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Cerebral palsy in Al-Quseir City, Egypt: prevalence, subtypes, and risk factors

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Abstract: Cerebral palsy (CP) is the most frequent cause of motor handicap. The present door-to-door survey was conducted in Al-Quseir City, Egypt, to investigate the epidemiology of CP. All inhabitants were screened by three neurologists. Medical and neurological examinations were performed for all residents and suspected cases of CP were confirmed by meticulous neurological assessment, brain magnetic resonance imaging, electroencephalography, and testing with the Stanford-Binet Intelligence Scale. Forty-six of 12,788 children aged ≤18 years were found to have CP, yielding a childhood prevalence of 3.6 (95% confidence interval 1.48–2.59) per 1,000 live births. Five adults (aged 19–40 years) among 13,056 inhabitants had CP, giving an adult prevalence of 0.4 (95% confidence interval 0.04–0.72) per 1,000. The risk factors for CP identified in this study were premature birth, low birth weight, neonatal jaundice, neonatal seizures, and recurrent abortion in mothers of children with CP.

Keywords: cerebral palsy, prevalence, subtypes, risk factors, Egypt

Introduction

Cerebral palsy (CP) is essentially a permanent disorder affecting movement and posture, causing limitations in activity due to nonprogressive disturbances that occur in the developing fetal or immature infant brain.[1] CP is one of the most common causes of physical disability in childhood, with a reported prevalence of approximately 1.5–3 per 1,000.[2–4] El-Tallawy et al reported that 52 of 25,540 children in Al-Karga District, Egypt, had CP, giving a prevalence of 2.04 (95% confidence interval 1.48–2.59) per 1,000 live births.[5] The subtypes and severity of CP vary between studies, as does the proportion of patients with associated impairments, and this variation is likely to be due to differences in the diagnostic criteria and classification used.[6]

Surveillance of Cerebral Palsy in Europe has agreed on a definition of CP, and has suggested a revised classification of subtypes that may be less dependent on subjective judgment.[7] Although the precise number of adults with cerebral palsy is not known,[8] it was estimated in 1990 that 90% of children with cerebral palsy survived until the age of 20 years.[9]

CP is associated with prenatal, perinatal, and neonatal risk factors.[10,11] Premature birth is recognized as the main risk factor for CP, while perinatal asphyxia accounts for less than 10%–20% of cases.[12] The aim of this study was to determine the prevalence and subtypes of CP and risk factors for the disease among children and adults in El-Quseir City, located in the Red Sea Governorate in Egypt.

Materials and methods

Study design

The study took the form of a door-to-door survey (every household included) among the population of Al-Quseir City, and was approved by the ethics committee of Assiut

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University. Informed written consent was obtained from the Health Institute of the Red Sea Governorate and from the responsible person in each patient's family.

Case ascertainment and classification

CP is divided into spastic, dyskinetic, and ataxic subtypes.[7] The spastic subtype is further divided into a hemiplegic or unilateral type (limb involvement on one side of the body) and a bilateral type (limb involvement on both sides of the body). In this study, the spastic bilateral type was further subdivided into quadriplegia and diplegia.[5]

Participants and recruitment

All individuals who had been living in Al-Quseir City for at least 6 months at the time of interview were included as a sampling frame to identify the potentially eligible population of children and adults with CP in the defined area. Screening of all households was done using a simple standardized Arabic screening questionnaire designed specifically for this study to identify neurological disorders including CP, as described previously.[5] CP, according to Andersen et al[7] comprises a group of permanent and nonprogressive disorders of movement and posture caused by a lesion, damage, or dysfunction of the central nervous, originating early in life. In the second stage of the study, suspected positive cases of CP were invited to attend Al-Quseir Hospital, where they underwent meticulous medical and neurological evaluation using a specifically prepared sheet.

Interictal electroencephalography and computed tomography head scans or cranial magnetic resonance imaging (MRI) findings were evaluated in all subjects with CP. Cranial computed tomography was performed with 1 cm thick slices using a Radix Turbo scanner (Hitachi, Tokyo, Japan), brain MRI was done with T1-weighted and T2-weighted axial and coronal images and T1-weighted sagittal images using a Picker 1 Tesla Vista HPQ (Picker Corporation, New York, NY, USA).

Associated impairment

Cognitive development was assessed using the standardized, validated Arabic version[13] of the Stanford Binet Intelligence Scale (Fourth Edition).[14] Total intelligence quotient (IQ) was classified according to Melika[13] as: mentally retarded (IQ ≤67), slow learner (IQ 68–78), below average intelligence (IQ 79–88), average intelligence (IQ 89–110), above average intelligence (IQ 111–120), high intelligence (IQ 121–131), and genius (IQ ≥132). Stanford Binet Intelligence Scale testing was done in only 24 of 51 patients (47.05%). IQ assessment was not done in 15 children who were under the age of 4 years, in five who refused to take the test, and in a further seven who were deaf mute.

Epilepsy was diagnosed on clinical grounds and on electroencephalographic changes. The diagnosis was confirmed according to Commission of Classification and Terminology of the International League against Epilepsy.[15] Active epilepsy is considered to exist when two or more unprovoked seizures have occurred during the previous year.[5,7]

Risk factors

A structured questionnaire was completed on direct interview with the responsible personnel in each family. Perinatal data were obtained, including toxemia of pregnancy, toxins, and maternal exposure to radiation, medication, or trauma during pregnancy.[5,12,16–19] A detailed pregnancy history was taken and any complications at delivery were noted. Complications in the neonatal period, such as premature labor, low birth weight, and neonatal jaundice, seizures, or cyanosis, were also taken in consideration. In addition, data on any history of previous abortion, family history of similar conditions, parental consanguinity, and parental age at delivery were collected for children with CP. We then applied the same questionnaire in a control group comprising 180 healthy children matched for age, sex, educational level, and socioeconomic status from the same population.

Sample size

In total, 33,285 residents of Al-Quseir City were screened. 12,788 were children (≤18 years of age), resident in the area of the study; all were included in this study. 13,056 were adult (19–40 years) inhabitants. No case was recorded in the age group of more than 40 years (7,441).

Study area

The Red Sea Governorate is the largest governorate in Egypt. All its cities lie directly on the Red Sea. The study area of Al Quseir City is one of largest cities of the Red Sea Governorate, which has a land surface area about 119,000 km².[20]

Statistical analysis

SPSS version 16 (SPSS Inc., Chicago, IL, USA) was used for the data analysis. Prevalence rates are presented with exact binomial 95% confidence intervals. The chi-squared test, independent-samples *t*-test, and one-way analysis of variance followed by the post hoc test (least significant difference) were used

to analyze differences in proportions between groups. A *P*-value <0.05 was considered to indicate a statistically significant difference.

Results

Detailed demographic data on CP, MRI findings, subtype of CP, and IQ are shown in Table 1. The lifetime prevalence of CP per 1,000 live births is shown in Table 2. Of the 12,788 children aged ≤18 years, 46 were diagnosed to have CP, yielding an age-specific prevalence rate of 3.6 per 1,000 live births. Five of the 13,056 adults were diagnosed to have CP, yielding an age-specific prevalence rate of 0.4 per 1,000. In our study, there were no adult cases aged 40 years or older. Prematurity was the most significant risk factor for CP when compared with the control group; this and other risk factors are shown in Table 3. The prevalence of CP in this study is compared with that in other studies worldwide in Table 4.

Discussion

CP is a complex disability syndrome that primarily involves impaired control of movement, and is frequently accompanied by lifelong neurological and psychosocial problems.[2] In this study, the prevalence of CP in children was 3.6 per 1,000, which is higher than that recorded in Al-Kharga, Egypt,[5] and in other studies worldwide.[1,5,7,21–24] The high prevalence of CP in our study area may be attributed to several factors. First, an improved survival rate of preterm and low birth weight infants has been reported.[25–27] Second, inclusion of mild CP cases in our study may have elevated the prevalence of CP, whereas other studies have focused only on "disabled" children. Third, a lack of neonatal intensive care facilities may have had an impact on local CP rates over time, but this influence is difficult to assess. Fourth, the prevalence of CP seems to have fluctuated over time, more than can be explained by simple random variation. This variation may be related to the level of health care and mortality rates in the study areas.[28]

In our study, the prevalence of CP in adults was 0.4 per 1,000. Evans et al[9] have reported a 90% survival rate in children with CP who were followed until the age of 20 years, but the precise number of adults with CP is not known.[8] According to our results, the prevalence of CP in children (3.6 per 1,000 live births) was higher than that in adults (0.4 per 1,000 live births). Unfortunately, there are no databases or reports in Egypt from which to obtain information on the number of children dying of probable CP annually, and the most serious cases are likely to die just after birth. In addition, increased survival rate of children with CP in recent years can be attributed to eating a well balanced diet. Children with profound mental retardation and multiple physical disabilities (including CP) did not survive to adulthood so easily in the past.[8] Further, adults with a disability may have left to look for work or seek other services outside the study area, so could not be included in our prevalence data.

Diplegia and quadriplegia, considered to be the most severe form of motor impairment arising from CP, was the most common subtype in our study (72.5%). That was followed by mixed type (23.5%), and ataxic type (3.9%). The proportion of children with various subtypes of CP in this study was similar to the proportions reported by other researchers.[5–7,29]

Active epilepsy was found in 47.1% and mental retardation in 37.7% of subjects with CP in this study. These high

Table 1 Age, sex, subtypes, active epilepsy, radiological and IQ of subjects with cerebral palsy

Variables	Subject data
Age (mean ± standard deviation)	10.3±6.8
Sex (n, %)	
Males	34 (66.7%)
Females	17 (33.3%)
Subtypes	
• Spastic	37 (72.5%)
• Mixed	12 (23.5%)
• Ataxic	2 (3.9%)
Active epilepsy (n, %)	24 (47.1%)
Abnormal MRI findings (n, %)	27 (52.9%)
Total IQ (n, %)	
Mentally retarded (≤67)	19 (37.3%)
Slow learners (68–78)	4 (7.8%)
Below average intelligent (79–88)	1 (2.0%)

Notes: Unless otherwise indicated, the data are expressed as the mean ± standard or number and percent. Spasticity include paraplegic (2 [3.9%]) hemiplegic (10 [19.6%]), and quadriplegic (25 [49%]) subtypes. IQ was only tested in 24 cases. Abnormal MRI findings refer to atrophic and white matter changes in the brain.
Abbreviations: IQ, intelligent quotient; MRI, magnetic resonance imaging.

Table 2 Age-specific prevalence of cerebral palsy per 1,000 population for both sexes

Type of CP	Cases (prevalence per 1,000)	95% CI
CP in children (of 12,788)	46 (3.6)	2.6–4.6
Males (of 6,621)	29 (4.4)	2.8–5.97
Females (of 6,167)	17 (2.8)	1.4–4.1
CP in adults (of 13,056)	5 (0.4)	
Males (of 6,286)	5 (0.8)	0.04–0.72
Females (of 6,770)	0	0.09–1.5

Notes: Values are shown as numbers of cases. Monte Carlo CIs are given at the 95% level.
Abbreviations: CP, cerebral palsy; CI, confidence interval.

Table 3 Maternal, prenatal, antenatal, and perinatal variables in children with CP and matched controls

	Cases n=51	Matched controls n=180	*P*-value
Prenatal complications	6 (11.8%)	14 (7.8%)	0.339
Cesarean section	6 (11.8%)	32 (17.8%)	0.394
Prolonged labor	4 (7.8%)	12 (6.6%)	0.758
Previous abortion	18 (35.3%)*	26 (14.4%)	0.002
Premature and low birth weight babies	18 (35.3%)*	18 (10%)	0.000
Neonatal seizures	8 (15.7%)*	5 (2.8%)	0.002
Jaundice	8 (15.7%)*	5 (2.8%)	0.002
Cyanosis of child at birth	11 (21.6%)	31 (17.2%)	0.538
Similar CP condition in family	4 (8.7%)	0	–
Consanguinous parents	10 (19.6%)	38 (21.1%)	1.000
Consanguinous paternal grandparents	10 (19.6%)	35 (19.4%)	1.000
Consanguinous maternal grandparents	10 (19.6%)	32 (17.8%)	0.837
Maternal age by year (mean ± SD)	27.9±7.5	27.8±5.99	0.817
Paternal age by year (mean ± SD)	36.76±10.117	34.33±9.31	0.131

Notes: Unless otherwise indicated, the data are expressed as mean ± standard deviation or number and percentage. Prenatal complications included toxemia of pregnancy, maternal medication, and exposure of mothers to radiation or trauma. *$P<0.05$.
Abbreviations: CP, cerebral palsy; SD, standard deviation.

rates could be explained by the fact that children with bilateral CP might suffer from extensive brain injury, including to the cortex, deep white matter, and central nuclei, and therefore are more liable to have mental retardation and epilepsy.[7,30]

Whether the insult producing CP acts during the peripartum period is a matter of speculation.[31] In this study, prematurity, low birth weight, recurrent abortion, neonatal seizures, and jaundice were significantly more common in the CP group than in the control group. This finding is consistent with other reports of significantly higher rates of prematurity and low birth weight in patients with CP.[18,31–33]

The prevalence of CP among preterm children has risen due to the effect of improved neonatal intensive care management during recent years, leading to increasing survival of children born extremely preterm.[34] Genetic factors are believed to play an important role in prematurity and CP generally.[23] Possible causes of CP related to early (premature) birth involve development of the brain. Babies born too early are at risk for intraventricular hemorrhage, ie, bleeding in the brain. Periventricular leukomalacia, which reflects injury to the white matter of the brain, is also more likely in babies born prematurely than in those born at term. Both intraventricular hemorrhage and periventricular leukomalacia increase the risk of CP.[12,19] In addition, children born preterm have a combination of antenatal and perinatal risk factors, and possible combination of interdependent risk factors were observed more often.[32] Therefore, early intervention programs such as the massage intervention developed by Guzzetta et al[35] based on manipulation of the extrauterine environment, have been used in preterm infants with the aim of improving development and functional outcomes.

Jaundice is caused by excessive bilirubin in the blood. Normally, bilirubin is filtered by the liver. However, it takes a few days for the neonatal liver to start doing this effectively, so it is not uncommon for infants to have jaundice for a few days after birth. In most cases, jaundice can be treated successfully with phototherapy and have no lasting health effects. However, in rare cases, severe untreated jaundice can

Table 4 Worldwide prevalence of cerebral palsy

	Place of study	Study cases (n)	Study year(s)	Prevalence rate per 1,000
El-Tallawy et al (present study)	Al-Quseir City, Egypt	12,788	2010–2011	3.6
El-Tallawy et al[5]	Al-Kharga District, Egypt	25,540	2007–2009	2.03
Park et al[1]	South Korea		2011	2.6
Surveillance of Cerebral Palsy in Europe[22]	Europe		2002	2.08
Andersen et al[7]	Norwegian		2006	2.10
Cans et al[28]	Northern Ireland		2002	2.26
Cans et al[28]	Scotland		2002	1.62
Stanley et al[23]	Developing countries		2000	1.5–5.6
Stanley et al[23]	Developed countries		2004	2.0–2.5
Al-Rajeh et al[24]	Saudi Arabia	202	1995	0.70

damage brain cells.[36] Prolonged jaundice may be responsible for CP.[36] Meconium staining of the amniotic fluid is likely to indicate intrapartum hypoxia, and is more common in CP cases. We also found that meconium staining of amniotic fluid was more frequent in children with CP. Jaundice was also significantly more common in CP cases, and given that jaundice is treatable, early treatment is advised to prevent CP. A neonatal seizure history was more common in children with CP in this study, again consistent with previous research.[33,37] Recurrent previous abortion was more common in mothers of CP cases than in those of controls. Recurrent previous abortion is considered to be a risk factor for CP and may increase the risk of preterm birth. This was in accordance with the finding of reviews in this century.[38,39] A review by Rooney and Calhoun[38] which included 49 meta-analyses, found that previous abortion increases the risk of preterm birth, and Thorp et al[39] also found a higher risk of premature birth in women with prior abortion.

Conclusion

The prevalence of CP in children (46/12,788) was 3.6 (95% confidence interval 2.6–4.6) per 1,000. The prevalence of CP in adults (five per 13,056) was 0.4 (95% confidence interval 0.04–0.72) per 1,000. The most common subtype was spastic. Significant risk factors of CP were prematurity and low birth weight, neonatal seizures, jaundice, and recurrent abortion in mothers of children with CP.

Disclosure

The authors report no conflicts of interest in this work.

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