Original Article

Child care choices and children's cognitive achievement: The case of single mothers

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Abstract

Background: The behavioral and cognitive results of school-going preterm-born children has been widely reported. Much of these reports include incorrect methodology and do not take into consideration the effects of prematurity in their results.

Objective: The objective of this study is to evaluate the effects of preterm birth on behavior and cognition in school-going children.

Material and method: A systematic review and metanalysis of articles which were published in English between 1981 to 2002 were selected for review in this study. The case-control reports of preterm-born children's behavior and/or cognitive data was examined for low attrition rates during their 5th birthday.

Result: A total of 15 reports of cognitive data and 16 studies of behavioral data were considered for this research. Data was extracted based on population demography, behavioral development and was entered into the customized database. The extracted data was repeatedly reviewed in order to ensure that it was free from error. Among 1720 control and 1556 cases, the control group had significantly higher cognitive scores than the preterm born children(mean difference is 10.9; Confidence interval 95% is 9.21-12.48). The mean cognitive value for the preterm babies is proportional to the birth weight (R^2value =0.52; P value<0.01) and also directly proportionate with the gestational age (R^2value =0.48; P value<0.01). The evaluation time age has no significant correlation with the cognitive score's mean difference (R^2value =0.11; P value<0.20). Thus, there is no difference found in behavior and cognition based on the quality of the paper.

Conclusion: Preterm-born babies are at the risk of the reduced cognitive test results, and their birth immaturity is directly proportional to the school-age mean cognitive test score. Preterm babies are also at increased risk of Attention Deficit Hyperactivity Disorder (ADHD) and other behavioral problems. [*Ethiop. J. Health Dev.*2021;35(4):00-00]

Keywords: Childcare, ADHD, Child mortality, Children's cognitive achievement.

Introduction

Child mortality raet in the United states is more than 12 per 1000 newborns, which has been reduced to up to 7 per 1000 newborn children. This reduction resulted from developments in post-natal baby care and the development of newborn care units. Reduced mortality rate occurs alongside the increasing neurodevelopment disabilities in school-going children, in a considerable number of newborn children. A significant number of children who were born with low birth weight or who were preterm had cerebral palsy, blindness, hydrocephalus, or deafness (1-3). Multiple reports of preterm-born children have reported behavioral and cognitive outcomes. Minor problems occur for children without neurological deficiency, resulting in a low cognitive score and behavioral complications (4, 5). However, some research shows no difference in the term-born control and preterm born cases (6).

The effect of the preterm delivery on the behavior and cognition of children has not been established. The variations in the data of published articles occur due to the small numbers used in their samples and methodology utilized which results in variation. Moreover, these reports have been discussed for their study design problems, inadequate samples, high attrition rate, exclusion of patient sub-groups, and other issues (7). This makes it difficult in identifying the preterm delivery effect on the child's behavior. This research, conducted a meta-analysis to find a better estimation for the preterm birth effect in school-going children. The meta-analysis on the patient population was published more than five years ago, and neurodevelopmental results were examined in preschool children (8,9). In this paper, behavioral and cognitive meta-analysis results of the school-aged preterm born children were reported by extracting and combining all related publications between 2000 and 2020.

Material and methods

According to the guidelines provided by Stroupet al., observation-related studies are allowed allowed in systematic reviews. The searches were conducted in databases such as MEDLINE, Cochrane, and other related medical databases from 2000 to 2020. The inclusion criteria was as follows: premature infants, newborn weight loss, child development, disability of growth, personality development, human development, etc. As per requirement, the search was narrowed. The inclusion criteria was defined for the searches in the meta-analysis. Only those reports which included the concurrent control evaluation were selected. The included studies contained the case-control plan, behavioral data, and cognitive data, or both. They also performed the fifth birthday of the subject, which had a, <30%attrition rate. The studies which did not meet the relevant criteria were excluded from the meta-

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analysis group. After sorting out the various articles, with the help of the different standards, out of the 227 studies, 31 studies were selected, of which 15 studies contained cognitive data and 16 studies with behavioral data were selected for further analysis.

Data Extraction

Data collected from the selected papers was entered into the database which was created for the meta-analysis. Data extracted was extracted based on the point-like demographic variable, attrition rate, detailed information on the behavioral and cognitive evaluation performance. Variables are chosen based on the association between cognitive and behavioral outcomes. The selected data was reviewed repeatedly to reduce errors which occur as a result of manual data entry. A large collection of behavior was evaluated, and several behavioral processes were utilized in the study. For this research, the subject of behavior was classified into the external or internal behaviors.

Data Analysis

Data analysis was performed using softwares R and STATA (Version 7). For every study, the difference between mean cognitive score between control and case group was weighted by the inverse of difference variance. These weighted mean differences (WMD) were collectively taken, to calculate the overall mean difference of cognition between control and case groups. Cognitive scores obtained from all studies, of comparative cognition tests had a mean of 100. So, the non-standard difference of Weighted means was taken as the mental result for collaborative research in this analysis. The fixed and random effects regression models (least squares) was utilized for combining the products. Two models had identical results, so results obtained from the random effect models have been indicated. The homogeneity means difference across studies was initially tested by utilizing the variance tested method according to Greenland. This test is known to have low power. The uniformity was tested using the Galbraith plot. These plots consider the contribution of every report to the whole statistic, so it can be tested visually. The plot graph of each Z test score versus the inverse of the standard deviation of the mean difference, which also fits with the most undersized square regression line, keeps the internet at zero. The studies with high heterogeneity have scores outside the two standard deviations below and above the fitted line.

In comparison, the linear regression model was used to examine the study-specific covariate impacts on heterogeneity. The publication bias was examined by skewness in the funnel plot. Skewness tests in funnel plots are used to test for publication bias and was implemented by Egger's linear regression method. The gestational age and birth weight relationship with the cognitive score was tested using inverse-variance weighted regression.

Results

Out of 15 reported studies, 17 groups had children which were examined post-fifteen birthday. The demography of these children's data is shown in table 1. The data are from USA reports, while nine reports looked at the local population, other patients followed the hospital cohorts. Cases ranged from 15 up to 255, and control studies ranged up to 500. Control population in all reports matched with more than one demographic character. Features like race, gender, and socio-economic status are not always mentioned. A meta-analysis indicated that, mean differences of cases and control cognitive scores was 10.9 (95% Confidence Interval 9.21-12.52), which favored the control group (P value=0.0061; Z value= 33.64). The y^2 test of heterogeneity shows a significant result (P value=0.0061, y^2= 33.64). A Galbraith plot was used to assess the heterogeneity study, which shows two populations with a maximum mean difference, were the reason behind this heterogeneity. According to Taylor et al., (10) the highest mean difference between the control and case groups is included in the cognitive assessment of children with a neurological disorder. They place them in the lower IQ limit (39-point IQ) to maintain sample size. Stjernqvist and Svenningsen have shown a similar effect. They also mentioned the IQ with severely disabled children (<70 IQ level). While other studies, like telpin et al., omitted the children who were not included in the cognition tests. After excluding the data published by Taylor from the meta-analysis, the heterogeneity did not remain significant(P value= 0.20 and y^2 value =19.4). In contrast, the pooled mean value from the remaining paper was 10.2 (CI 95%: 9.1-11.51), which favored the control patients (P value<0.001; z= 16.11). The birth weight is significantly correlated with the mean cognitive test score (P<0.001; R^2=0.50) and gestation (P<0.001; R^2=0.48). There was no correlation between the evaluation age and the mean difference between the control and case groups (P-value = 0.20: R^2= 0.12). There was no significant difference among the US peoples' cognitive outcomes (95% CI: 6.6-14.7) and the other countries cognitive outcomes (95% CI: 9.0-11.2); also, between the hospital studies (95% CI:7.2-11.7; P-value = 0.67). In the high-quality studies, there is the trend of higher mean difference relative to the low-quality studies(CI 95%, 9.6-12.5) vs. 9.38(CI 95%, 8.1-10.9) though this difference is not statistically significant (P=0.16). We also tested the publication bias possibility through the use of the funnel plot method for skewness assessment. This process shows no significant bias(P value=0.81). Formal testing was done further by the method suggested by Eager et al.. This also proves to have no bias (P value= 0.68, R squared value=0.31).

Table 1: **Cognitive data**

Data	% of Male	% of female	Date of Birth	Birth Weight (gram)	Age (week)	Evaluation time Age	Mean Score	Quality Score (Mean)
Data 1								
Cases (n = 45)	46	77	1976-1980	<1501 (1303) [851-1501]	322 (26-37)	8	94 (14)	6
Controls (n = 45)	47	77	1976-1978	ND	40	7	101.3 (12.89)	
Data 2								
Controls (n = 15)	61	65	1980-1981	>2501	38-42	5	104 (14)	8
Cases (n = 15)	59	67	1980-1981	<1001 (909)	ND	5	92 (21)	
Data 3								
Cases (n = 16)	ND	ND	ND	<2500; 1776 (510)	<35; 31.4 (3)	5	114 (21.2)	5
Controls (n = 18)	ND	ND	ND	3358 (481)	40	5	126 (13.2)	
Data 4								
Cases (n = 43)	47	86	1981	1305 (165) [851-1501]	>28	5	89.6 (14)	7
Controls (n = 43)	47	ND	1981	3343 (430)	>37	5	102 (13.2)	
Data 5								
Cases (n = 28)	50	46	1980	<1001; 907 (86)	27 (1.48)	6	87 (13.58)	6.5
Controls (n = 26)	ND	ND	1980	ND	41	6	98.72 (14.28)	
Data 6								
Cases (n = 29)	62	ND	1982-1983	<1501; 1252 (166)	32 (2.61)	8	92.2 (16.1)	8.5
Controls (n = 29)	62	ND	1981-1982	3651 (491)	40	8	103.9 (14.12)	
Data 7								
Cases (n = 90)	ND	ND	ND	<1500; 1190 (209)	29 (2.3)	13	104.1 (11.1)	7
Controls (n = 90)	ND	ND	ND	>2501; 3226 (334)	39 (1.2)	13	112.4 (9.68)	
Data 8								
Cases (n = 255)	ND	ND	1984	1000-1499	ND	8	92.9 (12.6)	6.5
Controls (n = 500)	ND	ND	1984	ND	40	8	101.1 (12.4)	
Cases (n = 44)	ND	ND	1984	<1001	ND	8	90.4 (10.9)	

Controls (n = 90)	ND	ND	1984	ND	40	8	101.5 (11.8)	
Data 9								
Cases (n = 145)	ND	ND	1985-1987	<2000;1556 (367)	31(4)	5	96(13)	8.48
Controls (n = 162)	ND	ND	1985-1987	>3000	41	5	103(14)	

Table 2: **Behavioral data**

Source	White, %	Male, %	Birth Weight, g†	Years of Birth	Gestational Age, week	Mean Age at Evaluation, y
Data 1						
Controls (n = 44)	77	47	NA	1975-1978	40	7
Cases (n = 44)	76	47	<1500 (1302 [850-1500])	1975-1979	32.1 (26-37)	7.2
Data 2						
Controls (n = 18)	NA	NA	3359 (481)	NA	40	5
Cases (n = 16)	NA	NA	<2500; 1776 (510)	NA	<35; 31.4 (3)	5
Data 3						
Controls (n = 208)	NA	51	>2500	1980-1982	40	5
Cases (n = 82)	NA	45	500-1000; 835 (125)	1980-1982	27.4 (2.7)	5
Data 4						
Cases (n = 28)	46	50	<1000; 905 (86)	1980	28 (1.5)	6
Controls (n = 26)	NA	NA	NA	1980	>37	6
Data 5						
Controls (n = 80)	50	51	NA	1978-1980	40	7.5
Cases (n = 88)	51	52	<1500; 1192 (200)	1978-1980	29.3 (1.8)	7.5
Data 6						
Controls (n = 50)	64	NA	3487.6 (2614-4706)	1974-1985	40 (38-42)	9
Cases (n = 90)	87	NA	500-800; 730 (520-800)	1974-1985	26 (23-38)	8
Data 7						
Cases (n = 77)	67	48	<1000; 823 (114)	1986	27.1 (1.9)	7.5
Controls (n = 1092)	86	51	3360 (534)	1986	39.6 (1.6)	8
Cases (n = 221)	67	48	1000-1499; 1267 (147)	1986	30 (2.2)	7.5
Data 8						
Controls (n = 167)	NA	NA	3352 (2098-4450)	1980-1981	40	14
Cases (n = 167)	NA	NA	<1500; 1259 (630-1500)	1980-1981	30.8 (26-37)	14
Data 9						
Controls (n = 61)	NA	43	3648 (533)	1985-1986	40.1 (1.43)	10.6
Cases (n = 61)	NA	41	500-1480; 1042 (242)	1985-1986	27.1 (1.03)	10.5
Data 10						
Cases (n = 60)	55	32	500-1000; 665.6 (68)	1982-1986	25.7 (1.8)	11
Controls (n = 49)	59	33	3300 (660)	1982-1986	40	11

Cases (n = 55)	51	31	1001-1500; >1173.2	1982-1986	29.4 (2.4)	11
Data 11						
Controls (n = 41)	NA	61	3417 (432)	1980-1982	39.9 (1)	14
Cases (n = 120)	NA	54	1167 (215)	1980-1982	29.3 (2)	14

Behavioral Data

Sixteen reports comparing two groups, i.e., preterm-born cases 1759 and term-born control 2629. The newborn child shows internal or external behavior in 13 reports out of the 16 reports. About ten reports out of 15 examined ADHD, which showed a significantly high prevalence of attention problems relatively with the controls. Also, 9 out of the 13 reports found significantly higher internalizing features in the control group vs. the case groups. More analysis of behavioral reports were not possible because of a variety of tools which were utilized to test and report this behavior in the school-going child. Six reports consisting of 7 populations tested by previously defined criteria (DSM-III-R, DSM-III, DSM-IV) was used to examine ADHD in control and case groups. These studies are chosen for random meta-analysis to calculate the RR of ADHD in preterm-born children. Cases had pooled RR of value 2.63 (CI of 95%=1.84-3.79) as compared to the control group (z value=5.31;P value<0.0012). The heterogeneity tests were not significant in these reports. The gross RR in these cases is the same for the high-quality labeled reports (CI of 95% is 1.43-4.32) vs. The low quality(CI of 95% is 1.72-4.42). The tests were done using Begg's and Eagers's method, which shows no significant bias. The low sample numbers of papers make these tests.

Discussion

According to this meta-analysis, it has been found that preterm delivery of a child has low cognitive value and an increase in ADHD in children of school-going age as compared to the control groups. The lower cognitive score also accounted for this report, while the mean difference of more than 10 cognitive scores between control and case groups was significant (10). Reduced birth weight and gestational age correlated with lower cognitive test outcomes, indicating the immature development of the childs brain. Along with these immaturity problems, the facts are linked to illness in preterm babies, adversely exposing physiological instability. These have a permanent effect on the development of the brain, which leads to the behavioral and cognitive results. The meta-analysis result must be observed with the study limitations. Many studies have examined the environmental and demographic effects on behavioral and cognitive development in the lifespan of the preterm infants(11). In a very recent study with 118 children of 10 year olds, born in the preterm condition, family factors were a strong influence on school performance. These comparisons were not published in the observational studies for meta-analysis. After excluding papers not published in english, the meta-analysis consists of data from many countries which shows no significant difference between the cognitive results in the preterm born child of USA and non-USA. For a complete result, a repeated MEDLINE search found only four papers which were not in english, and were designed as case-control studies with the behavioral and/or cognitive data for term-born or preterm school-going children(12). Due to the little information in the abstract, it was not possible to confirm about meeting the inclusion and exclusion criteria. All 4 of these publications are consistent with the meta-analysis results. Based on these considerations, it has been concluded that papers not published in english were not deviating from the findings. Moreover, the studies were published at a time when rapid advancement of fetal medicine and gerontology occurred. So, infant care in those times was not uniform, and this has developed over time. The selected publications differed based on the primary characters like gestational age and mean birth weight. All newborns born within the 37 weeks gestation age are defined as the cases, and the data obtained from them are relatively small due to gestation age, which was not accounted for in the study. Furthermore, some studies included full-term born and small gestation was not identified in the cohort description. Birth weight data and mean gestational age were not always reported as the range or Standard deviation (mean). The mean gestation period was 40 weeks with a birth weight(mean) of 3200g. Severe neurological and cognitive disability cases were not accounted for in all three meta-analysis studies. However, the exact definition of severe disability was inconsistent among the studies. The included studies with cognitive disability and extreme neurological ability have the highest mean difference between the control and the case groups (13). For the purpose of analysis, the cognitive score of the various tests was accounted for because of the same type of normative data. The ADHD diagnosis was considered as it had relative sensitivity and specificity (DSM-IV, DSM-III-R, DSM-III). These considerations ignored the slight differences between behavior tests and the cognitive and administering variability of these tests. The rigorous applications of the selection criteria resulted in inadequate methodology study exclusion and exclusion of the flawed generalized study. Study quality assessment of the study quality for meta-analysis of the random clinical trials resulted in discrepancies(14). For randomize trial quality assessment, particular criteria had been broadly accepted. However, the same standards have not changed for observational research. The meta-analysis indicates that a significant number of preterm born children, are at immediate risk of reduced cognitive scores at the school going age, and the birth weight and the gestational age is proportional to the mean value of the cognitive tests. These differences remove the mental result controversies. According to McCarton et al., only 4 points due to the cognitive score, produced prominent deviations between the children. The group-based difference was significant. Preterm-born children or low body weight babies are more likely to be incorporated into special education. Depending on the facts, it was hypothesized that the meta-analysis had a significant effect on the required education for preterm born children. This may even be linked to the future determination of social and economic ability. In neurocognitive incidents, behavioral abnormalities were linked to an increase in ADHD. For 14 year olds, behavioral and neurocognitive problems were related to magnetic resonance imaging(15).

Conclusion

This meta-analysis revealed that preterm children are 2.5 times more at risk for developing ADHD and repeatedly show internal and external school-age behavior. In addition, preterm-born children offer less capability of selective attention needed for learning. So, this research suggests a testable theory for identifying the pathogenesis of preterm children's poor cognition. Taking into consideration the effects of preterm birth on overall growth and development of children, it is imperative for therapeutic interference to be adapted to suit the needs of preterm children.

Reference

1. Wood NS, Marlow N, Costeloe K, Gibson AT, Wilkinson AR. Neurologic and developmental disability after extremely preterm birth. New England Journal of Medicine. 2000 Aug 10;343(6):378-84.
2. Roussounis SH, Hubley PA, Dear PR. Five-year-follow-up of very low birth weight infants: neurological and psychological outcome. Child: care, health and development. 1993 Jan;19(1):45-59.
3. Hack M, Taylor HG, Klein N, Eiben R, Schatschneider C, Mercuri-Minich N. School-age outcomes in children with birth weights under 750 g. New England Journal of Medicine. 1994 Sep 22;331(12):753-9.
4. Saigal S, Szatmari P, Rosenbaum P, Campbell D, King S. Cognitive abilities and school performance of extremely low birth weight children and matched term control children at age 8 years: a regional study. The Journal of pediatrics. 1991 May 1;118(5):751-60.
5. Sommerfelt K, Ellertsen B, Markestad T. Personality and behaviour in eight-year-old, non-handicapped children with birth weight under 1500 g. Acta Paediatrica. 1993 Oct;82(9):723-8.
6. Drillien CM, Thomson AJ, Burgoyne K. Low-birthweight children at early school-age: a longitudinal study. Developmental Medicine & Child Neurology. 1980 Feb;22(1):26-47.
7. Hack M, Klein NK, Taylor HG. Long-term developmental outcomes of low birth weight infants. The future of children. 1995 Apr 1:176-96.
8. Aylward GP, Pfeiffer SI, Wright A, Verhulst SJ. Outcome studies of low birth weight infants published in the last decade: a meta-analysis. The Journal of pediatrics. 1989 Oct 1;115(4):515-20.
9. Escobar GJ, Littenberg B, Petitti DB. Outcome among surviving very low birthweight infants: a meta-analysis. Archives of disease in childhood. 1991 Feb 1;66(2):204-11.
10. Taylor HG, Swartout MD, Yeates KO, Walz N, Stacin T, Wade SL. Traumatic brain injury in young children: Post-acute effects on cognitive and school readiness skills. J Int Neuropsychol Soc 2008;14:734–745.
11. McCarton CM, Brooks-Gunn J, Wallace IF, Bauer CR, Bennett FC, Bernbaum JC, Broyles RS, Casey PH, McCormick MC, Scott DT, Tyson J. Results at age 8 years of early intervention for low-birth-weight premature infants: The Infant Health and Development Program. Jama. 1997 Jan 8;277(2):126-32.
12. Hack M, Breslau N, Aram D, Weissman B, Klein N, Borawski-Clark E. The effect of very low birth weight and social risk on neurocognitive abilities at school age. Journal of Developmental and Behavioral Pediatrics. 1992 Dec.
13. Evers-Embden B, Scholte EM. Learning performance and neurological status present of preterm, premature dysmatures and dysmatures at the age of 8 years. Journal of Pediatrics. 1983; 51: 85-94.
14. Stjernqvist K, Svenningsen NW. Ten-year follow-up of children born before 29 gestational weeks: health, cognitive development, behaviour and school achievement. Acta Paediatrica. 1999 May;88(5):557-62.
15. Jüni P, Witschi A, Bloch R, Egger M. The hazards of scoring the quality of clinical trials for meta-analysis. Jama. 1999 Sep 15;282(11):1054-60.
16. Stewart AL, Rifkin L, Amess PN, Kirkbride V, Townsend JP, Miller DH, Lewis SW, Kingsley DP, Moseley IF, Foster O, Murray RM. Brain structure and neurocognitive and behavioural function in adolescents who were born very preterm. The lancet. 1999 May 15;353(9165):1653-7.