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Screening the intelligence of primary school children using 'draw a person' test

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Objectives
The objective of this study was to screen the intelligence of primary school children using 'draw a person' (DAP) test in Berket El Sabaa district, Menoufia governorate.

Background
The significance of children's drawings has been explored extensively since the late 19th century, and they are thought to provide indications of visual-motor development, levels of cognitive functioning and intellectual maturity, projections of personality and self-concept, and assessments of emotional state and disturbances. Drawing is an activity that children tend to enjoy, and they willingly produce spontaneous scribbles and drawings from a young age.

Patients and methods
This study was carried out on 1000 apparently healthy, primary school children aged 6–12 years in Berket El Sabaa district, Menoufia governorate. All participants were subjected to adequate assessment of history and complete clinical examination. Parents were required to complete a questionnaire to collect data on telephone number, full name, date of birth, any serious medical problems in the past, as well as educational level of parents, father's occupation, family size, and family income to assess socioeconomic level, school achievement, and DAP test.

Results
The present study showed that 9.2% of children were highly intelligent, 71.9% had average intelligence, 10.6% of children had borderline intellectual function, and 8.3% of children had mild mental retardation. In addition, positive correlations were found between IQ levels and socioeconomic status, school achievement, residence, and sex. There was a significant negative correlation between IQ levels and children's BMI.

Conclusion
The DAP test can be a useful developmental screening device for pediatricians and alert them to the possibility of developmental disorders.

Keywords:
draw a person test, intelligence, school achievement, socioeconomic status

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Introduction

The assessment of intelligence has a long yet controversial history. However, in recent years, an area that has received more intense focus in the study of cognition has been the assessment of neuropsychological functioning in children and adolescents [1].

The draw a person (DAP) test was developed with an aim to supplement Stanford Binet intelligence tests with a nonverbal test. However, later on, it was found that the details that were contained in drawing a person were more useful; therefore, the first assessment tool through drawing was created by Florence Goodenough in 1926 and it was introduced as 'draw a man' test [2].

DAP test is a projective test that allows the examinee to respond to questions through drawings. Projective tests can be applied in various settings such as schools, corporate offices, and private practices to assess different psychological aspects including personality, family background, intelligence, physical and emotional abuse, depression, etc., [3].

A reason for this popularity is that researchers have found that scoring the developmental level of human figure drawings and counting the number of details portrayed provide successful indexes of children's levels of cognitive development and psychometric intelligence [4].

Patients and methods

We obtained approval from the Local Institutional Ethical Committee of Menoufia educational affairs, and written consents were obtained from the parents

of all participants. The study was carried out on 1000 apparently healthy primary school children aged 6–12 years in Berket El Sabaa district, Menoufia governorate. The following schools were included: Alnnahdat Primary School from an urban area and Kafr Aleem Primary School from a rural area; the study was carried out from September 2015 to May 2016.

Parents were sent a questionnaire through their children, which contained questions on telephone number, full name, date of birth, any serious medical problems in the past, as well as educational level of parents, occupation of the father, family size, and family income to assess socioeconomic status (SES) using the Abdel-Rasoul *et al.* [5] scoring system.

All study children were subjected to complete clinical examination to exclude any chronic clinical problems.

Anthropometric measures (weight and height) were also recorded. All measurements were obtained using the same type of apparatus and followed the same procedures.

Height was measured without shoes using a stadiometer, and the head was aligned so that the auditory canal and lower rim of the orbit were in a horizontal plane [6].

Weight was measured without shoes and in light clothing using LAICA (Barbarano Vicentino, Italy) digital scales 150 kg.

BMI was calculated using the following equation: BMI = weight (kg) divided by height (m^2) [7]. Participants were divided into BMI groups on the basis of WHO criteria: underweight, normal, overweight, and obese individuals [8].

DAP test

Children were seated at individual tables with enough space to draw. We provided the following before the test:

(1) The examiner made sure that all children understood the instructions and felt comfortable during the test
(2) Sufficient lighting was assured
(3) Noise, visitors, and other distractions were avoided.
(4) A pencil with soft lead and a sheet of white paper were provided
(5) The administrator requested all children to DAP, with no time limit [9]
(6) The administrator did not make any comment on the drawing or ask the child to correct certain details, as this is not an art lesson but an attempt to ascertain the child's concept of the human figure
(7) If any child refused to draw, he or she was encouraged, and was allocated another time for testing otherwise
(8) Raw scores were obtained and were then converted to IQ scores using the modified Harris scoring guide [10]
(9) For example, if a boy aged 8 years had a raw drawing score of 30, then the IQ score was 108, obtained using reference tables.

Statistical analysis

Results were statistically analyzed using SPSS (version 20; SPSS Inc., Chicago, Illinois, USA).

Two types of statistics were performed: descriptive and analytical.

Descriptive statistics are represented using percentages, means, and SD.

Analytical statics were carried out using Student's *t* test, one-way analysis of variance (*F* test), post-hoc test, and Spearman's correlation analysis. Student's *t* test was used to collectively indicate the presence of any significant difference between two groups of normally distributed quantitative variables. One-way analysis of variance (*F* test) was used to collectively indicate the presence of any significant differences between several groups of normally distributed quantitative variables. A post-hoc test was carried out after one-way analysis of variance (*F* test) or Kruskal–Wallis test to show significant differences between individual groups.

A *P* value less than or equal to 0.05 was considered statistically significant.

Results

In this study, 9.2% of children had gifted or superior intelligence, 71.9% had average intelligence, 10.6% had borderline intellectual function, and 8.3% of children had mild mental retardation (Table 1). Children who lived in urban areas had higher IQ levels (97.01 ± 16.48) in comparison with those who lived in rural areas (93.42 ± 17.06) (Table 2).

A strong positive correlation was found between SES and IQ levels: those with higher SES has

Table 1 Distribution of the studied children regarding IQ level

	n (%) (*n*=1000)
IQ level	
Mean±SD	95.24±16.86
Range	60-132
Classification	
Gifted and superior intelligence	92 (9.2)
Average intelligence (including high and low)	719 (71.9)
Borderline impaired	106 (10.6)
Mildly impaired	83 (8.3)

higher IQ scores (100.16 ± 15.57) in comparison with those with average (95.08 ± 17.03) and low SES (85.08 ± 14.40) (Table 3).

There was a positive correlation between IQ levels and school achievement: IQ level was significantly higher among those with grade 'A' school achievement (111.63 ± 8.78) than those with grades 'B' (101.91 ± 8.77), 'C' (83.87 ± 11.53), and 'D' (79.13 ± 21.36) ($P < 0.001$) (Table 4).

We also found that there was a significant negative correlation between BMI and children's IQ ($P < 0.001$): IQ level was significantly higher among those who were underweight (BMI = 100.20 ± 16.65) than those who were normal (BMI = 94.60 ± 16.51), overweight (BMI = 82.27 ± 13.76), and obese (BMI = 88.78 ± 16.20) (Table 5).

In addition, we found that IQ levels were higher among females (96.96 ± 17.69) than among males (93.63 ± 15.89) with a significant difference ($P = 0.002$) (Table 6).

Discussion

The assessment of intelligence has a long yet controversial history. However, in recent years, an area that has received more intense focus in the study of cognition has been the assessment of neuropsychological functioning in children and adolescents [1].

Many studies conducted all over the world to find the impact of various risk factors that affect child cognition, such as education, occupation, and income of parents, which are indexes SES, have been found to moderate the heritability of their children's intelligence [11,12].

Table 2 Distribution of residence regarding IQ level

	Residence (mean±SD)		*t*-test	*P*
	Rural (*n*=493)	Urban (*n*=507)		
IQ level	93.42±17.06	97.01±16.48	3.38	0.001

As there are a number of risk factors that contribute to cognitive achievement, examining these factors in a cumulative risk model may be valuable because cumulative risk may be more influential than any specific risk factor alone in predicting negative child development outcomes [13,14].

The cumulative risk model posits that negative developmental outcomes in children are a result of an accumulation in the number of risks a child is exposed to rather than the influence of any one risk factor [15].

Fabry and Bertinetti [16] found substantial and significant correlations between the number of details in DAP test results and Wechsler Intelligence Scale for Children-Revised (WISC-R) – performance IQ, verbal IQ, and general IQ, respectively – in 6–10-year-old children with behavioral and emotional problems.

This study revealed that the distribution of IQ levels among the studied sample showed that children with superior intelligence included 0.9% of the studied sample, high percentage of average intelligence was found in 71.9%, borderline intellectual function was found in 10.6%, and mild mental retardation was found in 8.3%, with a mean IQ of 95.24 ± 16.86, which is considered higher than Egyptian IQ scores measured by previous studies performed to assess international IQ of many countries worldwide. For example, according to Lynn and Vanhanen [17], in their study 'World ranking of countries by their average', the Egyptian mean IQ was 81, as measured by the WISC-R. This difference may be due to the change in the methodology used or may be due to the Flynn effect (the Flynn effect is the substantial and long-sustained increase in both fluid and crystallized intelligence test scores measured in many parts of the world from roughly 1930 until now). Attempted explanations include improved nutrition, a trend toward smaller families, better education, greater environmental complexity, and heterosis (the occurrence of offspring with more pronounced phenotypical traits by genetic mixing). Another proposition is the gradual spread of test-taking skills.

Table 3 Distribution of socioeconomic status regarding IQ level

	SES (mean±SD)			*F* test (*P*)	*Post-hoc* test
	Low[1] (*n*=185)	Average[2] (*n*=487)	High[3] (*n*=349)		
IQ level	85.08±14.40	95.08±17.03	100.16 ± 15.57	56.07 (<0.001)	<0.001 (1 vs. 2, 1 vs. 3, 2 vs. 3)

SES, socioeconomic status.

Table 4 Distribution of school achievement regarding IQ level

School achievements	*n*	IQ level (mean±SD)	*F* test (*P*)	*Post-hoc* test
D	115	79.13±21.36	346.96 (<0.001)	<0.001 (1 vs. 2, 1 vs. 3, 1 vs. 4, 2 vs. 3, 2 vs. 4, 3 vs. 4)
C	338	83.87±11.53		
B	336	101.91±8.77		
A	211	111.63±8.78		

Table 5 Distribution of body mass index regarding IQ level

BMI	*n*	IQ level (mean±SD)	*F* test (*P*)	*Post-hoc* test
Underweight[1]	246	100.20±16.65	19.39 (<0.001)	<0.001 (1 vs. 2, 1 vs. 3, 2 vs. 3) 1 vs. 4=0.004 2 vs. 4=0.128 3 vs. 4=0.140
Normal[2]	684	94.60±16.51		
Overweight[3]	51	82.27±13.76		
Obese[4]	19	88.78±16.20		

Table 6 Distribution of sex regarding IQ level

	Sex (mean±SD)		*t*-test	*P*
	Female (*n*=482)	Male (*n*=518)		
IQ level	96.96±17.69	93.63±15.89	3.12	0.002

Children who lived in urban areas had higher IQ levels in comparison with those who lived in rural areas; this indicates a strong, positive correlation between cognitive function and residence.This is in agreement with the study conducted by Emmett [18], who showed that rural school children obtained lower scores than urban children and that the spread in intelligence among them was also smaller. Tabriz *et al.* [19] and colleagues examined data on 1151 preschool children in both rural and urban areas of Iran who were aged 6 or 7 during 2009–2013. Their analysis found that children's IQ, as determined by the WISC-R administered as part of the study, was found to be positively correlated to living in metropolitan and urban areas and father's educational level.

These findings are not in agreement with the study by Breslau *et al.* [20], 'Stability and change in children's intelligence quotient scores', who found that IQ was lower among children living in urban areas than those in rural areas. Further studies directed to investigate the relationship between child IQ and area of residence may be helpful in recognizing residence-related causes that may affect IQ levels, such as nutritional status, quality of education, genetic admixture, pollution, etc.

Moreover, an also strong positive correlation was found between SES and IQ levels: children with higher SES scores had higher DAP test scores and IQ levels in comparison with those with average and low SES.

These results are in agreement with Fernald *et al.* [21], who found a positive correlation between SES and IQ levels: children with higher SES had higher IQ.

Children from disadvantaged family backgrounds score on average lower on intelligence tests than their high SES peers [22]. We think that this may be due to specific risk factors related to SES such as lack of family resources or parental support, which may lead to low IQ levels.

Ulrich *et al.* [23] found the mean correlation between cognitive ability and parental SES to be (P = 0.28), indicating a weak-to-moderate relationship. This finding is similar to that reported by the 1996 American Psychological Association task force report on intelligence. Given this correlation, the question arises as to whether it is IQ or SES that causes variation in the other variable. The answer is almost certainly both.

Another finding was the positive correlation between IQ levels and school achievement: children with higher school achievement had higher DAP test scores and IQ levels among the whole studied sample and vice versa.

Our study is in line with a study conducted in UK schools to relate scores of statewide standardized achievement tests to measures of cognitive skills in a large and representative sample of students in a city that includes traditional district, exam, and charter public schools. They found substantial positive correlations between cognitive skills and achievement test scores, especially in math. These correlations are consistent with previous studies relating working memory to academic performance (grades) in UK schools [24].

Laidra *et al.* [25] reported that student achievement relies most strongly on their cognitive abilities through all grade levels.

The was also a significant correlation between BMI and children's IQ: IQ level was significantly higher among those who were underweight (BMI = 100.20 ± 16.65) compared with normal (BMI = 94.60 ± 16.51), overweight (BMI = 82.27 ± 13.76), and obese (BMI = 88.78 ± 16.20) individuals.

Tabriz *et al.* [19] examined data from a sample of 1151 preschool children in both rural and urban areas of Iran who were aged 6 or 7 during 2009–2013. They found that a lower IQ score is associated with higher BMI. However, this relationship appears to be largely mediated by SES.

IQ levels were higher among females (96.96 ± 17.69) than among males (93.63 ± 15.89) with a significant difference (P = 0.002). This is in agreement with a meta-analysis of sex differences in scholastic achievement published in the *Journal of Psychological Bulletin*. This study found that females outperformed males in teacher-assigned school marks throughout elementary, junior/middle, high school, and at both undergraduate and graduate university levels [26].

Another study on intelligence found that girls' overall educational achievement is better in 70% of all the 47–75 countries that participated in the study [27].

On other hand, Lynn and Irwing [28] found that male and female mean IQ scores were almost equal below the age of 15, but males had higher mean IQ scores from age 15 onward.

In addition, Nisbet [29] found that there was no evidence of sex differences in the mean level of g factor or in the variability of g factor. Males, on average, excel on some factors and females on others.

Conclusion

From the results of the present study, the following can be concluded:

The IQ level of our studied group ranged from 60 to 132 with a mean of 95.24 ± 16.86; 71.9% of the studied group had average intelligence.

IQ scores obtained by DAP test were positively correlated with sex, area of residence, SES, and school achievement.

IQ levels obtained by DAP test were negatively correlated with BMI.

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Conflicts of interest

There are no conflicts of interest.

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