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National Prevalence and Correlates of Autism: A Lebanese Cross-Sectional Study

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Abstract

Background: There is a lack of data regarding autism prevalence and factors associated with it in Arab Countries, especially in Lebanon. A study conducted in Beirut and Mount Lebanon governorates estimated the prevalence of Autism Spectrum Disorder (ASD) at 1.53% of children 16-48 months attending nurseries. This study aims at obtaining a total national ASD estimate and find factors associated with the disorder.

Methods: The methodology used to collect data at a national level consisted of administering the Modified Checklist for Autism in Toddlers (M-CHAT) for screening and a self-administered questionnaire for associated factors. The final sample included 1,373 children aged 16-48 months. Prevalence estimates and crude and adjusted Odds Ratios (ORs) with 95% confidence intervals (95% CI) were generated.

Results: ASD national prevalence is 1.48% with 95% CI (0.84, 2.12), with a 1.13 male/female ratio according to the M-CHAT. In the multivariable analysis, having an employed mother in the last year was protective against ASD (OR (95% CI): 0.36(0.14, 0.93)). Presence of delivery complications was a risk factor (3.58 (1.26, 10.15)). First/second born and moral support during pregnancy were protective, whereas mother not having a university education and family history of mental illness were risk factors. These variables were not significant in the multivariable analysis, probably due to small numbers.

Conclusion: This is the first study estimating ASD prevalence in the entire Lebanese population, a much needed step to know the magnitude of the disorder. More robust studies are needed to better understand this disorder and factors associated with it in Lebanon and the region that have distinct cultural/environmental characteristics.

Keywords: Autism spectrum disorder; Prevalence; Epidemiology; Lebanon; Risk/protective factors

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by weakened social communication and interactions, repetitive behaviors, limited interests and persistence on sameness [1]. Individuals with ASD have impaired emotion processes linked to social cognition and other emotional abnormalities [2]. The prevalence of Autism Spectrum Disorder (ASD) was found to vary in different regions and countries worldwide. A systematic review reported a global median prevalence of 62 per 10,000, since the year 2000 (noting that estimates from the majority of the worldwide population is lacking) [3]. Additionally, CDC figures report average prevalence of 100-200 per 10,000 in Asia, Europe and North America [4]. Nevertheless, recent studies show that reported ASD prevalence figures will likely decrease with changes in diagnostic criteria as per the Diagnostic and Statistical Manual (DSM)-5 [5-7]. The prevalence of Autism Spectrum Disorder (ASD) was 146 per 10,000 of children aged 8 years in the United States in 2012 [8]. Mandell and Lecavalier are skeptical about the methodology from which these estimates from the Centers for Disease Control and Prevention (CDC) were derived, since CDC clinicians assign the diagnosis based on ASD symptoms from patient charts and not in person [9]. In the Eastern Mediterranean Region (EMR), the few small scale studies on autism burden show a wide variation in prevalence estimates, ranging from 1.4 per 10,000 in Oman to 1,250 per 10,000 in Saudi Arabia [10-15]. These studies constitute the most recent evidence on ASD prevalence in the EMR. As for Lebanon, a low-to-middle income country, there are no national studies estimating the prevalence of ASD. A recent study in Beirut and Mount Lebanon governorates, found an estimated prevalence of ASD of 153 in 10,000 children aged 16-48 months in nurseries using the Modified Checklist for Autism in Toddlers (M-CHAT) screening instrument [16].

In recent years, ASD has globally gained increased interest and awareness. New evidence has contributed in reducing the gap between research and practice [3]. Though the increase in research and its multidisciplinarity are increasing autism understanding, varying diagnostic criteria and behavioral and genetic indicators make capturing the prevalence of ASD challenging [17]. As for ASD etiology, it is complex stemming from both genetic and environmental factors. The genetic component has a leading role in the pathophysiology of ASD. Recent studies are also examining environmental factors associated with this disorder [18]. Different pre and perinatal factors have been associated with ASD such prematurity, maternal exposure to air pollutants, lack of maternal supplementation in vitamins, infections during pregnancy, and pregnancy and delivery complications [18-23]. Parental history of mental illness, older parental age and socio-economic status were also associated with increased odds of ASD [19,24-26].

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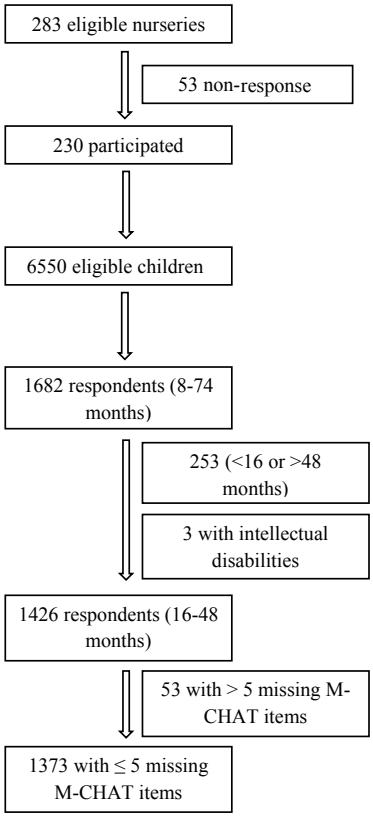
More importantly, there is an increased interest in understanding the gene versus environment interactions, hence a growing body of genetic epidemiology studies [27,28]. A twin study published in 2011 reported that environmental factors account for 55%-58% of the variance in the risk for autism [29]. Lebanon, has also witnessed an increase in autism awareness and public visibility, as evident by the growing body of Non-Governmental Organizations (NGOs) and treatment centers focused on autism. Little attention has been given to autism research in the EMR, with only 75 English manuscripts on autism from Arab countries published in international journals from 1992 to 2012 [30]. Although the highest proportion of nurseries in Lebanon is in these Beirut and Mount Lebanon governorates, children in nurseries located in remaining governorates might have different characteristics with respect to rates of consanguineous marriages, socio-economic status, rural versus urban settings, or culturally relevant behaviors. Assessing prevalence of ASD in these areas is of paramount importance and it provides a national estimate of ASD prevalence and allow comparison of prevalence across regions. The body of evidence on autism environmental factors in Lebanon is limited to one pilot case-control study [31]. A recent genetic study of the Lebanese population has identified new variants and susceptibility candidate genes that are specific to the Lebanese [32,33]. This is probably explained by high rates of consanguineous marriages and extensive shared ancestry in the Lebanese population, which further supports the importance of contextualized studies exploring factors associated with ASD. To address the above mentioned gaps in autism research, the main objective of the study is to assess the national prevalence of ASD in children 16-48 months attending nurseries. The second aim was to explore potential risk and protective factors that might be associated with the disorder in the Lebanese context.

Materials and Methods

Study design and sample

This is a national cross-sectional study of 1,373 children aged 16-48 months attending nurseries in all governorates. The sampling frame was a listing of nurseries registered at the syndicate of nurseries. All nurseries in Lebanon were contacted and all Lebanese children attending these nurseries were included. A total of 283 nurseries having Lebanese children aged 16-48 months were approached, out of which 230 agreed to participate in the study and these included 6,550 eligible children, as reported by nursery directors. Parents of eligible children were approached and 1,682 of them responded. The final sample size included 1,373 children who fit inclusion criteria (Figure 1). Data collection took place from February 2014 until January 2016 (February-September 2014 for Beirut and Mount Lebanon governorates and October 2015-January 2016 for the Bekaa, North and South governorates). Self-administered questionnaires were used for data collection. Consent forms and a document containing a description of main signs and symptoms with a listing of centers for autism diagnosis and treatment were also distributed to parents in an envelope by nursery directors at pick-up or drop-off of the child from the nursery. Consenting parents consisting mainly of mothers were those who returned a filled questionnaire to the



A: Non-response: Unreachable nursery directors after numerous attempts; nursery directors not able to decide whether to partake in the study; refusal to participate from directors

B: Number of eligible children as reported by nursery directors

Figure 1: Study participation flowchart for national ASD prevalence study.

nursery where a closed box was placed dedicated for this study. Boxes containing returned questionnaires were opened by researchers at the university. The study was approved by the Institutional Review Board (IRB) at the American University of Beirut (AUB) (number: BIOCh. RB.11).

Data collection tools and measures

Two self-administered tools were used for data collection: the Modified Checklist for Autism in Toddlers (M-CHAT) for ASD screening and a structured questionnaire for collecting data on potential ASD correlates. The questionnaire included information regarding pregnancy and delivery periods related to the index child (including gestational period, birth weight, complications during delivery and pregnancy, social support and others) and socio-demographic and behavioral attributes of the parents (educational level, smoking status during pregnancy, family history of mental disorders and others). The questionnaire also queried whether the child had been previously diagnosed with autism by a physician (Binary "Yes/No" question). The Arabic version of the M-CHAT was used. This version was validated using children aged 18 to 124 months, from nine different Arab countries including Lebanon and has a sensitivity of 0.86, a specificity of 0.80 and a positive predictive value of 0.88 [34]. For further methodological details, kindly refer to the Beirut and Mount Lebanon Study [16].

Statistical analysis

Data imputation was performed for those missing responses on 5 or less items of the M-CHAT amounting to 14.8 % of the sample. Missing items were replaced by the successful answer on this item (item not failed). Prevalence of ASD was computed as the product of the proportion who failed at least 3 of the 23 items (meaning that the child was potentially at risk of ASD) as per the latest recommendations, and the positive predictive value for the M-CHAT without a follow-up interview (0.058) [35-37]. Gender specific prevalence rates were generated with 95 % Confidence Intervals (95% CIs). Univariate analysis was conducted to describe the study population. As the M-CHAT only provides estimates regarding ASD prevalence and could not be used to explore factors associated with ASD, the binary question "Has the child been previously diagnosed with ASD by a physician?" was used when exploring risk/protective factors associated with the disorder. Pearson Chi-square tests and T-tests were used to assess the differences between those diagnosed with ASD and those not diagnosed with regards to potential risk and protective factors. Crude and Adjusted Odds Ratios (ORs) with their 95% CIs were generated for significant variables, having a p-value<0.05. Data was entered and analyzed using Epi Data 3.1 and the Statistical Package for the Social Sciences 23.0, respectively.

Results

descriptions of study population and ASD prevalence

Out of a total sample of 1,373 children, more than half went to nurseries in the Mount Lebanon governorate (56.9%), while 15.8%, 12.6%, 10.7% and 4.0% attended nurseries in Beirut, Bekaa, North and South governorates, respectively (Table 1). The population profile of children is presented in Table 2. Male children represented 55% of the study population. The mean age was 27.5 (± 6.9) months. The national Lebanese ASD estimate is 1.48% (95% CI: 0.84, 2.12) with a 1.13/1 male to female ratio, according to the M-CHAT results following correction (Table 1). Parents were also asked if their child had previously been diagnosed by a physician as being autistic and 22 (1.6%) responded affirmatively, with a male to female ratio of 2/1. Out of the 22 children diagnosed by a physician as having autism, 17 (77.3%) were captured by the M-CHAT.

Factors associated with ASD

Regarding child characteristics, only age and birth order associated with autism diagnosis were statistically significant (Table 2). Being aged 25-48 months with a third birth order or higher were more likely to have an autism diagnosis (0.004 and 0.010, respective p-values) in the bivariate analysis. Table 2 also examines the association between ASD diagnosis and pregnancy/delivery factors. Mothers who did not receive moral support during pregnancy and those who experienced any delivery complications were more likely to have a child with ASD (p-values: 0.045, 0.005). Table 3 examines ASD diagnosis and socio-demographic and behavioral variables of the parents. Having a family history of mental illness and a mother without a university education and/or who was unemployed were significantly associated with autism at p-values of 0.016, 0.002 and 0.003, respectively. Table 4 shows the crude and adjusted ORs for autism diagnosis with factors that were significantly associated with ASD at a p-value<0.05 in the bivariate analysis. Age was excluded as a variable since it was part of the inclusion criteria in the study. Presence of complications during delivery and being a working mother remained significantly associated with ASD in the offspring by multivariable analysis (respective ORs (95% CI): 3.58 (1.26, 10.15) and 0.36 (0.14, 0.93)). Though not all of the variables were statistically significant in the multivariable analysis, none of the ORs changed direction. Being first or second born, having a mother who had moral support during pregnancy and who was employed in the past year were protective against ASD. Having a mother who had experienced complications during delivery and who did not have a university education and a family history of mental illness were risk factors for ASD. Based on the statistical test for goodness of fit, the multivariable analysis model fits the data adequately.

	Prevalence ASD, according to M-CHAT N (%)	Prevalence ASD corrected and (95% CI) (M-CHAT prevalence x 0.058) %
Total (National)	350 (25.5)	1.48 (0.84, 2.12)
Gender		
Male	203 (26.8)	1.55 (0.67, 2.43)
Female	146 (23.7)	1.37 (0.45, 2.29)
Governorate		
Beirut	66 (30.4)	1.76 (0.01, 3.51)[a]
Mount Lebanon	197 (25.2)	1.46 (0.62, 2.30)[a]
Bekaa	28 (16.18)	0.94 (-0.50, 2.38)
North	39 (26.53)	1.54 (-0.45, 3.53)
South	20 (36.36)	2.11 (-1.69, 5.91)

a: Source: Chaaya et al. [16]

Table 1: Gender and governorate specific prevalence rates of ASD with 95% CI, national estimates.

Variables	Total N (%)[b]	Autism diagnosis[c] N (%)[b]	Non-autism diagnosis[c] N (%)[b]	p-value
Characteristics of the child				
Gender				
Male	749 (55.2)	15 (2.0)	734 (98.0)	0.131
Female	609 (44.8)	6 (1.0)	603 (99.0)	
Age				
16-24 months	521 (38.3)	2 (0.4)	519 (99.6)	0.004*
25-48 months	838 (61.7)	20 (2.4)	818 (97.6)	
Child birth order				
First or second	1204 (90.6)	15 (1.2)	1189 (98.8)	0.010[a]*
Third or later	125 (9.4)	6 (4.8)	119 (95.2)	
If not first born, years separating from older child (n=546)	3.3 ± 2.7[b]	4.2 ± 2.5[b]	3.3 ± 2.7[b]	0.660
Birth weight (grams, g) (n=1325)	3164.9 ± 536.2[b]	3112.1 ± 542.3[b]	3165.9 ± 536.8[b]	0.641
Number of gestational weeks (n=1126)	37.5 ± 2.6[b]	37.7 ± 2.3[b]	37.5 ± 2.6[b]	0.808
Breast feeding				
Yes	1065 (78.7)	19 (1.8)	1046 (98.2)	0.599[a]
No	289 (21.3)	3 (1.0)	286 (99.0)	
Duration of breast feeding (weeks) (n=1017)	20.6 ± 20.9[b]	26.9 ± 18.1[b]	20.5 ± 20.8[b]	0.207
Age at which child started taking other liquids and foods (n=1322)	5.4 ± 1.5[b]	5.3 ± 1.3[b]	5.4 ± 1.4[b]	0.668
Frequency pediatrician visit				
Less than once a month	434 (36.1)	5 (1.2)	429 (98.8)	0.686
At least once a month	769 (63.9)	11 (1.4)	758 (98.6)	
Age at first words (n=1245)	9.4 ± 4.3[b]	12.5 ± 8.5[b]	9.4 ± 4.2[b]	0.119
Factors related to pregnancy and delivery				
Medicine during pregnancy				
Yes	284 (21.4)	4 (1.4)	280 (98.6)	1.000
No	1041 (78.6)	16 (1.5)	1025 (98.5)	
Complications during pregnancy				
Yes	201 (15.0)	5 (2.5)	196 (97.5)	0.207
No	1136 (85.0)	15 (1.3)	1121 (98.7)	
Nausea/vomiting during pregnancy				
Yes	761 (57.0)	14 (1.8)	747 (98.2)	0.365
No	575 (43.0)	7 (1.2)	568 (98.8)	
Influenza virus infection during pregnancy				
Yes	234 (18.1)	5 (2.1)	229 (97.9)	0.349[a]
No	1056 (81.9)	13 (1.2)	1043 (98.8)	
Asthma or allergies in second trimester				
Yes	71 (5.4)	1 (1.4)	70 (98.6)	1.000[a]
No	1234 (94.6)	17 (1.4)	1217 (98.6)	
Moral support during pregnancy				
Yes	1183 (87.6)	16 (1.4)	1166 (98.6)	0.045[a]*
No	167 (12.4)	6 (3.6)	161 (96.4)	
Depression during pregnancy				
Yes	308 (22.9)	8 (2.6)	300 (97.4)	0.129
No	1039 (77.1)	14 (1.3)	1025 (98.7)	
Echography during pregnancy				
Yes	1236 (92.4)	18 (1.5)	1218 (98.5)	0.080[a]
No	102 (7.6)	4 (3.9)	98 (96.1)	
Type of delivery				
Vaginal	672 (49.4)	13 (1.9)	659 (98.1)	0.362
Ceasarean section	687 (50.6)	9 (1.3)	678 (98.7)	
Complications during delivery				
Yes	155 (11.6)	7 (4.5)	148 (95.5)	0.005[a]*
No	1185 (88.4)	13 (1.1)	1172 (98.9)	
Moral support during and after delivery				
Yes	1197 (88.5)	17 (1.4)	1180 (98.6)	0.098[a]
No	155 (11.5)	5 (3.2)	150 (96.8)	
Post-partum depression				
Yes	494 (37.0)	10 (2.0)	484 (98.0)	0.309
No	842 (63.0)	11 (1.3)	831 (98.7)	

a: fisher exact test
b: mean ± standard deviation, and p-value for independent samples t-test for continuous variables
c: Diagnosis is presented as reported in the questionnaire and not from M-CHAT estimates
*: significant at P<0.05

Table 2: Comparison between children diagnosed with autism and those not diagnosed, with regards to some characteristics of the child and factors related to pregnancy and delivery.

Variables	Total N (%)[b]	Autism diagnosis N (%)[b,c]	Non-autism diagnosis N (%)[b, c]	p-value
Mother age (in years) (n=1341)	30.7 ± 4.7[b]	30.4 ± 4.8[b]	30.7 ± 4.7[b]	0.781
Father age (in years) (n=1327)	35.7 ± 5.3[b]	37.0±6.3[b]	35.6 ± 5.3[b]	0.235
Mother highest educational level				
Below university	229 (16.9)	10 (4.4)	219 (95.6)	0.002*
University	1123 (83.1)	12 (1.1)	1111 (98.9)	
Father highest educational level				
Below university	525 (39.2)	10 (1.9)	515 (98.1)	
University	815 (60.8)	11 (1.3)	804 (98.7)	0.425
Mother's professional status, past 12 months				
Working	1023 (76.5)	11 (1.1)	1012 (98.9)	
Not working	314 (23.5)	11 (3.5)	303 (96.5)	0.003*
Mother's work requires spending time in front of computer				
Yes	726 (55.8)	8 (1.1)	718 (98.9)	
No	574 (44.2)	12 (2.1)	562 (97.9)	0.150
Father's work requires spending time in front of computer				
Yes	750 (56.4)	9 (1.2)	741 (98.8)	
No	579 (43.6)	12 (2.1)	567 (97.9)	0.206
Mother smoking (cigarettes and/or water pipe) before index pregnancy				
Yes	517 (38.4)	4 (0.8)	513 (99.2)	0.050
No	831 (61.6)	18 (2.2)	813 (97.8)	
Father smoked (cigarettes and/or water pipe) at home in front of mother, during index pregnancy				
Yes	281 (21.0)	7 (2.5)	274 (97.5)	0.176[a]
No	1059 (79.0)	14 (1.3)	1045 (98.7)	
Anyone else living with mother, smoked (cigarettes and/or water pipe) in front of her during index pregnancy				
Yes	174 (13.0)	5 (2.9)	169 (97.1)	0.167[a]
No	1162 (87.0)	15 (1.3)	1147 (98.7)	
Mother's co-workers smoked in front of her, during index pregnancy				
Yes	202 (15.9)	4 (2.0)	198 (98.0)	
No	1067 (84.1)	17 (1.6)	1050 (98.4)	0.762[a]
Use of contraception methods before index pregnancy				
Yes	183 (13.7)	2 (1.1)	181 (98.9)	
No	1156 (86.3)	17 (1.5)	1139 (98.5)	1.000[a]
Family members diagnosed with mental illness				
Yes	65 (4.8)	4 (6.2)	61 (93.8)	
No	1278 (95.2)	17 (1.3)	1261 (98.7)	0.016[a*]

a: fisher exact test
b: mean ± standard deviation, and p-value for independent samples t-test for continuous variables
c: Diagnosis is presented as reported in the questionnaire and not from M-CHAT estimates
*: significant at P<0.05

Table 3: Comparison between children diagnosed with autism and those not diagnosed, with regards to some socio-demographic and behavioral variables of the parents.

	Bivariate Analysis Crude OR (95%CI)	Multivariable Analysis Adjusted OR (95%CI)
Characteristics of the child		
Child birth order		
Third or later (reference)	1.00	1.00
First or second	0.25 (0.10, 0.66)	0.36 (0.11, 1.17)
Factors related to pregnancy and delivery		
Moral support during pregnancy		
Not present (reference)	1.00	1.00
Present	0.37 (0.14, 0.96)	0.40 (0.14, 1.20)
Complications during delivery		
Not present (reference)	1.00	1.00
Present	4.26 (1.68, 10.86)	3.58 (1.26, 10.15)
Socio-demographic and behavioral variables of the parents		
Mother's highest educational level		
University degree (reference)	1.00	1.00
Below university	4.23 (1.80, 9.91)	2.1 (0.79, 5.62)
Mother's professional status in the past 12 months		
Not working (reference)	1.00	1.00
Working	0.30 (0.13, 0.70)	0.36 (0.14, 0.93)
Family member(s) diagnosed with any mental illness		
No (reference)	1.00	1.00
Yes	4.86 (1.59, 14.89)	3.07 (0.78, 12.15)

Table 4: Factors associated with autism diagnosis according to bivariate and multivariable logistic regressions.

Discussion and Conclusion

The national ASD prevalence estimate (148 per 10,000 children aged 16-48 months) did not vary by much from the earlier estimate of 153 per 10,000 based on two Lebanese governorates using the same methodology [16]. This prevalence is comparable to the CDC figures of 146 per 10,000, but is much higher than the global median ASD prevalence of 62 per 10,000 [3,8]. This difference could be explained by the diverse methodologies used in these studies related to the diagnostic criteria, the age of children in the sample, country and rural/urban setting [38]. Prevalence according to parental reporting on diagnosis of their child with ASD was 160 per 10,000, slightly higher than the M-CHAT estimate. These findings might suggest better parental awareness in Lebanon compared to other Arab countries. Eapen et al. [13] determined that none of the preschoolers they identified as autistic had been diagnosed with autism prior to their study. Additionally, the male/female ratio of prevalence rates according to the M-CHAT was close to 1. It was 2, in those previously diagnosed with autism. These findings are consistent with those from the Beirut and Mount Lebanon study, in which an elaborate discussion and comparison with international evidence are detailed [16]. Few studies were conducted in Arab countries to explore genetic and autoimmune factors, effect of environmental toxins and nutritional deficiencies [30]. In this study we are comparing results of prenatal and perinatal factors to those from developed countries. Some of the findings in this current study were in accordance with other published results. Having family member(s) diagnosed with mental illness(es) was a significant risk factor for ASD. This reflects the strong genetic component of the disorder, which has already been identified in many studies [39,40]. Furthermore, parental smoking was not associated with autism in the current study. In fact, there is no conclusive evidence regarding smoking and increased risk of ASD. Tran et al. [41] found no association between maternal smoking and autism. Even though most prenatal and perinatal risk factors for autism did not show any significance in the multivariable analysis like in other studies, complications during delivery were highly significant at the bivariate and multivariable level in this current study [42]. Mothers' working status in the previous 12 months was protective against autism after controlling for birth order and family history of mental illnesses. This might actually be a consequence of autism diagnosis, noting that temporality could not be ascertained in cross-sectional surveys. Some of the factors associated with ASD in other studies did not exhibit statistical significance in our results. Unlike the case-control study conducted in Lebanon, male gender, older parental age and depression during pregnancy were not significantly associated with ASD in this study [31]. These differences might be due to various factors including sampling strategies, inclusion criteria and screening/diagnostic tools. Older parental age and male gender were found to be significantly associated with ASD in many international studies [25,42,43]. Unlike the international body of evidence, prematurity was not a significant factor in the current study [19]. A recent Canadian study conducted on 218,110 singleton live births found that the risk of ASD increases gradually with shorter gestational periods [44]. Finally, birth order is our study was protective for first or second born as compared to third or later, which is the opposite to results found in most international studies regarding first born being associated with a higher risk for ASD [26,42,43]. Findings from the current study are echoed by results from a study conducted by Moore et al. [20] that found the odds of for being autistic in those born third or later to be 3.18 times higher than the odds of being autistic for those born first. Additionally, preliminary results of an ongoing case-control study by our research team, clearly point to the fact that being born first or second is protective against ASD. This could be explained by differences in population characteristics and behaviors between the Lebanese and others. Durkin et al. [24] explained that parents of an autistic child not having subsequent children could potentially account for first-born children having an increased ASD risk.

Limitations

There are limitations to be considered when interpreting the findings of the current study. First, no ascertainment of autism diagnosis was conducted to properly assess risk and protective factors. The analysis from the study solely relies on reported ASD diagnosis by the parents. Second, the number of children with previous ASD diagnosis is very small (22 children) which might have negatively impacted significance of some of the factors. Third, the M-CHAT used for prevalence estimates is a screening tool and has low specificity [36,45]. Also, the fact that it was used without follow-up (as per the recommendations) reduces its psychometric characteristics' values. Moreover, the 0.058 PPV used to correct the M-CHAT estimates was taken from a particular study [37] and might not be generalizable across samples. However, given the cultural context and stigmatization of ASD, it was important to conduct a completely anonymous study and to account for possible shortfalls in methodology as much as possible. In fact, stigma associated with ASD diagnosis is a potential contributor to scarcity of studies in the Middle-East [46]. Fourth, given the cross-sectional nature of the study, temporality is hard to determine, and mothers of autistic children are more likely to remember factors associated with the disorder. Fifth, there might be issues with the representativeness of the data which might be due to the distribution of children in this study across governorates not being similar to the real distribution of children 0-4 years by governorates, parents' low response rate, and insufficient sample sizes in the Bekaa, North and South governorates to allow generation of governorate-specific prevalence rates [47]. These differences in distribution could be due to the difference in population age groups (0-4 years for the Central Administration of Statistics (CAS) distribution as compared to 16-48 months for this study). The CAS estimates include non-Lebanese residents, whereas only Lebanese children were included in the current study. Furthermore, parents of children in the current study have a higher educational level than in the general population [16]. This study is a much needed and long overdue first step in obtaining a national estimate for ASD in Lebanon. Nevertheless, more robust studies are needed to assess the prevalence, such as ones drawn from a national registry for autism and other associated disorders. Further scientific studies with more sophisticated designs are needed to better understand the different aspects of this disorder and factors associated to it.

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