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Advanced Maternal Age and Autism Spectrum Disorder: Evidence from a Clinical Study in Sulaimania, Iraq

Maryam Omar[1], *Daniel Hamid[1], Van Qadir[1]

1.Department of Psychiatry, College of Medicine, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq.

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ABSTRACT

Introduction:
Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition with multifactorial etiology. Advanced Maternal Age (AMA), defined as maternal age ≥35 years at childbirth, has been proposed as a potential risk factor for ASD. This study examined the association between AMA and ASD prevalence among children.

Materials and Methods:
An observational, cross-sectional study was conducted among 177 mother–child dyads referred to the Committee for Diagnosing Mental Health at Shaheed Hemin Hospital in 2023. ASD diagnoses were established by a multidisciplinary committee consisting of psychiatrists, a pediatric neurologist, a psychologist, and a special education expert, following standardized clinical criteria. Maternal age was categorized as Adolescent (<20 years), Ideal (20–34 years), or Advanced (≥35 years). Associations between maternal age group and ASD diagnosis were evaluated using Chi-square tests.

Results:
A statistically significant association was found between maternal age group and ASD diagnosis. A higher proportion of ASD cases occurred among children born to mothers aged ≥35 years. Males represented 83% of diagnosed cases, yielding a male-to-female ratio of 4.9:1, which was also statistically significant. The mean maternal age at childbirth was 31.0 years, and the mean child age at presentation was 6.7 years. The most frequent age at diagnosis was 6 years.

Conclusion:
This study demonstrates a significant association between advanced maternal age and increased ASD risk within a clinical cohort from the Kurdistan Region-Iraq. These findings contribute region-specific epidemiological evidence and underscore the importance of incorporating maternal age considerations into early ASD screening and counseling protocols in comparable populations.

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Corresponding author:
Department of Psychiatry, College of Medicine, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq.
E-mail: daniel.hamid@univsul.edu.iq

Introduction

Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental condition characterized by persistent deficits in social communication and interaction, accompanied by restricted and repetitive behaviors, interests, or activities (1).

The etiology of ASD is multifactorial, involving a complex interplay between genetic susceptibility and environmental influences during critical periods of brain development (2).

Among the demographic and environmental factors proposed to contribute to ASD risk, Advanced Maternal Age (AMA), commonly defined as maternal age ≥35 years at childbirth, has received growing attention in recent epidemiological research (3,4).

In parallel with rising global ASD prevalence, the proportion of pregnancies among women of AMA has also increased (5), driven by social and economic trends toward delayed childbearing and the expanding use of assisted reproductive technologies (6).

Pregnancies in women of AMA are associated with a higher incidence of adverse perinatal outcomes, including preterm birth, low birth weight, chromosomal abnormalities, and developmental complications (7-9).

Maternal health risks such as gestational diabetes, hypertensive disorders, and preeclampsia are also more common in this population (10). Evidence from large-scale studies supports a potential association between AMA and ASD (11).

Durkin et al. reported that mothers aged ≥40 years had a 51% higher likelihood of having a child with ASD compared with those aged 25–29 years (12).

Similarly, Sandin et al., in a meta-analysis encompassing over 8.6 million participants, found a 31% increased ASD risk among offspring of mothers aged ≥35 years (13). These findings reinforce a plausible biological link between advanced maternal age and neurodevelopmental vulnerability, potentially mediated by cumulative genetic mutations, epigenetic alterations, or age-related obstetric factors. However, the literature remains inconsistent.

Several population-based studies have failed to demonstrate a significant relationship between parental age and autistic traits. For instance, Robinson et al. found no association between maternal or paternal age and social-communicative deficits in a cohort of 5,246 children (14).

Likewise, a sibling-controlled analysis published in 2020 suggested that familial genetic factors, rather than maternal age itself, may account for the increased recurrence of ASD in later-born children (15).

Given these discrepancies and the near absence of data from the Kurdistan Region of Iraq, the contribution of AMA to ASD risk in this context remains uncertain.

Therefore, the present study investigates the association between maternal age and ASD diagnosis in a clinical cohort from Sulaimani City.

Materials and Methods

Study Design and Setting

This observational, cross-sectional study was conducted at the Committee for Diagnosing Mental Health Disorders of Children in Sulaimani (CDMHDCS), located within Shaheed Hemin Hospital for Mental Disorders, Sulaimani City, Kurdistan Region of Iraq.

The CDMHDCS is the only authorized governmental body responsible for official diagnoses of neurodevelopmental and psychiatric disorders in children under 18 years of age. Data were collected from routine diagnostic sessions held weekly between January 10 and December 12, 2023.

Study Population and Sampling

The study included 177 mother–child dyads in which the child had been formally diagnosed with autism spectrum disorder (ASD) during the study period. Of 208 eligible dyads registered with the CDMHDCS, 177 (85.1%) provided informed consent for inclusion. This was a descriptive, single-group study; no control group was included.

Inclusion and Exclusion Criteria

Inclusion criteria included: Child aged ≤18 years; Formal diagnosis of ASD confirmed by the CDMHDCS during 2023;

Written informed consent obtained from the mother for participation. Exclusion criteria included: Absence of ASD diagnosis, Lack of maternal consent, and incomplete demographic or clinical data. A total of 31 dyads were excluded solely due to lack of

consent; no participants were excluded based on diagnostic uncertainty.

Diagnostic Procedure and Variables

ASD diagnoses were established in accordance with the DSM-5 criteria [American Psychiatric Association, 2013]. Each child underwent comprehensive evaluation by a multidisciplinary committee comprising two child psychiatrists, one pediatric neurologist, one clinical psychologist, and one sociologist specializing in special education. The diagnostic process included a detailed developmental history, structured parental interviews, and direct behavioral observation. Although structured instruments such as the Autism Diagnostic Observation Schedule (ADOS-2) were unavailable due to resource limitations, diagnostic consensus was achieved through collaborative team review, ensuring adherence to DSM-5 standards, a methodology validated in comparable regional studies (16).

The primary exposure variable was maternal age at childbirth, categorized as: Adolescent Maternal Age (<20 years), Ideal Maternal Age (20–34 years), and Advanced Maternal Age (AMA) (≥35 years). Secondary variables included the child's sex, maternal age at presentation, and child's age at diagnosis.

Data Collection

After obtaining oral and written informed consent (via telephone and in-person), data were extracted from CDMHDCS medical records. The following information was collected: maternal and child date of birth, child's sex, date of diagnostic presentation, and confirmed ASD status. Maternal age at childbirth and at presentation were calculated in years using recorded birth dates.

Statistical Analysis

All analyses were conducted using IBM SPSS Statistics version 26.0. Continuous variables (e.g., maternal age, child age) were summarized as means ± standard deviations and tested for normality. Categorical variables (e.g., maternal age group, child sex) were expressed as frequencies and percentages. Associations between categorical variables were evaluated using Chi-square tests, with Fisher's exact test applied where expected cell counts were <5. A two-tailed p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Ethical Committee of the College of Medicine, University of Sulaimani (Ref: REC-COM/2023/07). All study procedures complied with the Declaration of Helsinki. Written informed consent was obtained from all participating mothers after full explanation of study objectives, data confidentiality, and voluntary participation. All data were anonymized prior to analysis to ensure privacy and confidentiality.

Results

A total of 177 mother–child dyads with a confirmed diagnosis of Autism Spectrum Disorder (ASD) were included in the final analysis. Maternal age at childbirth was categorized into three groups: Advanced Maternal Age (AMA, ≥35 years), n = 53 (29.9%), Ideal Maternal Age (20–34 years), n = 121 (68.4%), and Adolescent Maternal Age (<20 years), n = 3 (1.7%). The distribution of ASD cases by maternal age group is presented in Figure 1. A statistically significant association was observed between maternal age category and ASD diagnosis, as determined by a Chi-square test, $\chi^2(2, N = 177) = 8.42$, $p = 0.014$. Children of mothers aged ≥35 years accounted for nearly one-third of all cases, a proportion exceeding what would be expected under uniform risk assumptions, particularly relative to the small adolescent group (1.7%).

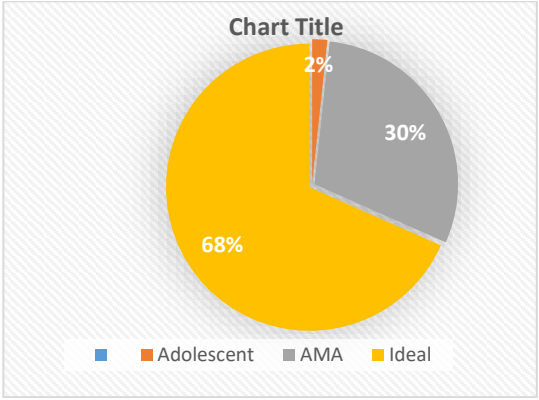

Figure 1: The relative percentage of ASD, separated into three maternal age groups

The year-by-year distribution of maternal age at childbirth (Figure 2) revealed a concentration of births during the early 30s, peaking at age 32 (n = 15), followed by a gradual decline toward both younger and older maternal ages.

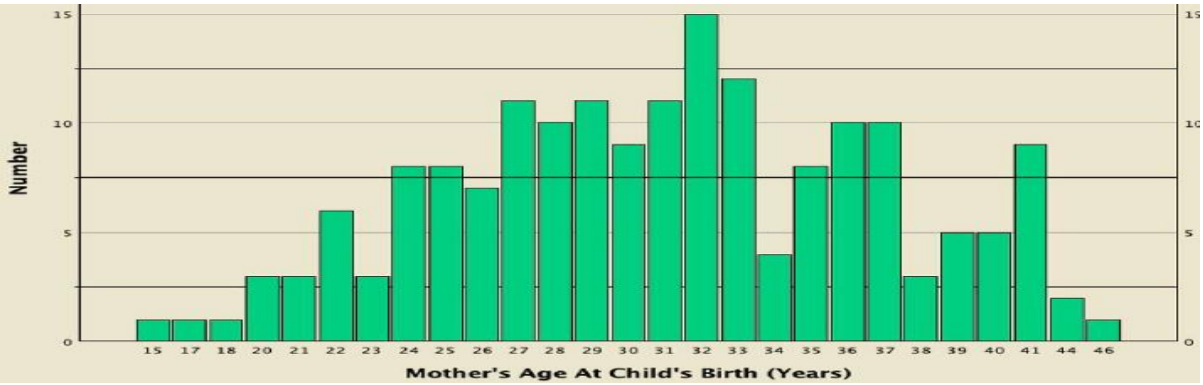

Figure 2: The most common maternal ages of mothers with ASD children

The distribution of maternal age at presentation (Figure 3) showed slightly higher frequencies within the 34–36 and 41–42-year intervals, with a modest dip between 37–39 years. This observation is reported descriptively and does not imply statistical bimodality, as no formal dip test was performed.

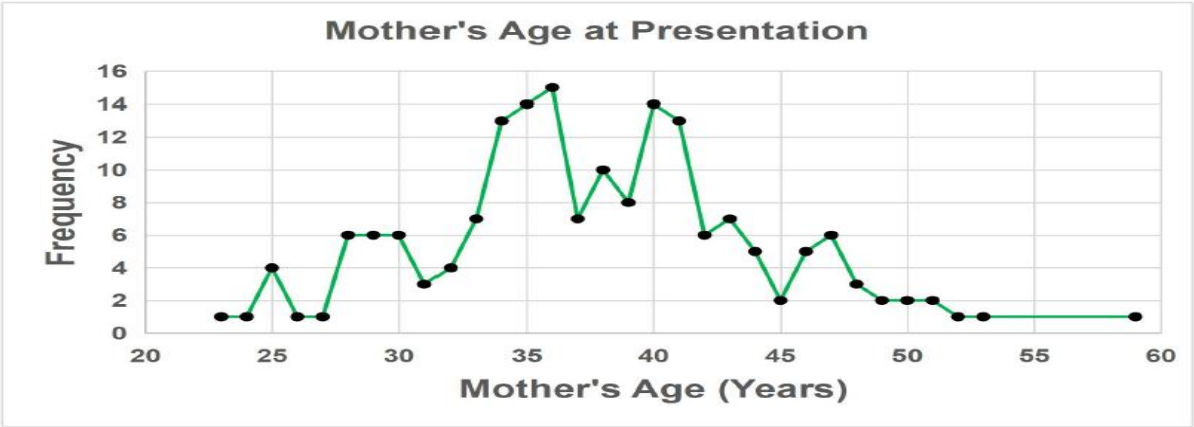

Figure 3: The mother's age at the time of presentation to the CDMHDCS.

The most frequent age at diagnosis was 6 years (n = 34), as illustrated in Figure 4, indicating the typical age of ASD recognition within the studied clinical population.

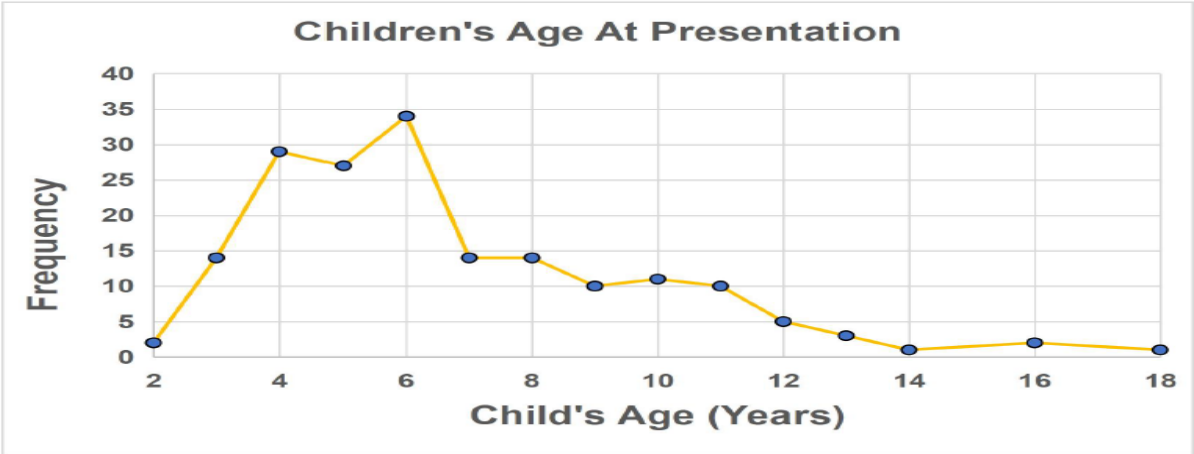

Figure 4: The most common children's age at the time of presentation to the CDMHDCS

Child sex also demonstrated a statistically significant association with ASD. Of the total sample, 147 children (83.0%) were male and 30 (17.0%) were female, yielding a male-to-female ratio of 4.9:1.

This sex difference was statistically significant ($\chi^2(1, N = 177) = 4.98$, $p = 0.026$) and consistent with the well-documented global pattern of male predominance in ASD (see Figure 5).

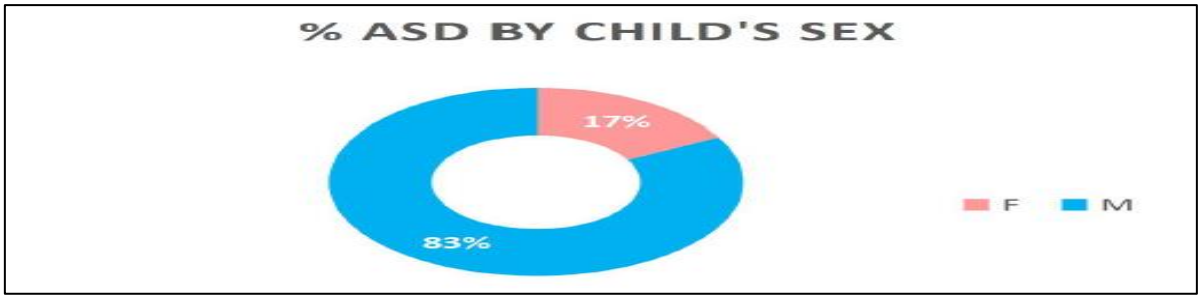

Figure 5: Gender distribution of children at the time of presentation to the CDMHDCS.

The mean maternal age at childbirth was 31.01 years (SD = 5.99), with a median of 31.0 and a mode of 32 years (Table 1).

Table 1: Maternal age at childbirth

Variable		
Maternal age at childbirth	Mean	31.01
	Median	31.00
	Mode	32
	Std. Deviation	5.987
	Range	31
	Minimum	15
	Maximum	46

Maternal ages ranged from 15 to 46 years. At the time of presentation to the CDMHDCS, the mean maternal age was 37.70 years (SD = 6.42), median 37.0, and mode 36 years (Table 2).

Table 2: Maternal age at presentation to the CDMHDCS

Variable		
Mother's age at presentation	Mean	37.7
	Median	37.00
	Mode	36
	Std. Deviation	6.418
	Range	36
	Minimum	23
	Maximum	59

Children's age at diagnosis ranged from 2 to 18 years, with a mean of 6.69 years (SD = 2.96), median of 6.0, and mode of 6 years (Table 3).

Table 3: Child's age at presentation to the CDMHDCS

Variable		
Child's age at presentation	Mean	6.69
	Median	6.00
	Mode	6
	Std. Deviation	2.956
	Range	16
	Minimum	2
	Maximum	18

Discussion

This study examined the association between maternal age at childbirth and the diagnosis of Autism Spectrum Disorder (ASD) among children referred to a specialized diagnostic committee in Sulaimani, Iraq. Within this clinical cohort, children born to mothers aged 35 years or older were disproportionately represented compared with those born to younger mothers, suggesting that advanced maternal age (AMA) may be linked, directly or indirectly, to ASD identification patterns in this regional setting. However, as a cross-sectional, hospital-based analysis, this study demonstrates association rather than causation, and its findings should not be interpreted as reflecting population-level ASD risk.

The observation that approximately 30% of ASD diagnoses occurred among children of AMA mothers appears higher than the 19.7% reported in a U.S. population-based surveillance study (17). Nevertheless, these values are not directly comparable. Our estimate reflects the proportion of AMA mothers within a clinical cohort of already-diagnosed children, whereas the U.S. figure represents population-level prevalence of ASD among all births. Such methodological distinctions are crucial: population-based data capture overall risk, whereas clinical samples particularly those from tertiary centers, reflect patterns of healthcare-seeking behavior and service access. Variables such as maternal education, socioeconomic status, and health literacy each correlated with age, may increase the likelihood of diagnostic referral among older mothers (18, 19), thereby influencing the observed association.

The mean maternal age at childbirth (31.0 years) observed in this study is higher than earlier regional estimates (16) but aligns with more recent ASD-specific cohorts (15). This may reflect a demographic transition toward delayed parenthood in Sulaimani, consistent with global trends linked to women's education, professional engagement, and advances in reproductive technology (6). The clustering of maternal presentation ages between 34–36 and 41–42 years may also reflect enhanced healthcare navigation skills or greater vigilance among older mothers, rather than an underlying biological predisposition. The mean child age at diagnosis (6.69 years) is consistent with international data (20) and corresponds to the early school years, when social-communication demands increase and autistic traits become more apparent (21). By contrast, later diagnostic ages reported in some European cohorts (22) highlight how variations in diagnostic infrastructure, cultural norms, and awareness levels influence when ASD is recognized and formally diagnosed.

The predominance of male cases (83%), yielding a male-to-female ratio of 4.9:1, aligns with global epidemiological patterns (13). This sex disparity may reflect both biological susceptibility and diagnostic bias, as girls with ASD are often underrecognized due to subtler symptom expression and better compensatory behaviors.

The observed association between AMA and ASD is consistent with several large-scale studies reporting a modest but significant elevation in ASD likelihood among older mothers (13). However, some research such as population-based analyses of autistic traits, has found no relationship between maternal age and ASD risk (14). Thus, our findings contribute regionally relevant evidence supporting an age-related pattern within a clinical population but must be interpreted in light of broader, heterogeneous literature.

From a biological standpoint, AMA is associated with increased rates of de novo germline mutations, chromosomal instability, and epigenetic alterations, as well as higher risks of obstetric complications including gestational diabetes and preeclampsia (5, 10, 13). These factors may plausibly influence neurodevelopmental trajectories; however, our study did not directly investigate these mechanisms. Hence, any such interpretation remains speculative and hypothesis-generating rather than confirmatory.

Several limitations merit acknowledgment. First, the hospital-based, cross-sectional design introduces potential selection bias, as families seeking specialized diagnostic evaluation may differ systematically from the general population, particularly in socioeconomic status or symptom severity.

Second, the absence of a control group and longitudinal follow-up precludes causal inference or assessment of developmental trajectories. Third, the study did not collect data on paternal age, familial ASD history, maternal medical or psychiatric conditions, or environmental exposures (e.g., air pollutants, heavy metals) factors known to influence ASD risk (23–27).

Finally, the lack of data on maternal education and socioeconomic variables limits interpretation of social determinants of diagnostic patterns (26).

Conclusion

This study identifies a significant association between advanced maternal age (≥35 years) and ASD diagnosis within a clinical cohort in Sulaimani, Iraq. The findings also reaffirm the pronounced male predominance in ASD, with males comprising 83% of diagnosed cases, a pattern consistent with international epidemiological data. While maternal age may represent one of several demographic correlates of ASD in this setting, it should not be interpreted as a causal determinant. Future research employing population-based designs, incorporating paternal and familial variables, and examining genetic and environmental influences is essential to elucidate the multifactorial etiology of ASD in this understudied region.

Availability of Data and Materials

The datasets supporting the conclusions of this article are included in the article's appendix.

Competing Interests

The authors declare that they have no competing interests.

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