A Comparison of the Academic Performance and Intelligence Scores of Asthmatic and Nonasthmatic Primary School Pupils in Enugu State, Nigeria

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Abstract

Background: Children with asthma (subjects), just as their non asthmatic colleagues, are expected to perform optimally academically and with a good intelligent score. A number of activities in children with asthma may be affected by asthmatic attacks including their education/academic performance. Report on academic performance and IQ of school children with asthma and comparisons with those without asthma (controls) within and outside Nigeria are scanty. **Aims:** This study compared the academic performance and IQ of asthmatics and nonasthmatic school children. **Materials and Methods:** One hundred and twenty children with asthma aged 5-11 years were consecutively recruited at the asthma clinic of UNTH Enugu and their age, gender and socio-economic class-matched normal classmates were enrolled as controls. Academic performance of the children with asthma was studied using the overall scores achieved in the three term examinations in the preceding academic year (2012/2013), while their IQ was determined using the Draw-A-Person-test. The findings were compared with that of the 120 controls. **Results:** The median (range) overall academic scores for the subjects 79.04% (36.08%-99.57%) was similar to that of controls 80.01% (50.65%-97.47%) ($U = 6804$, $P = 0.461$). However, a significant number of subjects compared to controls had poor academic performance. The mean IQ scores for subjects (123.28 ± 21.45) and controls (118.41 ± 19.87) did not differ significantly ($t = 1.83$; $P = 0.069$). There was also a significant and negative correlation (Pearson's) between age and mean DAPQ in both the subjects and controls ($r = -0.377$, $P < 0.001$; $r = -0.492$, $P < 0.001$ respectively). **Conclusions:** The intelligence scores and overall academic performance of children with asthma compares favorably with that of children without asthma.

Keywords: Academic performance, asthma, children, intelligence quotient

INTRODUCTION

Asthma is one of the most common chronic illnesses among children, affecting over six million children globally.[1] Children with asthma, similar to children with other chronic illnesses, are at the intersection of the health and education systems, and are expected to compete with nonasthmatic counterparts in the same classroom under the same learning conditions.[2] At school, their health needs may be attended to by a school nurse, whereas their educational needs may be overlooked or underestimated.[3]

The restriction from normal activities due to recurring, episodic attacks in children with asthma can impact significantly on the quality of life and increase the burden due to asthma.[4] Frequent attacks in children with poor asthma control can affect their academic performance.[5,6]

Intelligence, measured as the intelligence quotient (IQ), is one of the important prognostic variables in the academic performance of a child,[7] and many factors including chronic diseases may impact upon it.[8,9] IQ scores, as has been suggested, may be an appropriate guide in the proper placement of schoolchildren at the beginning of their education.[10] Children with borderline intelligence (IQ 68–83) or mental subnormality, irrespective of the etiology, are known to present with poor school performance.[11] Studies on children with sickle cell anemia (SCA) have reported a significant correlation

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between IQ and academic performance.[12,13] Chodorkoff and Whitten[12] in their study among children with SCA found a significant correlation between IQ and school grade-level placement. Swift et al. also reported academic achievement to be commensurate with the measured intellectual ability in children with SCA.[13]

Most of the studies[14-16] on academic performance of children with asthma have been in developed countries and despite the high prevalence of asthma among Nigerian schoolchildren,[17,18] only a few studies have investigated the relationship between IQ score and academic performance of children with asthma compared with those without. Ghaffari et al.[8] in a comparative study of the overall IQ scores of asthmatics and healthy children found that there were no significant differences in the overall scores and in the scores of males and females. Similar findings were also reported by Daramola et al.[9] among children with asthma. However, a study among primary school-aged children with SCA[19] did not reveal any significant difference in the intelligence scores between children with SCA and their normal controls.

This study was, therefore, carried out to find out the relationship between academic performance and IQ of children with asthma and compare with that of children without asthma. The results are expected to contribute to the development of school health programs for children with asthma in Nigeria.

MATERIALS AND METHODS

Ethics
Ethical approval was obtained from the Health Research Ethics Committee of University of Nigeria Teaching Hospital (UNTH), Ituku/Ozalla, and the ethical approval was obtained on May 21, 2012, with the approved protocol number NHREC/05/01/2008B. Written informed consent was obtained from caregivers of all participants. This work was done in keeping with the Helsinki declaration of 1975, as revised in 2000.

Study design
This was a descriptive, cross-sectional, hospital- and school-based study.

Study area
The study was carried out in Enugu, the capital of Enugu State in Nigeria, West Africa. Children with asthma and nonasthmatic controls were children resident within Enugu metropolis.

Study site
The UNTH, Ituku/Ozalla, Enugu State, and the primary schools in Enugu metropolis were the sites for the study. The UNTH offers primary, secondary, and, importantly, tertiary health-care services to persons of all social classes and is the referral center for the populations of South-East Nigeria.

Study population
The study population comprised schoolchildren with asthma (patients) living in Enugu metropolis, whereas the control population (children without asthma) were their healthy classmates. The choice of classmates as controls was informed by the need to remove school-related bias and to control for class grade as suggested by Richard and Burlew.[20]

Sample size
The minimum sample size for the study was determined using the formula for sample size calculation when the study population is >10,000: $n = \dfrac{z^2 \, pq}{d^2}$

Where n = Sample size

z = z score at 95% confidence limit (1.96)

p = Estimated prevalence when prevalence of poor academic performance in children with asthma is not known = 0.50

q = 1.0 − p = 0.5

d = degree of accuracy at 95% confidence limit (0.05)

$$n = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 384$$

and when the study population is <10,000, $nf = \dfrac{n}{1 + \dfrac{n}{N}}$

where nf = Final sample size

n = Sample size when the study population is >10,000

N = Study population size (number of school-aged asthmatics attending the asthma clinic) =148

$$nf = \frac{384}{1 + \dfrac{384}{148}} = 107$$

Sample size allowing for 10% attrition = 120

The total number of children with a diagnosis of asthma enrolled into the study was 120. Their age-, sex-, and social class-matched controls were also 120. The total number of study participants was therefore 240.

Inclusion criteria
1. Children aged 5–11 years, attending primary school in Enugu metropolis
2. Children diagnosed with asthma[21,22]
3. Attendance in the same school for at least one session before the study enrollment
4. Attendance at the asthma clinic for at least 12 months
5. Consent for the study given by caregiver.

Exclusion criteria
1. Out-of-school children
2. Age <5 years or more than 11 years
3. Children with other chronic diseases such as sickle cell disease, diabetes mellitus, tuberculosis, congenital heart diseases, or with a history of neurologic illness such as seizure disorders and cerebral palsy
4. Children attending school outside Enugu metropolis

5. Attendance of the present primary school for less than one session before enrollment
6. Refusal of consent by caregiver
7. Asthmatic children with incomplete data because some of the information were obtained from the case notes.

Control group

The child next to the asthma patient in the class register was selected as control if he/she met the following criteria:

1. Of same sex, age within 6 months, and socioeconomic class similar to that of the child with asthma
2. Has been in the same primary school and class as the asthmatic child for at least one session before the study enrollment
3. Does not have any of the exclusion criteria as listed for the children.

If the next child to the asthmatic in the class register did not meet the criteria, the most suitable child without asthma down the register who meets the criteria was chosen as control.

Selection and evaluation of the subjects

The study was carried out in two phases. First, the children were enrolled from the clinic, whereas their controls were enrolled from the corresponding schools. Children with asthma and controls were matched for age, sex, and socioeconomic class.

At the asthma clinic

On presentation to the clinic, the caregiver and the child with asthma were informed of the study, and written informed consent was obtained from the caregiver. Before enrollment, in order to ascertain eligibility, the asthmatic child's sociodemographic data were obtained and the child was subsequently assessed clinically for chronic and debilitating medical conditions such as heart disease, seizure disorders, and cerebral palsy that are known to affect academic performance independently.[23] The information obtained was recorded in the questionnaire.

Children who met the inclusion criteria were enrolled consecutively till the sample size was reached, while those excluded were scheduled for consultation. The socioeconomic status of the children was determined using the method described by Oyedeji.[24] This was determined using the occupation and educational attainment of the caregiver to obtain the socioeconomic class. The socioeconomic class was obtained by finding the mean score for the parents' educational attainment and occupation rounded off to the nearest whole number. Where any of the parents were dead, the social class of the child was assessed using that of the living parent. Socioeconomic Class I represents the highest socioeconomic class and Class V the lowest.

The level of asthma control was ascertained using the Childhood Asthma Control Test (C-ACT™).[25] The C-ACT tool for children aged 4–11 years is made up of seven questions with a total score of 27 as the highest score obtainable. Each child, as much as possible, was allowed to answer the first four

questions unaided while the caregiver answered the remaining three. A score of 19 and below signified poor control, whereas scores above 19 indicate good control.[26,27]

The participants were then given a sheet of paper and pencil and left alone with as much time as they needed with the instruction to draw a person.[28,29] IQ was assessed using the Draw-A-Person Test (DAPT).[28] The IQ of the participants was calculated using the validated Ziler criteria and the table of Draw-A-Person-Quotient (DAPQ) by Ebigbo and Izuora.[28] The total number of points scored is the Draw-A-Person Point (DAPP). DAPQ = Draw-A-Person–Aggregate (DAPA)/chronologic age, where DAPA = DAPP + 3/4. The DAPQ score obtained was compared with the expected DAPQ score for age and sex using the table for average DAPQ scores by Ebigbo and Izuora. A score of <75% for sex and age was regarded as mental dullness or backwardness.[28]

Children with asthma were subsequently reviewed, complaints were attended to, and a future clinic appointment was given. However, children with acute exacerbation of asthma were first managed in the Children Emergency Room of UNTH before evaluation for the study. Children whose caregiver refused to give consent for participation in the study were exempted from being part of the study, but were given due attention in the clinic.

In the schools

The clearance letter from the Ministry of Education was used to obtain permission for the study at the various schools. At the school/class of each enrolled asthmatic child, the head/class teacher was informed of the study in order to access the child with asthma and to enroll the child without asthma. In addition, the need to obtain the information with regard to the children's school performance was explained.

With the help of the class teacher, the nonasthmatic child, next to the child with asthma in the class register, who was of the same age and sex as the child with asthma was selected. The child was then informed of the study and given the consent form for the caregiver to fill. The consent form was retrieved on a subsequent visit to the school. The nonasthmatic child whose caregiver gave consent was then interviewed for eligibility for the study, and the socioeconomic status was determined as described for the children with asthma. The selected control was then enrolled and the questionnaire was administered.

The control was also given a sheet of paper and pencil and left alone with as much time as needed with the instruction to draw a person and was scored using the validated Ziler criteria by Ebigbo and Izuora. The DAPQ was also ascertained just as was done for the children with asthma.

With the help of the class teacher, using the pupils' academic records, information on class position, overall score, and scores in key subjects (Mathematics, English, Social Studies, and Science) for the children with asthma and controls was obtained and recorded. The average overall percentage score for each child in the three terminal examinations in the 2012/2013 academic

year was documented and was used as an index of the general/overall academic performance.[30,31] The average of the three scores from the three academic terms for each child in four selected key subjects was used as the index of specific academic performance.[30,31] Children who scored <50% overall or in a specific academic skill were considered as having poor academic performance overall or with respect to that specific academic skill/key subject, whereas scores ≥50% (average 50%–74% and high scores ≥75%) were considered good academic performance.[29,30] Good academic performance was further classified into average scores (50%–74%) and high scores (≥75%).[30,31]

From the class attendance register, each child's total number of days of absence from school for the entire academic year was obtained. School absence was classified as described by Weitzman et al.[32] Information not properly filled or missing on the questionnaire was requested for directly from the caregiver through personal and/or phone contacts.

Statistical analysis

Information obtained from the participants was recorded in the questionnaire and subsequently transferred to the data editor of Statistical Package for the Social Sciences (SPSS) software for Windows® version 19.0 (IBM Inc., Chicago, IL, USA, 2011) for analysis. Descriptive statistics such as mean ± standard deviation (SD) and median were obtained for continuous variables, whereas categorical variables were summarized using frequencies and percentages. The comparison of the means of IQ which were normally distributed was done using Student's t-test and ANOVA, whereas academic performance that was not normally distributed was compared using the Mann–Whitney U-test. The significance of the association between categorical variables was determined using Chi-square test. Tests of relationships were also done using Pearson's and Spearman's rho correlation. All the tests were taken as statistically significant at $P < 0.05$. Results are presented in tables, figures, and prose.

RESULTS

A total of 81 (67.5%) males and 39 (32.5%) females (male: female ratio 2.1:1) were in each group (study group and control). The age range was 5–11 years, and the overall mean age ± SD was 8.20 ± 1.92 years. Sixty-nine (57.5%) of the 120 children with asthma and controls were in early primary school age (5–8 years), whereas 51 (42.5%) were in late primary school age (9–11 years). Out of the 69 children with asthma and controls in early school age, 45 (65.2%) were male and 24 (34.8%) were female, whereas 36 (70.6%) of the 51 children with asthma and controls in late school age were male and 15 (29.4%) were female ($\chi^2 = 0.39$; $P < 0.535$). The mean age ± SD for males and females was 8.07 ± 1.73 and 8.47 ± 2.26 years, respectively ($t = 1.47$, $P = 0.143$). Thirty (25%) of the children with asthma were from socioeconomic Class I and sixty (50%) from socioeconomic Class II, whereas only 12 (10%) were from socioeconomic Class III and 18 (15%) from Class IV. No child with asthma or control studied was from socioeconomic

Class V. Thirty out of the 120 children with asthma (25%) had poor asthma control, whereas 90 (75%) had good asthma control.

Of the 120 children with asthma studied, 6 had poor academic performance, whereas 114 had good academic performance (48 average performance and 66 had high performance). None of the 120 controls had poor academic performance (51 had average performance and 69 had high performance). However, the median (range) overall academic scores for the children with asthma and controls were 79.04% (36.08%–99.57%) and 80.01% (50.65%–97.47%), respectively. The difference was also not statistically significant ($U = 6804$, $P = 0.461$). There was also no statistically significant difference between children with asthma and controls in selected key subjects [Table 1].

There were statistically significant differences in the median overall academic scores at ages 7 ($P = 0.045$), 9 ($P = 0.015$), and 11 ($P = 0.009$) years. The differences at 6 and 10 years approached statistical significance. The median score of children with asthma was higher than that of controls at 6, 7, and 9 years and lower at 10 and 11 years. There was a statistically significant weak negative correlation (Pearson) between age and median overall scores in children with asthma ($r = -0.467$, $P < 0.001$) but not for controls ($r = -0.146$, $P = 0.112$) [Table 2].

There was no significant difference in the median (range) overall academic score for children with poor asthma control compared to those with good control ($U = 1235$, $P = 0.486$).

All the children with asthma and controls had normal IQ (≥75% of expected for age and sex). The mean DAPQ scores

Table 1: Comparison of median overall and specific subject scores of children with asthma and controls

Subjects	Median (mean rank)		Mann-Whitney U	P
	Subjects (n=120)	Controls (n=120)		
Overall score	79.04 (123.80)	80.01 (117.20)	6804.00	0.461
Mathematics	78.67 (125.23)	71.00 (115.78)	6633.00	0.292
English	78.67 (113.90)	83.17 (127.10)	6408.00	0.141
Social Studies	83.00 (129.24)	82.17 (111.76)	6151.50	0.051
Science	79.34 (121.55)	81.33 (119.45)	7074.00	0.815

Table 2: Age-specific comparison of median overall scores between children with asthma and controls

Age (years)	Median (mean rank)		Mann-Whitney U-test	P
	Subjects	Controls		
5	80.63 (18.50)	82.34 (18.50)	162.00	1.000
6	99.10 (5.00)	91.49 (2.00)	0.00	0.050
7	87.68 (22.00)	82.38 (15.00)	99.00	0.045
8	84.35 (31.70)	86.39 (29.30)	414.00	0.594
9	72.54 (29.38)	59.88 (19.63)	171.00	0.015
10	91.47 (2.00)	97.47 (5.00)	0.00	0.050
11	65.00 (19.25)	71.83 (29.75)	162.00	0.009

for children with asthma and controls were 123.28 ± 21.45 and 118.41 ± 19.87, respectively. The difference was not statistically significant ($t = 1.83$; $P = 0.069$). However, female children with asthma had significantly higher mean DAPQ scores compared to controls ($t = 3.521$; $P = 0.001$) [Table 3].

There are increased cluster of points in an upward manner from left to right indicating a statistically significant correlation between academic performance and DAPQ in both children

Table 3: Mean±standard deviation of overall and gender-related Draw-A-Person-Quotient scores of children with asthma and controls

Status	DAPQ scores, mean±SD		t	P
	Children with asthma (n=120)	Controls (n=120)		
Overall	123.28±21.45	118.41±19.87	1.826	0.069
Males	119.18±21.24	119.33±20.37	0.047	0.963
Females	131.80±19.52	116.49±18.89	3.521	0.001
t	3.128	0.734		
P	0.002	0.464		

DAPQ – Draw-A-Person-Quotient; SD – Standard deviation

with asthma ($r = 0.213$, $P = 0.020$) and controls ($r = 0.318$, $P < 0.001$) [Figure 1a and b].

DISCUSSION

In this study, the intelligence scores and the overall academic performance (overall and in specific subjects) of children with asthma were comparable with that of age-, sex-, and socioeconomic class-matched controls.

The finding of a male preponderance among children with asthma is consistent with the reports from previous studies[18,33,34] which noted that males are more affected by asthma before puberty. The reason suggested was the smaller lung size in males in childhood which, however, becomes larger in adulthood.[33] The male preponderance may also reflect preferential treatment, even in health matters, given to male children in our environment.[35] Children with asthma in this study were recruited from the hospital.

Majority of the children with asthma belonged to socioeconomic Classes I and II, and none of the children with asthma were in socioeconomic Class V. This is in keeping with earlier reports[4,36] that noted asthma to be one of the few diseases that are more
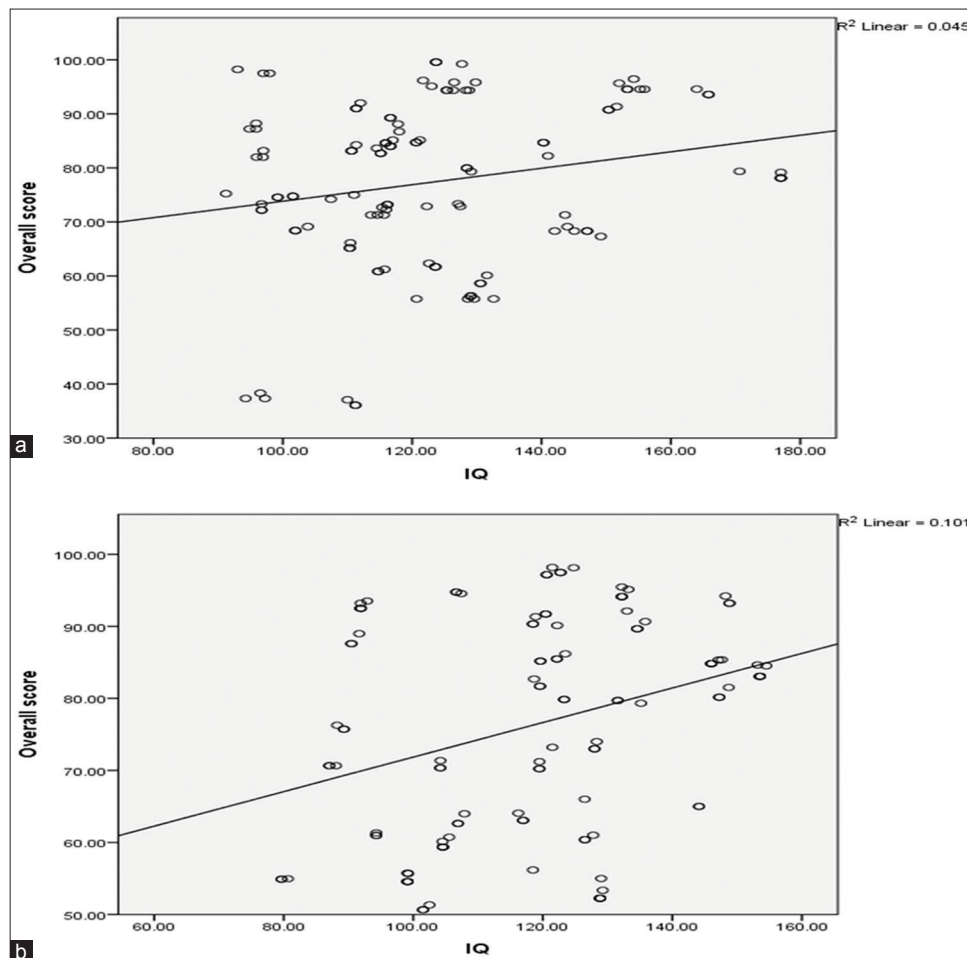

Figure 1: (a) A scatter diagram showing the relationship between intelligence quotient and academic performance among children with asthma. (b) A scatter diagram showing the relationship between intelligence quotient and academic performance among controls

common in the higher socioeconomic classes. The reason could be due to lifestyle encounters such as early use of formula feeds, canned foods with additives, and other social factors that are more common among people of higher socioeconomic class compared to those in the lower socioeconomic classes and can predispose to airway hypersensitivity. It could also indicate that more parents in the socioeconomic Classes I and II, compared to those in the socioeconomic Classes III and IV, avail themselves of the specialized services offered by the teaching hospital.[35]

Although all the six participants with poor academic performance were children with asthma (study group), the overall academic performance of those in the study group did not differ from those of controls. This corroborates the findings of earlier studies.[37-39] This could be because majority of the children with asthma in this study had good asthma control which may have masked the effect of asthma on academic performance. However, Fowler et al.[40] working in the USA reported a greater likelihood of poor academic performance among children with asthma compared with healthy children. This was an epidemiological survey on children using the grade system of education which did not exclude other chronic conditions known to affect academic performance. In contrast to the study by Fowler et al.,[40] this study excluded children with chronic diseases such as SCA, epilepsy, and cerebral palsy that are known to affect the academic performance of children. Other confounding variables such as socioeconomic class were also accounted for. Furthermore, in contrast to this study, the level of asthma control was not considered in the study by Fowler et al.

Studies[30,35] on academic performance of children with other chronic diseases such as SCA and epilepsy done in the same study environment using similar study design as used in this study, found that the overall academic performance of these children was not significantly different from those of their normal classmates. The reason for this finding could be the similarity in the IQ of the study and control groups in these studies. In addition, these studies,[30,35] similar to this study, are hospital based involving children who are accessing specialized care in the hospital, and this could have masked the effect of the disease on their academic performance compared to their healthy controls.

There was also no difference in academic performance between children with asthma and controls with regard to selected specific subjects. This is in agreement with the work by Gutstadt et al.[38] and is also similar to the report from studies on other chronic diseases such as SCA and epilepsy.[11,31,32] However, this finding is at variance with that of Krenitsky-Korn[15] who reported that children with asthma scored significantly lower in Mathematics when compared with children without asthma. While Krenitsky-Korn's work was based on interviewer-reported responses on performance in Mathematics only, this study more objectively obtained and used the scores of the children in Mathematics as well as in three additional key subjects (English, Science, and Social Studies) over an academic year.

With respect to gender, differences were noted between children with asthma and controls in overall academic performance and performance in selected key subjects. The academic performance of male children with asthma was significantly higher overall as well as in Mathematics and Social Studies when compared to male controls. This differs from the report by Krenitsky-Korn[15] and Gutstadt et al.[38] In addition, female children with asthma performed poorer than their female controls in English. The reason for these differences in gender and overall performance as well as performance in specific subjects between male and female children with asthma and controls is unclear. The better academic performance noticed among male asthmatics compared to male controls could be because these male asthmatics, due to reduced activity as a result of asthma attacks, channel their time and energy to reading and other academic activities. Furthermore, the high proportion of children with good asthma control could have masked the effect of asthma on the academic performance of these male controls. The significantly higher proportion of males compared to females in the study population may also have influenced these findings.

All the children in this study had IQs within the normal range for age and sex, and there was no significant difference in IQ between children with asthma and controls. This is consistent with the findings of Daramola et al.[9] at Ibadan, Nigeria, as well as with those of Ghaffari et al.[8] in Iran. While this study used the DAPT to assess IQ, Ghaffari et al.[8] used Wechsler's Intelligence Scale for Children (WISC), and Daramola et al.[9] in Ibadan, Nigeria, used Standard Progressive Matrices. The similarity in the findings from the studies by Ghaffari et al. and Daramola et al. with that of this study despite the use of different IQ assessment tools and having been done in three different areas aligns with a report of high correlation between DAPT and other IQ assessment tests.[38]

Although female children with asthma had a significantly higher IQ compared to female controls, this appeared not to reflect on their academic performance overall and in specific subjects except in English where the controls had a significantly higher median score compared to children with asthma. This was rather an opposite of what is reflected in their IQ. This reason for this isolated finding is unclear, but this could suggest that, besides IQ, there could be other important factors outside the scope of this study that influence academic performance.

IQ had a linear relationship with academic performance in both children with asthma and controls. This is consistent with the observations by Ghaffari et al.[8] and Daramola et al.[9] A number of other related studies have shown a positive correlation between IQ and academic performance.[7,11-13] This finding in this study, therefore, supports the idea that IQ scores serve as appropriate guide in the proper placement of schoolchildren at the beginning of their education.[10]

CONCLUSION

The IQ and overall academic performance of primary children with asthma do not significantly differ from those of normal children in the same setting, though there is a comparatively higher prevalence of poor academic performance in children with asthma.

Recommendation

Children with asthma who have normal IQ do not need special schools as they can compete favorably well academically in regular schools with their nonasthmatic peers.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Masoli M, Fabian D, Holt S, Beasley R; Global Initiative for Asthma (GINA) Program. The global burden of asthma: Executive summary of the GINA dissemination committee report. Allergy 2004;59:469-78.
2. Bateman ED, Hurd SS, Barnes PJ, Bousquet J, Drazen JM, FitzGerald JM, et al. Global strategy for asthma management and prevention: GINA executive summary. Eur Respir J 2008;31:143-78.
3. Thies KM. Identifying the educational implications of chronic illness in school children. J Sch Health 1999;69:392-7.
4. Liu AH, Covar RA, Spahn JD, Leung DYM. Childhood Asthma In: Kliegman RM, Berhman RE, Jenson HB, Stanton BF, editors. Nelson Textbook of pediatrics. 18th ed. Philadelphia: Saunders Elsevier; 2007. p. 143.
5. Taras H, Potts-Datema W. Chronic health conditions and student performance at school. J Sch Health 2005;75:255-66.
6. Diette GB, Markson L, Skinner EA, Nguyen TT, Algatt-Bergstrom P, Wu AW. Nocturnal asthma in children affects school attendance, school performance, and parents' work attendance. Arch Pediatr Adolesc Med 2000;154:923-8.
7. Karande S, Kulkarni M. Poor school performance. Indian J Pediatr 2005;72:961-7.
8. Ghaffari J, Abbaskhanian A, Jalili M. IQ scores of children with moderate asthma: A comparison with healthy children. Oman Med J 2014;29:71-4.
9. Daramola OO, Ayoola OO, Ogunbiyi AO. The comparison of intelligence quotients of atopic and nonatopic children in Ibadan, Nigeria. Indian J Dermatol 2010;55:221-4.
10. Day S, Chismark E. The cognitive and academic impact of sickle cell disease. J Sch Nurs 2006;22:330-5.
11. Alikor EA. Common growth and development problems. In: Azubike JC, Nkanginieme KE, editors. Paeditrics and Child Health in a Tropical Region. 2nd ed. Owerri: African Educational Series; 2007. p. 70-82.
12. Chodorkoff J, Whitten CF. Intellectual status of children with sickle cell anemia. J Pediatr 1963;63:29-35.
13. Swift AV, Cohen MJ, Hynd GW, Wisenbaker JM, McKie KM, Makari G, et al. Neuropsychologic impairment in children with sickle cell anemia.

Pediatrics 1989;84:1077-85.
14. Moonie S, Sterling DA, Figgs LW, Castro M. The relationship between school absence, academic performance, and asthma status. J Sch Health 2008;78:140-8.
15. Krenitsky-Korn S. High school students with asthma: Attitudes about school health, absenteeism, and its impact on academic achievement. Pediatr Nurs 2011;37:61-8.
16. Lindgren S, Lokshin B, Stromquist A, Weinberger M, Nassif E, McCubbin M, et al. Does asthma or treatment with theophylline limit children's academic performance? N Engl J Med 1992;327:926-30.
17. Okoromah NC. A Study of Bronchial Asthma among Primary School Children in Enugu Urban Area. Part 2. Fellowship Dissertation, National Postgraduate Medical College of Nigeria; 1995.
18. Falade AG, Olawuyi F, Osinusi K, Onadeko BO. Prevalence and severity of symptoms of asthma, allergic rhino-conjunctivitis and atopic eczema in secondary school children in Ibadan, Nigeria. East Afr Med J 1998;75:695-8.
19. Ezenwosu O, Emodi I, Ikefuna A, Chukwu B. Academic performance and intelligence scores of primary school-aged children with sickle cell anemia. Pediatr Hematol Oncol 2013;30:733-41.
20. Richard HW, Burlew AK. Academic performance among children with sickle cell disease: Setting minimum standards for comparison groups. Psychol Rep 1997;81:27-34.
21. Dolan CM, Fraher KE, Bleecker ER, Borish L, Chipps B, Hayden ML, et al. Design and baseline characteristics of the epidemiology and natural history of asthma: Outcomes and treatment regimens (TENOR) study: A large cohort of patients with severe or difficult-to-treat asthma. Ann Allergy Asthma Immunol 2004;92:32-9.
22. Patel PH, Welsh C, Foggs MB. Improved asthma outcomes using a coordinated care approach in a large medical group. Dis Manag 2004;7:102-11.
23. Perrin JM. Chronic illness in Children In: Kliegman RM, Arvin AM editors. Nelson's textbook of Paediatrics. 15th ed. Philadelphia: W.B Saunders Co; 1996. p. 124-7.
24. Oyedeji GA. Socio-economic and cultural background of hospitalized children in Ilesha. Niger J Paediatr 1985;12:111-7.
25. Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JT, Marcus P, et al. Development of the asthma control test: A survey for assessing asthma control. J Allergy Clin Immunol 2004;113:59-65.
26. Rimington LD, Davies DH, Lowe D, Pearson MG. Relationship between anxiety, depression, and morbidity in adult asthma patients. Thorax 2001;56:266-71.
27. Schatz M, Sorkness CA, Li JT, Marcus P, Murray JJ, Nathan RA, et al. Asthma control test: Reliability, validity, and responsiveness in patients not previously followed by asthma specialists. J Allergy Clin Immunol 2006;117:549-56.
28. Ebigbo PO, Izuora GI. Draw a Person Test – Standardization, validation and guidelines for use in Nigeria. Enugu: Chuka Printing Company Ltd.; 1981. p. 7-32.
29. William TO, Fall A, Eaves RC, Woods-Groves S. The reliability of scores for the draw-A-person intellectual ability test for children, adolescents and adults. J Psycoeduc Assess 2006;24:137-44.
30. Ibekwe RC, Ojinnaka NC, Iloeje SO. Academic performance of school children with epilepsy. J Coll Med 2008;13:18-22.
31. Ogunfowora OB, Olanrewaju DM, Akenzua GI. A comparative study of academic achievement of children with sickle cell anemia and their healthy siblings. J Natl Med Assoc 2005;97:405-8.
32. Weitzman M, Klerman LV, Lamb G, Menary J, Alpert JJ. School absence: A problem for the pediatrician. Pediatrics 1982;69:739-46.
33. Fajt ML, Wenzel SE. Asthma phenotypes in adults and clinical implications. Expert Rev Respir Med 2009;3:607-25.
34. Detjen P. Allergic bronchopulmonary aspergillosis. In: Lynch JP, editor. Immunologically Mediated Pulmonary Disease. USA: Lippincott Co.; 1991. p. 399-412.
35. Ezenwosu OU, Emodi IJ, Ikefuna AN, Chukwu BF, Osuorah CD. Determinants of academic performance in children with sickle cell anaemia. BMC Pediatr 2013;13:189.
36. Littlejohns P, Macdonald LD. The relationship between severe asthma and social class. Respir Med 1993;87:139-43.
37. Silverstein MD, Mair JE, Katusic SK, Wollan PC,

O'connell EJ, Yunginger JW. School attendance and school performance: A population-based study of children with asthma. J Pediatr 2001;139:278-83.

38. Gutstadt LB, Gillette JW, Mrazek DA, Fukuhara JT, LaBrecque JF, Strunk RC. Determinants of school performance in children with chronic asthma. Am J Dis Child 1989;143:471-5.

39. Le Louarn A, Schweitzer B. Relationship between asthma or asthma-related symptoms and school problems among French children attending kindergarten. Rev Epidemiol Sante Publique 2004;52:29-38.

40. Fowler MG, Davenport MG, Garg R. School functioning of US children with asthma. Pediatrics 1992;90:939-44.