
Private school	-8.113
SE	(45.79)**
Students gender	1.56
SE	(8.87)**
Parent drinking problem	-2.14
SE	(5.95)**
Finance problem	-0.902
SE	(4.14)**
_cons	52.492
SE	(233.00)**
R2	0.22
N	13,008
	* p<0.05; ** p<0.01

Table 6 Regression model results

¹ We also try to include interactive variables between single parenting and private school. The coefficient is positive and significant for children living with single dad and going to private school, while insignificant for those who live with single mom and going to private school. Because private school's tuition fee is generally more expensive than public school, this may partly capture better off economic situation for students going to private school resulting to better academic performance even when living with single dad.

8. Conclusion and Discussion

The findings from the regression analysis provide valuable insights into the relationship between family types and academic performance. The results consistently indicate that students from single-parent families, whether it is a single dad or single mom, tend to exhibit lower academic performance compared to those from complete families. Additionally, students living with only one parent, without the presence of other family members, shows even larger negative association with academic performance.

These findings suggest that non-traditional family types may present additional challenges that impact students' academic achievement. Factors such as reduced social support, increased parental responsibilities, financial constraints, and limited opportunities for peer interactions may contribute to the lower academic performance observed in these family types. The absence of a second parent or other family members may result in less support and resources available for students' educational development.

Furthermore, the finding points out the negative association between living with dad or mom alone and academic performance. Without considering the presence of other family members, students in such situation still face challenges that may affect their academic outcomes. The reasons behind this could include increased responsibilities on the single parent to fulfill both parental and household duties, which may result in reduced time and resources available for academic support and engagement.

Comparing the results across different family types, it is evident that family structure plays a significant role in shaping students' academic performance. The

negative associations observed in single-parent families and living with only one parent highlight the need to address the specific challenges faced by students in these family arrangements. Targeted interventions and support systems can be developed to provide additional resources, mentorship programs, and academic support to enhance the educational experiences of students in non-traditional family types.

Additionally, the finding that students living with others have the worst academic performance can be attributed to several potential reasons. Firstly, these students may lack stability and support in their living situation, as they often stay with relatives, friends, or in foster care, leading to frequent changes in their environment and disruptions in their daily routines. This instability can make it challenging for them to establish a consistent study schedule and receive the necessary guidance from a stable family structure.

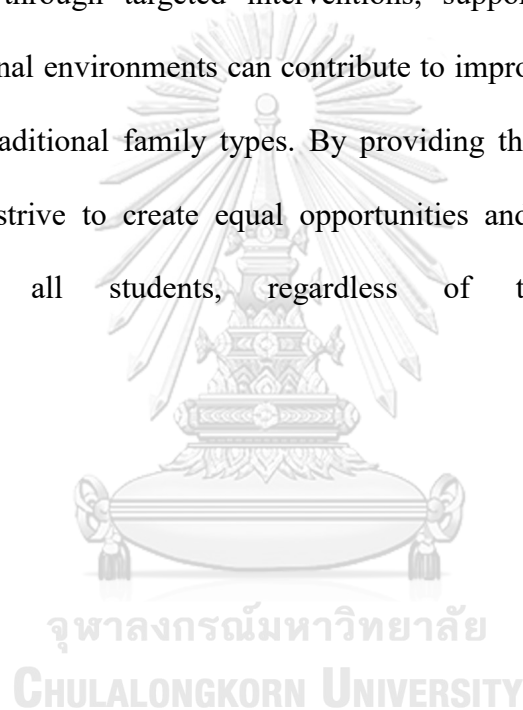
Secondly, students living with others may have limited access to crucial educational resources. They might not have a dedicated study space, adequate access to educational materials, or a conducive learning environment, hindering their ability to concentrate and perform well academically.

Moreover, the emotional and psychological impact of living with others can also affect their academic performance. Feelings of loneliness, alienation, and insecurity may arise, negatively influencing their overall well-being and focus on their studies. Additionally, challenges in forming stable relationships and a sense of belonging can impact their academic motivation and engagement.

Furthermore, living with others might introduce additional responsibilities and distractions. Students may need to take on household chores or caregiving duties,

leaving less time for their studies. Living in a shared environment can also lead to distractions and disruptions, further impeding their ability to concentrate.

In conclusion, the findings emphasize the importance of considering family structure when examining academic performance. Students from single-parent families, as well as those living with only one parent without other family members, face unique challenges that may hinder their educational outcomes. Recognizing and addressing these challenges through targeted interventions, support systems, and fostering inclusive educational environments can contribute to improving academic success for students in non-traditional family types. By providing the necessary resources and support, we can strive to create equal opportunities and enhance the educational experiences of all students, regardless of their family structure.



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