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Anthropometric Measures and IQ in Down Syndrome and Healthy Children: A Case Control Study

Nesreen Safwat El-Feel [a*], Heba El Sayed Dawoud [a], Rasha Ahmed El-Shafey [b], Ahmed Abdel Basset Abo El-Ezz [a] and Heba Saied El Mahdy [a]

[a] Pediatrics Department, Faculty of Medicine, Tanta University, Tanta, Egypt.
[b] Radiology Department, Faculty of Medicine, Tanta University, Tanta, Egypt.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: In humans, the most prevalent chromosomal disorder and most well-known cause of intellectual impairment is Down syndrome. Chromosome 21 trisomy is the main cause of it. This study's goal was to compare anthropometric measures and intelligence quotient (IQ) in Down syndrome and healthy children.
Methods: The study included 80 patients divided in to 2 groups: Group A patients: included Forty Down syndrome cases were recruited to the study, their age was between 6-15 years. Group B control: included Forty healthy children were enrolled to the study as a control group, their age and sex were matched with the Down syndrome group.
Results: There were significantly lower in DS group than Controls group as regards height and height z-score. There were significantly higher in DS group than Controls group as regards mean

**Corresponding author: E-mail: nesreensafwat2015@yahoo.com;*

BMI & BMI z-score. There were significantly higher in Controls group than DS group as regards head circumference. There was statistically significant difference between DS & control groups as regard weight status distribution. IQ was statistically lower in DS group than that of the control group.
Conclusions: DS children had lower IQ, height and head circumference with higher BMI and BMI z-score.

Keywords: IQ; down syndrome.

1. INTRODUCTION

In humans, the most prevalent chromosomal disorder and most well-known cause of intellectual impairment is Down syndrome. Chromosome 21 trisomy is the main cause of it. It causes a variety of systemic complications as a component of the syndrome [1].

Nearly every organ system is affected by the extra added chromosome 21, which has a broad range of phenotypic effects. These include altered physical characteristics, clinically substantial life course alteration (e.g., intellectual disability), and life-threatening complications. Down syndrome raises postnatal and prenatal morbidity and reduces fetal viability Children that are affected have delays in maturity, physical development, dental eruption, and bone development [2].

In 94 % of Down syndrome individuals, etiology is full trisomy 21 The remaining cases are accounted for by translocations (3.3%) and mosaicism (2.4%). De novo translocations account for around 75% of unbalanced translocations, whereas familial translocations account for about 25% [3].

To clarify how the Down syndrome gene acts, two distinct theories have been put forward.: Gene dosage effect and developmental instabilities (i.e., lack of chromosomal balance). The gene dosage effect theory suggests, In the cells and tissues of individuals with Down syndrome, the genes on chromosome 21 are overexpressed, which leads to the phenotypic anomalies [4].

The most prevalent intellectual disability genetic cause, Down syndrome (trisomy 21), is linked to deficits in language, cognition, memory, and learning. All individuals with DS have cognitive impairment. The majority of adults and children with DS have mild to moderate intellectual impairment. Approximately 10% have just a low average-borderline intellectual impairment. A small percentage of people develop profound or severe cognitive deficits. The range of intelligence quotient (IQ) score among DS patients is about 50, with individual scores between 30 to 70. People with DS induced by mosaicism for trisomy 21 have higher cognitive ability [5].

The study's aim was to compare anthropometric measures in addition to IQ in Down syndrome and healthy children**.**

2. METHODOLOGY

This case control study was conducted at Genetics Unit, Pediatric Department, Tanta University after approval faculty of medicine and parental consent. The study included 80 patients divided in to 2 groups: Group A patients: included Forty Down syndrome cases were recruited to the study, their age was between 6-15 years. Group B control: included Forty healthy children were enrolled to the study as a control group, their age and sex were matched with the Down syndrome group.

Inclusion criteria: Any case diagnosed as Down syndrome with age between 6-15 years.

Exclusion criteria: Any Down syndrome patient with complex congenital heart disease, congenital brain anomalies, history of perinatal asphyxia, suspected metabolic disease, epilepsy, suspected psychological disorders (attention deficit hyperactivity disorders using Vanderbilt ADHD Diagnostic Rating Scale (VADRS) & autistic spectrum disorders using Childhood Autism Rating Scale (CARS) and children with known endocrinal disorders as hypothyroidism or diabetes mellitus.

All patients included in this study were subjected to complete medical history including prenatal history, natal history and postnatal history. clinical examination including general examination, features of down syndrome, cardiac examination, chest examination, abdominal examination and neurological assessment. Routine investigations: including laboratory, imaging, electrophysiological and intelligence quotient (IQ).

2.1 Statistical Analysis

Data were analyzed using SPSS version 20. Qualitative variables were recorded as frequencies and percentages and were compared by Chi-square test. Quantitative variables were presented as means ± standard deviation (SD) and were compared by Student t-test. P value < 0.05 was significant.

3. RESULTS

There was no significant difference between DS group and control group as regard the age & sex. Table 1.

There was no significant difference between DS group and control group as regard the Mean weight and weight z-score. There were a significantly decrease in DS group than Controls group as regards Ht. and Ht. z-score (P<0.001). There were significantly higher in DS group than Controls group as regards mean BMI & BMI z-score (P<0.001). There were significantly higher in Controls group than DS group as regards HC (P<0.001) Table 2.

There was statistically significant difference between DS & control groups as regard Wt. status distribution table.

IQ was statistically lower in DS group than that of the control group table.

Table 1. Demographic data of the studied groups

		DS group (n = 40)	Controls group (n = 40)	Test	P-value
Age (Years)	**Range**	6 - 15	7 - 15	T = 0.250	0.803
	Mean ±SD	10.85 ± 2.723	10.7 ± 2.643		
Sex	**Male**	28 (70%)	24 (60%)	X^2 = 0.879	0.348
	Female	12 (30%)	16 (40%)		

Table 2. Anthropometric measurements of the studied groups

Anthropometric measures		DS group (n = 40)	Controls group (n = 40)	Test	P-value
WT (Kg)	**Range**	20 - 63	25 - 85	T =0.368	0.714
	Mean ±SD	42.450 ± 15.088	41.100 ± 17.602		
WT (Kg) Z-score	**Range**	-0.39 - 1.52	-0.04 - 2.21	T = -0.145	0.885
	Mean ±SD	0.524 ± 0.599	0.543 ± 0.608		
HT(m)	**Range**	1.05 - 1.48	1.13 - 1.62	T = -3.090	0.003*
	Mean ±SD	1.272 ± 0.110	1.371 ± 0.171		
HT(m) Z-score	**Range**	-2.26 - 0.57	-0.13 - 2.87	T = -9.665	<0.001*
	Mean ±SD	-0.817 ± 0.808	1.028 ± 0.897		
BMI	**Range**	17.8 - 34.9	18.5 - 33.62	T = 3.669	<0.001*
	Mean ±SD	25.472 ± 6.446	20.965 ± 4.333		
BMI Z-score	**Range**	-0.08 - 2.19	-0.53 - 1.54	T = 5.077	<0.001*
	Mean ±SD	1.035 ± 0.713	0.265 ± 0.641		
H.C. (cm)	**Range**	47 - 53	50 - 54	T = -8.799	<0.001*
	Mean ±SD	49.450 ± 1.518	52.100 ± 1.150		

Table 3. Anthropometric measurements of the studied groups

Weight status	DS group (n = 40)	Controls group (n = 40)	Test	P-value
UW	4 (10%)	0 (0%)	X^2 = 0.879	0.348
NW	16 (40%)	36 (90%)		
OW	6 (15%)	0 (0%)		
Obese	14 (35%)	4 (10%)		

UW: underweight, NW: normal weight, OW: overweight

Table 4. I.Q Distribution of the studied groups

		DS group (n = 40)	Controls group (n = 40)	Test	P-value
I.Q	**Range**	55 - 79	90 - 100	T = -24.894	<0.001*
	Mean ±SD	68.450 ± 6.114	94.725 ± 2.679		

4. DISCUSSION

The most common chromosomal anomaly in humans, Down syndrome (DS) affects between 1 in 400 and 1500 newborns, based on the mother's age and prenatal screening protocols [6].

DS is the most prevalent genetic cause of cognitive disability worldwide, and a significant portion of patients also have a variety of other health problems, including as heart anomalies, haematological diseases, and premature Alzheimer disease [7].

The smallest human autosome, chromosome 21, has 48 million nucleotides and represents around 1-1.5 percent of genome of human. 21q and 21P are each 33.5 Mb and 5–15 Mb in length, respectively. Chromosome 21 is thought to contain more than 400 genes [6].

Long terminal repeats (LTRs), short interspersed repetitive elements (SINEs), and long interspersed repetitive elements (LINEs) make up 40.06 percent of chromosome 21's repeat content (LTRs) [8]. The gene-dosage hypothesis, which claims that all alterations are brought on by the addition of an extra copy of chromosome 21, is the most widely accepted explanation for the pathophysiology of trisomy 21 [9].

Our results were in agreement with Williams [10] who reported that height growth is slower, as a consequence, adults tend to be short in stature.— Men's average height is 154 cm (5 foot 1 in), while women's average height is 142 cm (4 foot 8 in). As people age, those with Down syndrome have a higher risk of becoming obese [11].

45 original research publications published from 1988 to 2015 were picked from a total of 4280 studies, Bertapelli et al. [12] found that early infancy is when obesity often begins., and upwards to 50% of people could be obese. it is thought that obesity and decreased metabolic rate are related.

The mixed prevalence of obesity and overweight ranged between studies between 23% - 70%. Young people with Down syndrome exhibited a greater prevalence of obesity and overweight than young people without Down syndrome. Increased leptin, lower resting energy expenditure, comorbidities, a poor diet, and insufficient physical exercise were all likely contributors to obesity. Obesity was strongly correlated with gait problems, dyslipidaemia, hyperinsulinemia, and obstructive sleep apnoea. Most obesity prevention and control interventions relied on exercise-based programmes, which were insufficient to cause weight reduction or fat loss [12].

As regard to intelligence quotient (IQ), this study showed significant reduction in IQ in children with DS relative to normal children, IQ of DS children was between (55- 79) so they have mild degree of intellectual disability.

This was in agreement with Rachidi and Lopes [5], who noted that Every DS patient has some level of cognitive impairment. Most adults and children with DS have mild to moderate intellectual impairments. A relative low borderline level of intellectual impairment affects 10% of the population. A small percentage of people have profound or severe cognitive deficits. The range of IQ score among DS patients is about 50, with individual results ranging from 30 to 70. Also, it agreed with Lanfranchis et al's findings that there is significant variation in cognitive capabilities both between and within individuals, and that practically all people with Down syndrome (DS) have an intellectual disability (ID; mean IQ is about 50). decision-making function, language , and memory are three cognitive functions that are significantly impacted [13].

This was also in agreement with Reilly [14] who stated that The majority of people with Down syndrome exhibit mild (IQ: 50–69) or moderate (IQ: 35–50) intellectual disabilities, however others have more serious difficulties (IQ: 20–35). The average IQ of people with mosaic Down syndrome is 10 to 30 degrees better. Individuals with Down syndrome often do worse as they mature than their peers of the same age [15]. This was in agreement with Huang et al. [16].

They conducted research on 19 persons without dementia who had trisomy 21 Down syndrome and were recruited from family or group homes.

These participants were split into two age groups: those under 40 and those over 40.

The eight young people had an average age of 35 years (SD=4, range=28-39), including six males and two women.

The 11 older individuals had a mean age of 47 years (SD=6, range=42-62) and were made up of

four males and seven women.; 6 of these patients were above 45 years old The variation of ages (t=0.03, df=34, n.s.) and genders (2=0.1, df=1, n.s.) did not differ between the two groups. Throughout this study, the occipital area of the adults with DS had considerably higher concentrations of compounds that contain choline than the comparison individuals, which was consistent with our findings.

Limitations of the study was the small sample size and being a single center.

5. CONCLUSIONS

DS children had lower IQ, height and height z-score with higher BMI and BMI z-score.

CONSENT

As per international standard or university standard, parental written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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