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Examining the influence of sibling structure on academic performance: A comparative study of younger and elder siblings

Felix. C. Aguboshim * and Obinna. O. Otuu

Department of Computer Science, Federal Polytechnic, Oko Nigeria.

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Abstract

Empirical evidence has shown that academic performance is shaped by the dynamic interplay between three spheres: the family, the school, and the community. Epstein's theory suggests that sibling structure can impact academic performance through various mechanisms. This study examines the influence of sibling structure on academic performance, with a specific focus on younger and elder siblings. Utilizing a sample of 600 students from three tertiary institutions in Enugu, Nigeria, the authors investigated the impact of birth order and age gap within siblings on academic achievement. The authors adopted the Epstein Model (1987) as the theoretical framework for this study. Results from statistical analysis, including t-tests and correlation analysis, show that the mean academic performance of elder siblings was significantly higher than those of younger siblings (t = -6.331; mean1=2.75; mean2=3.26; df= 589; p<0.01). There was a statistically significant dependence relationship between academic performance and sibling structure (χ^2 = 154.973; df =4; n = 600; p<0.01), with a coefficient of variation of approximately 0.4532, suggesting that about 45.32% of the variations or dependence in academic performance can be attributed to sibling structure. Siblings' family socioeconomic status had no statistically significant influence on their academic performances (χ^2= 10.676; df=16; p=.829; p>0.055), These findings contribute to the existing literature by highlighting the importance of considering sibling structure when examining academic outcomes. Understanding the differential impact of birth order and age gap on academic performance can inform educational policies and interventions aimed at enhancing educational opportunities and support for both younger and elder siblings.

Keywords: Sibling structure; Academic performance; Birth order; Age gap; Educational outcomes; Parental investment

1. Introduction

Siblings play a significant role in the socialization and development of children, with their interactions and relationships shaping various aspects of their lives. One important area of investigation is the influence of sibling structure on academic performance. Sibling structure refers to the combination of birth order and age spacing within a family. Understanding how sibling structure affects academic achievement can provide valuable insights into the dynamics of family environments and educational outcomes. This study aims to examine the influence of sibling structure on academic performance, specifically comparing the experiences of younger and elder siblings. Some studies have found a significant association between birth order and academic achievement, with first-born children often demonstrating higher levels of achievement compared to later-born siblings [40]. Other studies have shown inconsistent or non-significant results, emphasizing the need for further investigation. Moreover, limited research has specifically compared the academic performance of younger and elder siblings, warranting a comparative study to shed light on potential differences. The significance of studying sibling structure and academic performance extends to multiple stakeholders. Parents can benefit from understanding how birth order and age spacing influence educational outcomes, enabling them to provide tailored guidance and support for their children's academic success.

*Corresponding author: Felix. C. Aguboshim

Educators can use this knowledge to develop strategies and interventions that address the unique needs of students based on their sibling position. Policymakers responsible for educational policies can utilize these findings to inform evidence-based decision-making processes and design interventions aimed at improving educational outcomes on a broader scale. Thus, this study seeks to contribute to the existing body of knowledge by examining the influence of sibling structure on academic performance among younger and elder siblings, and comparing the academic achievements of these sibling groups, in order to provide insights into the relationship between birth order, age spacing, and educational outcomes. The findings from this study may have practical implications for parents, educators, and policymakers, ultimately promoting academic success and fostering supportive family and educational environments.

1.1. Research Questions

The following research questions are addressed in this study.

- Are there significant differences in the mean performance of siblings among the two classified sibling structure: younger siblings and elder siblings?
- To what extent does sibling structure affect academic performance of siblings?
- To what extent does family socioeconomic status, availability of educational resources at home, andparental factors affect academic performance of siblings?

1.2. Conceptual Framework

The Epstein Model (1987) was adopted as the theoretical framework for this study to provide guides and coherence in this empirical study. Epstein's theory has been considered as an elaborate and ecological theory, specifically tied to family–school partnerships. Epstein's theory is claimed to be founded on Bronfenbrenner's and others' models of "natural, nested, and necessary connections between individuals and their groups and organizations" ([34], p. 26). Epstein's Model has been used by researchers to provide explanations about the relationship between birth order and academic achievement in middle childhood. [72], and is based on the fact that first-born children tend to have higher academic achievement compared to later-born siblings [9] and [72]. Epstein's theory of overlapping spheres of influence provides a framework for understanding the various factors that influence academic performance, including the influence of sibling structure. According to Epstein, academic performance is shaped by the dynamic interplay between three spheres: the family, the school, and the community [33], [34], and [35]. Epstein's theory suggests that sibling structure can impact academic performance through various mechanisms [14], and can serve as sources of social support, providing academic assistance, guidance, and encouragement [32].

Positive sibling relationships characterized by cooperation and shared learning experiences can enhance academic engagement and performance [58] and [60]. On the other hand, sibling rivalry and competition can also affect academic outcomes. Siblings may engage in comparison processes, where their academic achievements are compared and evaluated, leading to either motivation or disengagement depending on the nature of the comparison. Sibling structure can influence academic performance indirectly through the family's educational resources and practices, and through older siblings who have already experienced the education. Epstein's theory emphasizes the importance of the school and community spheres in shaping academic performance [81], while Schools provide educational opportunities, instructional quality, and support systems that can mediate the influence of sibling structure [76]. Quantitative measures such as surveys, standardized tests, and academic records can be used to assess academic performance, while qualitative methods such as interviews and observations can provide deeper insights into the sibling dynamics and their influence on academic outcomes [6], [20], and [68]. Epstein's theory of overlapping spheres of influence provides a comprehensive framework for studying the influence of sibling structure on academic performance. It highlights the interplay between the family, school, and community spheres and emphasizes the importance of understanding the various mechanisms through which siblings can impact academic achievement. By considering the dynamics within each sphere and their interactions, researchers have gained a more holistic understanding of the complex relationship between sibling structure and academic performance.

1.3. Contrasting Views on the Epstein Model

Not all researchers agreed with Epstein's Model as a theoretical framework to provide or examine how sibling structure interacts with parental involvement, and family-school communication to shape academic performance. There are contrasting or opposing research on Epstein Model especially in not putting into consideration the varying roles of fathers in shaping child behavior in the family system [7]. Some researchers of sibling structure interaction with academic performance have criticized Epstein Model that it tends to overlook power dynamics and inequities within school-family-community partnerships, adding that the model does not adequately address the power imbalances that exist between schools and families, particularly those from marginalized or disadvantaged backgrounds [42], [51], and

[84]. Other researchers have questioned the assumption that increased parental involvement universally leads to positive outcomes, arguing that the Epstein Model may not fully consider variations in a parental capacity, resources, and cultural values, which can affect the extent and nature of parental involvement [19], [48], [55], and [59]. Other criticisms were founded on the claim that the Epstein Model prioritizes and assumes the presence of a traditional nuclear family structure, which can exclude diverse family forms and configurations [25], [38], and [71]. The model may not fully consider the experiences and needs of families with non-traditional structures, such as single-parent households, LGBTQ+ families, or families with non-biological caregivers. This limitation may hinder the inclusivity and relevance of the model in diverse educational contexts [50], [56], and [71].

The contrasting views of these researchers on Epstein's Model notwithstanding, Epstein's Model is theoretically justified based on measuring instruments that are quite strong, consistent, valid, and reliable. Epstein's Model can easily be operationalized and measured in a relationship with many other variables to determine their impact on siblings' academic performances. This property of Epstein's Model makes Epstein's Model to be the preferred theoretical framework or model for this study which focuses on influence of sibling structure on academic performance with a comparative study of younger and elder siblings.

2. Literature Review

The influence of sibling structure on academic performance is a complex and multifaceted topic that has garnered significant attention in research. Several key factors have been explored in recent studies, shedding light on the relationship between sibling structure and academic outcomes. This study examines three main aspects: birth order, sibling spacing, and parental investment. Research on birth order suggests that first-born children tend to have higher academic achievement compared to their later-born siblings. Studies such as [36] and [86] have supported this notion. However, the relationship between birth order and academic performance is not consistent across all studies or across cultures, socioeconomic backgrounds, and educational systems [52] and [73]. [28], and [10] have found contrasting results, indicating the complexity of this relationship. Sibling spacing, referring to the age gap or spacing between siblings, has also been found to have an impact on academic performance. Research also suggests that closer sibling spacing may be associated with better academic performance as a result of potential benefits resulting from increased competition and resource-sharing among closely spaced siblings [11] and [31]. Parental investment plays a crucial role in shaping the academic performance of siblings. Factors such as educational resources, parental involvement, and academic expectations have been identified as key components of parental investment. Studies by [80] and [27] emphasize the importance of parental influence in determining academic outcomes for siblings. Empirical evidence suggest that sibling structure influence children's educational outcomes [41], while the negative effect of the number of sibling is quite consistent, indicating there are mixed findings for birth order and birth spacing [74]. Overall, the research on the influence of sibling structure on academic performance underscores the significance of birth order, sibling spacing, and parental investment. However, individual and contextual factors can also influence academic achievement, and the effect sizes may vary across different studies. Further research is needed to gain a comprehensive understanding of the complex interplay between sibling structure and academic performance.

2.1. Contrasting Relationship between Birth Order and Academic Achievement

Contrasting results regarding the relationship between birth order and academic achievement have been observed in the literature. While some studies support the notion that first-born children tend to have higher academic achievement, others present contrasting findings that birth order does not have a consistent impact on academic outcomes [23], no significant differences in attachment patterns between first-born and later-born children, suggesting that birth order may not have a direct influence on academic achievement through attachment-related mechanisms [15]. This finding by [15] suggests that birth order effects on intelligence were weak and inconsistent, implying that birth order may not be a robust predictor of academic achievement [70]. [37] conducted a quantitative review of the literature on only-children and found that there were no consistent differences in academic achievement between only-children and those with siblings. This suggests that birth order may not be a significant predictor of academic performance. Birth order effects on academic achievement, according to [12], can be influenced by educational policies and school-related factors. Recent empirical research by [3] revealed that the mean academic performance of siblings among in-school adolescents from parents who are married and living together was significantly higher than those from divorced or geographically separated couples. This again suggests that birth order may not be a significant predictor of academic performance. Also, Contrasting results in the literature may arise due to various factors such as sample characteristics, study design, and contextual differences.

The complex nature of birth order effects highlights the need for further research to better understand the underlying mechanisms and identify potential moderators that may explain the variability in academic achievement among siblings

of different birth orders. Although the relationship between birth order and academic performance is complex, and findings are not consistent across all studies [52] and [73], research suggests that first-born children tend to have higher academic achievement compared to later-born siblings [45], [62], and [75], while closer sibling spacing may be associated with better academic performance [11], [31], and [46], possibly due to increased competition and resource-sharing. Parental investment, including factors such as educational resources, parental involvement, academic expectations, and parental marital status play a crucial role in shaping the academic performance of siblings [3], [29], [61], and [77].

2.2. Complex Dynamics or Theories on Sibling Structure and Academic Performance

Numerous theories have been proposed to explain the potential relationship between sibling structure and academic performance. These complex dynamics or theories include Resource Dilution Hypothesis. The resource dilution hypothesis suggests that as family size increases, the available resources and attention that parents can provide (such as parental time, attention, and financial resources) are distributed among more children, and potentially diluting the benefits for each child [31], [44], [79], and [83], resulting in lower academic performance for each child in the family [13]. According to this hypothesis, earlier-born children may benefit from more concentrated parental resources, leading to higher academic achievement [24] and [87]. Conversely, later-born children may experience resource dilution, resulting in relatively lower academic performance [40]. Another prominent theory is the confluence model, which proposes that sibling relationships and interactions within the family influence academic outcomes [64]. These theories highlight the potential significance of birth order and age spacing in shaping academic trajectories. The confluence model suggests that sibling relationships and interactions play a significant role in shaping academic outcomes [66], can serve as important socialization agents, and contribute to the development of cognitive and academic skills [43]. This model argues that the characteristics and dynamics of sibling relationships, such as warmth, support, conflict, and competition, can have both direct and indirect effects on academic achievement [18]. Previous research has provided mixed findings regarding the relationship between sibling structure and academic performance, positive sibling relationship quality, characterized by warmth and support, is associated with better academic performance [39] and [82]. Positive sibling relationship qualities, including warmth, support, and positive attitudes toward education, are consistently associated with better academic performance and engagement [57]. These findings underscore the importance of considering the dynamics of sibling relationships when examining academic outcomes and highlight the potential long-term influence of sibling relationships on individuals' educational aspirations and adjustment.

Other theories include the Sibling Socialization Theory which posits that siblings serve as socialization agents, influencing each other's academic attitudes, behaviors, and skills through interaction, modeling, and competition [64], Birth Order Theory which suggests that birth order, such as being an older or younger sibling, influences academic performance, in the sense that the first-born children tend to have higher academic achievement due to more parental investment and increased responsibility [86], and the Sibling Comparison Theory, which claims that academic performance is influenced by comparisons between siblings who compare themselves to each other and strive for differentiation or similarity in their achievements, which may impact their academic performance [31]. Others include the Differential Parental Investment Theory, a theory that argues that parents allocate their resources unequally among their children based on their perceptions of each child's abilities or needs [47], the Sibling Competition Theory which suggests that sibling competition for resources, attention, and recognition within the family can impact academic performance [63], the Differential Parental Expectations Theory which suggests that parents may have different expectations for the academic performance of their children based on their birth order or perceived abilities and these parental expectations can shape children's own beliefs and aspirations, thereby influencing their academic outcomes [64], and the Sibling Social Support Theory that claims that siblings can provide emotional and academic support to each other, in the nature of assistance, or tutoring, thereby fostering a supportive academic environment within the family that can positively impact academic performance [16]. While these theories provide different perspectives on the potential mechanisms underlying the relationship between sibling structure and academic performance, it is important to note that multiple factors interact and influence academic outcomes, and these theories offer different lenses through which to understand these complex dynamics.

2.3. Assumptions

Aside from the influence of sibling structure, relationships, and interactions within the family academic influence [64], available family resources and attention parents can provide [24] and [87], sibling socialization [64], and differential parental investment [47] that plays a crucial role in shaping the academic performance of siblings as classified in this study, other factors that may affect the academic performance of siblings are siblings-parents relationship that makes for good academic performances in school, good attention to home -school communications, socio-economic status of parents, parents life satisfaction,marital status of parents [3] and [22] and working status. Others include parents'

educational background, siblings' food intake or feeding habits, peer group effect, the financial status of parents, parents providing equal support and attention, expectations, assistance and guidance with schoolwork to both siblings, availability of educational resources at home, family socioeconomic status and other issues related to time availability, and other demographic factors that could account for siblings differences [69].

In this study, the author assumedly took other variables that may influence siblings' academic performance for granted and only majored in the influence of sibling structure variable. Simply put, assumptions are conditions related to the study that can be accepted or assumed as true or to be true or at least plausible, without proof or verification [30]. Most researchers make assumptions in agreement that there is no correct absolute measurement to form a construct [65]. According to [65], when a coin is tossed, the probability of obtaining a head is 0.5, under the assumption that there are only two possible outcomes: head or tail. Based on this assumption, mathematical probability systems have assumed a fair or unbiased coin that will never stand on its own when tossed. By the same assumption the occurrence of a third possibility aside from head or tail, in the outcome space was assumed as having a zero probability, though there is a possibility of the coin standing on itself [65]. Another mathematical system where similar assumptions were made was in geometry which deals with conceptual perfect circles, and lines with zero width [65]. In real and ideal situations lines with zero width do not exist or are never exactly realized in practice. These assumptions are common practices in statistics, mathematics, and other fields [54] and [65]. Similarly, there are no absolute correct measurements to measure all influences of sibling structure on academic performance in school, but the measurements used are theoretically justified based on these assumptions.

3. Material and method

To examine the influence of sibling structure on academic performance, a quantitative methodology approach was adopted. Quantitative methodology study involves structured numerically measured data collection methods, such as surveys, experiments, and structured observation that are analyzed using mathematically based methods [85] to answer research questions and test hypotheses [21] and [49], using standardized instruments and procedures so as to make inferences, or generalizations, about a larger population [26]. It also involves Sampling methods that randomly select large representative samples [1] and [8], and generalization of relationships among variables [26] to ensure consistency and standardization in data collection to enhance reliability and validity. [17].

3.1. Data Collection

The data for this study were collected from 600 students selected in Enugu state, Nigeria by simple random sampling from three tertiary institutions in Enugu metropolis within the strata selected using multi-stage sampling techniques. The sibling structure of students categorized as younger and elder siblings were used as a major key for random selection. Academic performance was measured using Likert scale quantification. A good sampling technique is one that deploys strategies that are logically connected to the research objectives and questions [78], practical and feasibly implemented within the available resources, time, and constraints [67], suitable for the research context, and considering factors such as the nature of the population, research design, and research goals [4] and [53], and can explicitly and systematically address greater validity and stronger quality of the study [2] and [5]. To avoid bias and embarrassment, students were interviewed using questionnaires as the major instrument of data collection. An equal number of students is based on the two categories of students: younger and elder siblings. Probability sampling such as simple random sampling, stratified, cluster, and quota sampling, etc., are characterized by a well-defined sampling frame, randomized sample selection, and by the fact that each population unit has a known, calculable, and nonzero chance of being included in the samples for study [3]. A probability sampling technique was adopted resulting in a total of 600 students: 300 each from each of the two categories of students: younger and elder siblings. Informed consent was obtained from all individual participants included in the study. Informed consent also includes informing participants about their autonomous right to voluntarily enroll in the research and voluntarily withdraw at any point in the course of the study without facing negative consequences. Other research ethics such as confidentiality, anonymity, data protection, data storage, and participant/researcher safety were also adopted.

4. Result and discussion

Analysis of data was facilitated by the use of Statistical Package for Social Sciences (SPSS) (version 21). SPSS was adopted for its benefit of enhancing credibility building by making the research processes more transparent and replicable.

4.1. Research Question 2.1

4.1.1. Are there significant differences in the mean performance of siblings among the two classified sibling structures: younger siblings and elder siblings?

Table 1 shows the t-test for Equality of Means of Academic Performance of students in tertiary institutions in Enugu, Nigeria among Younger and Elder siblings and SPSS output generated from the analysis.

Table 1 T-test for Equality of Means of Academic Performance of students intertiary institutions in Enugu, Nigeria among Younger and Elder siblings

Academic Performance (GPA) of students in tertiary institutions in Enugu, Nigeria.										
		N	**Mean**	**Std. Dev.**	**Std. Error Mean**	**Mean Diff.**	**Std. Error Diff.**	**t**	**df**	**Sig.**
Grade Point Average (GPA)	Younger	300	2.75	1.17	0.068	-0.51	0.08	-6.331	598	0.000
	Elder	300	3.26	0.753	0.044	-0.51	0.08			

(t = -6.331; df= 589; mean$_1$=2.75; mean$_2$=3.26; p<0.01; Test is significant)

The results of the independent t-test suggest that there is a significant difference between the means of the Younger sibling and the Elder sibling (t = -6.331; mean$_1$=2.75; mean$_2$=3.26; p<0.01; Test is significant). The Elder sibling has a significantly higher mean GPA value (3.26) compared to the Younger sibling (2.75). The difference between the means of the two groups is statistically significant (p<0.01), implying that the probability of obtaining such a large difference in means by chance alone is less than 1%.

4.2. Research Question 2.2

4.2.1. To what extent does sibling structure affect the academic performance of siblings?

In Table 2, the relationship between sibling structure and academic performance of siblings among tertiary institutions in Enugu, Nigeria is depicted together with the SPSS output generated from the analysis.

Table 2 Relationship between sibling structure and academic performance of siblings among tertiary institutions in Enugu, Nigeria

		Grade Point Average (GPA)					**Total**	**Pearson Chi-Square Value**	**df**	**Asymp. Sig. (2-sided)**
		below 2.0	**2- 2.4**	**2.5- 2.9**	**3.0- 3.4**	**3.5- 4.0**				
Sibling Structure	Younger	29	128	70	35	38	300	154.973	4	0.000
	Elder	5	30	158	96	11	300			
Total		34	158	228	131	49	600			

(χ^2 = 154.973; df=4; p<0.01; Test is significant; coefficient of variation (cv) =0.4532

Analysis results in Table 2 show that there is a statistically significant dependence relationship between academic performance and sibling structure (χ^2 *= 154.973; df=4; p<0.01*). The coefficient of variation (cv) measures the degree of relationship between the two variables and is given by the formula cv=$\sqrt{(\chi^2/(\chi^2+n))}$, where$\chi^2$ is the computed chi-square value, and n is the sample size. Therefore, using the given parameters (χ^2 = 154.973 and n = 600), the coefficient of variation (CV) is approximately 0.4532, suggesting that about 45.32% of the variations or dependence in academic performance of siblings may be attributed to sibling structure.

4.3. Research Question 2.3

4.3.1. To what extent do family socioeconomic status, availability of educational resources at home, and parental factors affect the academic performance of siblings?

Table 3 Relationship between sibling's family socioeconomic status and academic performance of siblings among tertiary institutions in Enugu, Nigeria

		Last Grade Point Average (GPA)					Total	Pearson Chi-Square Value	df	Asymp. Sig. (2-sided)
		below 2.0	2 -2.4	2.5- 2.9	3.0- 3.4	3.5 - 4.0				
Family socioeconomic status:	Low	3	7	12	8	2	32	10.676	16	.829
	Below Average	5	29	43	21	11	109			
	Average	11	72	85	58	19	245			
	Above Average	8	33	55	28	14	138			
	High	7	17	33	16	3	76			
Total		34	158	228	131	49	600			

(χ^2 = 10.676; df=16; p=.829; p>0.05; Test is not Significant).

Table 3 shows the relationship between sibling family socioeconomic status and academic performance of siblings among tertiary institutions in Enugu, Nigeria together with the SPSS output generated from the analysis. As shown in Table 3, the Academic Performance (GPA) of Students is not related to or affected by siblings' family socioeconomic status. The test is not statistically significant (χ^2 = 10.676; *df*=16; *p*=.829; *p*>0.055), suggesting that there is no significant relationship between sibling family socioeconomic status and academic performance '

5. Conclusion

The study revealed significant differences in academic performance between younger and elder siblings. The Elder sibling has a significantly higher mean GPA value (3.26) compared to the Younger sibling (2.75). This result is consistent with those of [36] and [86]. The difference between the means of the two groups is statistically significant (p<0.01), implying that the probability of obtaining such a large difference in means by chance alone is less than 1%. The study suggests some birth order effects in the sense that it shows that being an elder or younger sibling has a noticeable impact on academic performance, possibly because elder siblings receive more attention, guidance, or higher expectations from parents. This is consistent with results from studies by [24] and [87]. The findings reveal a statistically significant dependence relationship between academic performance and sibling structure (χ^2 = 154.973; df=4; *p*<0.01), with a coefficient of variation (CV) of approximately 0.4532, suggesting that about 45.32% of the variations or dependence in academic performance of can be attributed to sibling structure. The Academic Performance (GPA) of Students is not significantly related to or affected by siblings' family socioeconomic status (χ^2= 10.676; df=16; p=.829; *p*>0.055), suggesting that there is no significant relationship between sibling family socioeconomic status and academic performance.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors had no potential conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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