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Research Article

Cognitive and Behavioral Development in Triplets and Twins: A Follow-Up Study

Eline Meireson, Msc[1,2*], Evert Thiery, MD PhD[3], Noortje van Oostrum, MD PhD[2], Kristien Roelens, MD PhD[1,2], Catherine Derom, MD PhD[2]

Abstract

Objective*:* Triplet pregnancies have a high risk of perinatal complications. While cognitive and behavioral challenges during childhood have been documented in twins, research on triplets remains limited. This prospective follow-up study aims to assess intellectual and behavioral abilities in triplets and twins.

Method*:* Intellectual and behavioral abilities were evaluated using the intelligence quotient (IQ) and child behavior checklist scores, respectively. First, we characterized these abilities within the triplet cohort. Second, we examined their association with birthweight and gestational age. Third, we compared those abilities between triplets and twins.

Results*:* A total of 52 triplet sets and 663 twin pairs participated. Among triplets, total IQ was positively associated with maternal socio-economic status and gestational age. Additionally, 13.57% of triplets exhibited a discrepancy of ≥ 20 points between verbal and performance IQ, potentially indicating a risk for learning difficulties. Comparative analysis revealed statistically significant differences in intellectual abilities between triplets and twins, dependent on maternal socio-economic status. Among children of mothers with lower socio-economic status, triplets scored significantly lower on IQ compared to twins. In contrast, no significant differences were found in the subgroup of mothers with high socio-economic status. Furthermore, no differences in behavioral abilities were found between triplets and twins.

Conclusion*:* Total IQ in triplets was positively associated with gestational age and maternal socio-economic status. Comparative analysis showed that triplets of mothers with lower socio-economic status had significantly lower IQ than twins. These findings underscore the pivotal role of maternal socio-economic conditions in shaping cognitive development. Ongoing longitudinal follow-up of the triplet cohort will further clarify developmental outcomes in adulthood.

Keywords: Triplets; IQ; Perinatal outcomes; Maternal; Belgium; Preterm birth; Early miscarriage Fetal; Triplets; Twins

Introduction

Triplet pregnancies in humans are rare, with an incidence of 0.003% in Belgium in 2024 [1]. They are associated with higher rates of morbidity and mortality compared to twin and singleton pregnancies [2-4]. The primary perinatal complications include low birthweight, preterm birth, early miscarriage, fetal growth restriction, and intrauterine fetal demise. The likelihood of these complications varies depending on gestational age and chorionicity, with a

Affiliation:
[1]Department of Obstetrics, Ghent University Hospital, Corneel Heymanslaan, Gent, Belgium
[2]Department of Human Structure and Repair, Ghent University, Corneel Heymanslaan, Gent, Belgium
[3]Department of Neurology, Ghent University Hospital, Corneel Heymanslaan, Gent, Belgium

***Corresponding author:**
Eline Meireson, Department of Obstetrics, Ghent University Hospital, Corneel Heymanslaan, Gent, Belgium.

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greater risk observed in those with shorter gestational age and those involving a monochorionic component [2,4-7]. Additionally, triplet pregnancies have an increased risk for aneuploidy compared to singletons [4].

Beyond the increased risk of perinatal complications, twins, compared to singletons, are at higher risk for cognitive delays, behavioral problems, cerebral palsy, and other developmental challenges in childhood and adolescence [8-14]. Also, twins show higher rates of intellectual disability and lower average IQ compared to singletons, with zygosity and chorionicity having minimal impact on the overall IQ [15]. The increased risk of long-term developmental problems in twins may be explained by the higher rates of preterm birth in twins [9,11,16], with the following contributing factors: low birthweight, shorter gestation, lower socio-economic status, and female sex [15].

Triplet pregnancies are associated with even lower birthweight and gestational age at birth than twins [17-19]. In contrast to twins, the available studies on long-term developmental outcomes in triplets are limited[8,12,13,20,21]. The ones available showed an increased risk of cerebral palsy and cognitive delay compared to twins and singletons [8,12-14,20-23]. However, these studies on long-term development often involved small sample sizes, included triplets born across a wide range of gestational ages or didn't adjust for gestational age, focused solely on triplets with very low birthweight, did not take the socio-economic status of the parents into account, or provided follow-up data limited to very young children (1-5 years)[8,12,13,20,21]. To the best of our knowledge, this is the first study that aims to address these gaps by evaluating long-term cognitive and behavioral outcomes in triplets and twins, taking birthweight, gestational age at birth, and the socio-economic status of the mother into account.

Methods

Study population and objectives

This prospective follow-up study includes triplets and twins registered at birth in the East-Flanders Prospective Twin Survey (EFPTS), a population-based register initiated in 1964 at Ghent University. The register records 95% of multiple births in East-Flanders, collecting basic perinatal data, chorion type, zygosity, and a placenta biopsy for every multiple birth [24]. Ethical approval was granted by University Hospital Leuven (B32220096237).

Eligible participants, who were registered between 1982 and 1995, aged 6–16, with parental consent and at least one surviving child, were contacted via mail and phone. Upon obtaining consent, the assessments for the triplets were conducted at the participants' homes by orthopedagogues, while the twins were tested at private rooms provided for the study, each in separate rooms with a trained psychiatric assistant.

The study objectives are the following:

1. To assess the intellectual and behavioral abilities of triplets aged 6 to 16 years.
2. To evaluate the association of triplets' birthweight and gestational age with their intellectual and behavioral abilities.
3. To compare the intellectual and behavioral abilities between triplets and twins, hypothesizing that triplets may have a higher risk of intellectual disability and behavioral problems.

Study assessments

Wechsler Intelligence Scale for Children-Revised

The intellectual ability of twins and triplets was evaluated using the Wechsler Intelligence Scale for Children-Revised (WISC-R), which is a widely used and validated diagnostic instrument for intelligence profiles in children [25]. At the time of the assessments (1992–2002), it was the most suitable instrument available. The subtest scores of the instrument are age-standardized and combined into two overall scores: Verbal Intelligence Quotient (VIQ) and Performance Intelligence Quotient (PIQ). The combination of VIQ and PIQ leads to the total Intelligence Quotient (TIQ), defined as the average of all cognitive skills [25]. The instrument is well-validated in Dutch [26]. The Dutch classification system of TIQ scores used in this study was the following: TIQ ≥ 90 was classified as normal; TIQ between 80 and 89 was classified as borderline; TIQ score < 80 was classified as intellectually disabled [27].

Child Behavior Checklist

Behavioral problems in children were assessed using the Child Behavior Checklist (CBCL, version 1/93), a validated instrument designed to identify significant behavioral issues and deficits in social skills [28]. This study focused on the total CBCL scores only (total CBCL score, total externalizing score, total internalizing score) as measures of overall psychopathology [29,30]. This study classified CBCL scores as follows: normal (<65), borderline (65–69), and clinical behavioral problems (≥70) [28].

Questionnaire for parents

Parents completed a questionnaire (Supplementary material 1) on administrative, educational, and medical details, including maternal education as a socio-economic indicator. Mothers with education beyond secondary school were classified as having 'higher education'. Non-consenting parents completed a brief survey (Supplementary material 2) on reasons for decline, education, and health.

Statistical analysis

Statistical analysis was conducted in Rstudio 2025.05.1.

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In the descriptives, the continuous variables are presented as means (± standard deviations), and categorical variables as frequencies (%). The distribution of IQ and CBCL scores was assessed for normality using a Q-Q plot, histogram, and the Shapiro-Wilk normality test. Where distributions deviated substantially from normality, scores were normalized using appropriate transformations prior to inclusion in linear mixed models. For the second objective, the triplet cohort was analyzed using random-intercept linear mixed models to account for within-pair correlations. These models examined associations between birthweight and IQ scores or CBCL scores. Covariates included gestational age at birth, maternal age at birth, maternal socio-economic status, and the child's sex.

For the third objective, mean IQ and CBCL scores were compared between the triplets and twins using random intercept linear mixed models, adjusting for maternal age at birth, maternal socio-economic status, child's sex, and type of multiple birth (twin or triplet). Birthweight and gestational age were not included as covariates, as these factors are inherently lower in triplets compared to twins and are considered characteristics of the triplet population. To evaluate whether maternal educational level modified the association between multiple birth type (twin vs. triplet) and developmental outcomes, an interaction term between maternal education and multiple birth type was added to the linear mixed-effects model. This allowed formal testing of effect modification within the full sample.

In addition, stratified analyses by maternal educational level (high vs. low) were conducted to further explore subgroup-specific patterns. Within each stratum, mean IQ scores were compared between twins and triplets using the same random-intercept mixed model structure described above.

Results

Study population

The flowchart of the inclusion of triplet sets is summarized in Figure 1. From the 80 eligible triplet sets, 52 agreed to participate in the study (response rate = 65%). The parents of 9 out of 13 triplet sets who declined participation completed the short questionnaire.

The total triplet cohort consisted of 52 triplet sets or 140 triplets (see Table 1), whereof 27 (19.3%) dizygous (DZ) triplets, 111 (79.3%) trizygous (TZ) triplets, and 2 triplets with undefined zygosity (due to the in-utero death of the third child). Of the 52 triplet sets, 16 triplets could not participate

Table 1: Summary of the perinatal outcomes divided by chorion type of the study population.

	Triplets			Twins	
	TCTA	DCTA	DCDA	DCDA	MCDA
Number (%)*	125 (89.3%)	13 (9.3%)	2 (1.4%)	932 (72.0%)	362 (28.0%)
Number (%) born at:°					
<28 weeks	8 (6.4%)	-	-	1 (0.1%)	3 (0.83%)
28-32 weeks	18 (14.4%)	-	-	42 (4.51%)	12 (3.31%)
32-34 weeks	22 (17.6%)	3 (23.1%)	-	96 (10.30%)	34 (9.39%)
34-37 weeks	63 (50.4%)	9 (69.2%)	2 (100%)	204 (21.89%)	86 (23.76%)
≥37 weeks	12 (9.6%)	1 (7.69%)	-	493 (52.89%)	197 (54.4%)
Mean (± SD)					
Mother's age at birth (in years)	29.13 (± 3.469)	29.23 (± 3.032)	30 (± 0.0)	27.95 (± 4.03)	27.56 (± 4.41)
Gestational age (in weeks)	34,07 (± 2,692)	34.15 (± 2.703)	35.0 (± 0.0)	36.53 (± 2.53)	36.69 (± 2.67)
Birthweight (in g)	2034.44 (± 440.621)	2003.08 (± 670.962)	1825.0 (± 219.203)	2493.94 (± 509.56)	2432.02 (± 528.47)
Frequency (%)					
Multiparous mother	45 (36.9%)	6 (46.2%)	2 (100%)	432 (47.06%)	191 (54.58%)
Conception by medically assisted reproduction techniques	117 (93.6%)	4 (30.8%)	2 (100%)	251 (26.9%)	16 (4.4%)
Delivery by cesarean section	71 (56.8%)	7 (53.8%)	0 (0%)	263 (28.3%)	78 (22.2%)
Male triplets	69 (55.2%)	12 (92.3%)	2 (100%)	465 (49.9%)	179 (49.4%)
Birth defects**	5 (4.0%)	0 (0%)	1 (50.0%)	18 (1.9%)	5 (1.4%)

TCTA= trichorionic triamniotic, DCTA= dichorionic triamniotic, DCDA= dichorionic diamniotic; MCDA= monochorionic dichorionic; *4 twins are not included in the table, due to an undefined chorion type; °missing data on gestational age of following multiples: 2 TCTA triplets, 96 DCDA twins, 30 MCDA twins; **congenital defects reported by the obstetrician at birth

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in the study due to death (supplementary material 3). The mean birthweight and gestational age of the participating 140 triplets were 2028.54g (± 461.622) and 34.09 weeks (± 2.666), respectively. The perinatal outcomes of the study population are summarized per chorion type in Table 1.

The mean age of the triplets at the time of the study assessments was 10.3 years (± 2.577). Of 140 triplets, 90 (64.29%) were in primary education, with 6 (6.6%) in special needs primary education. Additionally, 50/140 triplets (35.71%) were in secondary education, with 2 (4%) in special needs secondary education. Of the 140 triplets, 32 (22.9%) experienced health issues, most commonly visual impairments (8 triplets) and neurological conditions (6 triplets), including spasticity, hypotonia, disability, and cerebral palsy. Among the mothers, 88.89% were employed, and 66.4% had completed higher education.

The twin cohort consisted of 663 twin pairs (1294 twins), of which 736 (57.0%) DZ twins and 558 (43.0%) monozygous (MZ) twins. Of these, 28 twins could not participate in the study due to death (supplementary material 4) or severe handicap (2 twins). Among 1294 twins, the mean birthweight and gestational age were 2474.93g (±516.25) and 36.58 weeks (±2.57), respectively. The primary perinatal outcomes of the twin cohort are summarized per chorion type in Table 1. The mean age of the twins at the time of the study assessments was 10.4 years (± 1.80).

Study assessments

The study assessments performed in the twin cohort were previously described [10,15]. Therefore, we only described the results of the study assessments in the triplet cohort in detail.

WISC-R

The IQ scores are summarized in Table 2. The PIQ scores were significantly lower overall than the VIQ scores ($p<0.001$). In 19 (13.57%) triplets, a difference of ≥ 20 points between the PIQ score and VIQ score was observed.

Ten out of 140 (7.1%) triplets scored an IQ score lower than 80. In this subgroup, the mean birthweight and gestational age were respectively 1624.0g (±440.41) and 31.5 weeks (± 2.32), which is significantly lower than the mean birthweight (2059,65g± 449,9; p=0.004) and gestational age (34,30 weeks ±2,59; p=0.001) of triplets with a total IQ score ≥ 80. Within this subgroup, 3 (30%) triplets were diagnosed with cerebral palsy. Among the intellectually disabled triplets, 5 were born extremely preterm (<32 weeks) and 5 were born moderate preterm (32-35 weeks).

The TIQ, PIQ, and VIQ scores were higher in the male (TIQ: 105.89 ±19.03; PIQ: 102.84 ±18.88; VIQ: 107.08 ±17.43) triplets compared to the female (TIQ: 101.40 ± 15.59; PIQ: 99.23 ± 16.81; VIQ: 102.89 ± 13.77) triplets, without reaching statistical significance. The TIQ score of the 32 triplets with reported health issues (i.e., visual impairments and neurological conditions, including spasticity, hypotonia, disability, and cerebral palsy) was significantly lower than the TIQ score of triplets without reported health issues (p=0.011).

The analysis indicated that higher maternal socio-economic status was positively associated with the triplet's TIQ score, showing a mean increase of 16.21 points (95% CI [-23.13, -9.527], p < 0.001). Additionally, gestational age demonstrated a positive association with TIQ score, with an estimated increase of 1.70 points per additional week of gestation (95% CI [0.356, 3.037], p = 0.015). The linear

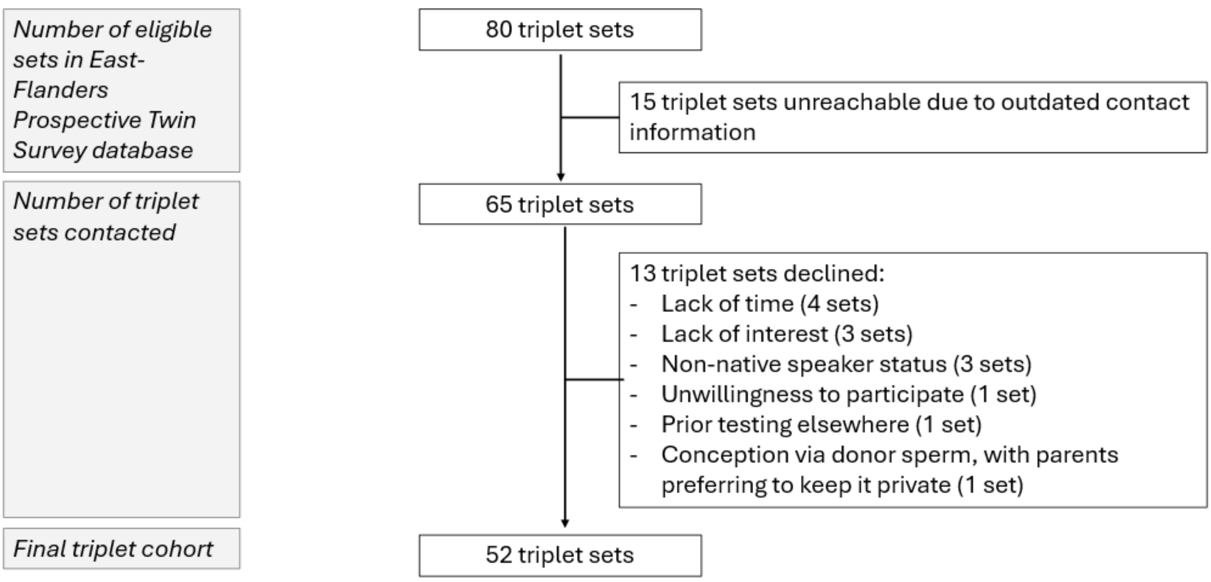

Figure 1: Flowchart of the recruitment of the triplets from the East-Flanders Prospective Twin Survey.

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Table 2: Descriptives of study assessments in the twin and triplet cohorts.

	Triplets	Twins
Number of subjects (%)	140 (9.76%)	1294 (90.23%)
Mean (± SD)		
Maternal age at birth (in years)	29.15 (±3.40)	27.84 (±4.14)
Gestational age at birth (in weeks)	34.09 (± 2.666)	36.58 (±2.57)
Birth weight (in g)	2028.54 (± 461.622)	2474.93 (±516.25)
Age at the time of measurement (years)	10.34 (± 2.577)	10.44 (± 1.80)
Total IQ score	104.06 (± 17.79)	102.42 (± 14.80)
Total performance IQ	101.37 (±18.09)	100.54 (± 15.22)
Total verbal IQ	105.38 (± 16.12)	103.24 (± 14.41)
Total CBCL score	46.18 (±11.32)	46.49 (±10.44)
Internalizing CBCL score	48.13 (±10.67)	47.58 (±9.64)
Externalizing CBCL score	47.12 (±9.76)	46.46 (±10.24)
Frequencies (%)		
Medical assisted reproduction techniques used for conception	121 (86.4%)	267 (20.6%)
Mothers with higher education	93 (66.4%)	506 (39.0%)
Male sex	82 (58.6%)	646 (49.9%)
Number of subjects with total IQ <80	10 (7.1%)	77 (5.9%)
Number of subjects with ≥ 20 points difference between VIQ and PIQ	19 (13.6%)	205 (15.8%)
Number of subjects with total CBCL ≥70	1 (0.7%)	32 (2.1%)

mixed model analysis between TIQ and birthweight of the triplet showed no other significant associations (birthweight, sex of the child, and maternal age at birth). The results of the linear mixed model analysis in the triplets are presented in Table 3.

CBCL

138 triplets completed the CBCL, the total scores are summarized in Table 2. Of these triplets, 4/138 (2.9%) had a total CBCL score categorized as borderline, and 1/138 (0.7%) had a total CBCL score categorized as clinical behavioral problems. The CBCL scores of the male triplets (total CBCL score: 47.32 ±11.72; total externalizing score: 47.44 ±10.27; total internalizing score 49.25 ±10.95) were not statistically different from the CBCL scores of the female triplets (total CBCL: 44.52 ±10.59; total externalizing score: 46.66 ±9.06; total internalizing score:46.52 ±10.13).

Table 3: Results of random-intercept linear mixed models in triplets.

Parameter	Estimate	95% confidence interval	p-value
TIQ			
Male sex	-3.40	[-7.957, 1.354]	0.153
Higher education mother	-16.207	[-23.13, -9.527]	**<0.001**
Maternal age at birth	-0.156	[-1.218; 0.85]	0.769
Gestational age	1.70	[0.356, 3.037]	**0.015**
Birthweight	0.002	[-0.004, 0.009]	0.532
Total CBCL score			
Male sex	-0.076	[-0.322, 0.178]	0.554
Higher education mother	0.225	[-0.238, 0.684]	0.347
Maternal age at birth	-0.049	[-0.12, 0.023]	0.179
Gestational age	-0.11	[-0.196, -0.021]	**0.017**
Birthweight	0.00004	[-0.0003, 0.0004]	0.824

*Female sex and secondary education are reference categories.

The analysis with the total CBCL score showed a small negative association with gestational age. The other covariables (birthweight, sex, maternal age at birth, and maternal socio-economic status) showed no statistically significant association (Table 3).

Comparison of the triplet and twin cohorts

The main results of perinatal outcomes and study assessments in the twins and triplets are summarized in Table 2. The linear mixed-effects model revealed a significant interaction between maternal socio-economic status and multiple birth type (β = –0.624, 95% CI [–1.05, –0.19], p = .007), indicating that the difference in IQ between triplets and twins varies according to maternal socio-economic status. Given the markedly higher socio-economic status among mothers of triplets, stratified analyses were conducted to examine these effects within educational subgroups (low vs high).

Among highly educated mothers, no significant IQ differences were observed between twins and triplets. In contrast, within the subgroup of lower-educated mothers, triplets showed markedly lower IQ scores across all domains. Specifically, triplets had significantly lower TIQ (β = –7.51, 95% CI [–13.5, –5.7], p = .015), PIQ (β = –0.47, 95% CI [–0.90, –0.06], p = .029), and VIQ (β = –0.49, 95% CI [–0.92, –0.06], p = .023) compared with twins.

Regarding behavioral outcomes, no significant effect was found for total CBCL score (β= 0.029; 95% CI [-0.22, 0.28]; p=0.82), internalizing CBCL score (β= 0.096, 95%CI [-0.15, 0.33], p= 0.44), or externalizing CBCL score (β= 0.15, 95%CI [-0.09, 0.4], p= 0.22).

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Discussion

To the best of our knowledge, this is the first study to describe the intellectual and behavioral abilities of triplets between the ages of 6 and 16 years, to explore the relationship between perinatal outcomes and these abilities, and to compare them with those of twins. Literature on triplet births is rare, leaving a major gap in knowledge on later childhood development. This study, therefore, offers a uniquely detailed developmental perspective that has not previously been available.

Our findings indicate a positive association between the intellectual abilities of triplets and both maternal socio-economic status and gestational age, while behavioral abilities showed no clinically relevant associations. Comparative analysis showed no differences among children of higher-educated mothers, whereas triplets born to lower-educated mothers exhibited markedly lower IQ scores than twins. This highlights the critical role of maternal education in shaping developmental outcomes.

Perinatal outcomes of triplets

The incidence of triplet pregnancies increased significantly with the introduction of assisted reproductive technology (ART) in the ‘80s, rising from one spontaneous triplet annually to over ten registered in the EFPTS [31,32]. International guidelines for single embryo transfer and fetal reduction procedures have reduced multiple births [33,34], with Belgium’s triplet incidence at 0.003% in 2024 [1].

In this study, 140 triplets were included, and in line with the perinatal outcomes of other described triplet cohorts, the birthweight of triplets with a monochorionic component was lower than TCTA triplets [2,5]. Triplets with a monochorionic component have a higher mortality rate than TCTA triplets, with intrauterine deaths at 5.2% in DCTA triplets versus 2.1% in TCTA triplets [2,5]. In our cohort, the intrauterine death rate was 3.85%, all TCTA triplets, likely due to fewer DCTA and DCDA cases. The overall mortality rates differed significantly between our triplets (10.25%) and twins (1.96%) (χ^2=34.88, p<0.001).

Intellectual abilities of triplets

The mean TIQ, PIQ, and VIQ scores in our triplet cohort are, respectively 104.06 (±17.79), 101.37 (±18.09), and 105.38 (±16.12). Feldman et al. [8] reported a similar mean VIQ of 106.27 (±16.42) in triplets [8]. Notably, in our triplet cohort, the PIQ scores were significantly lower than the VIQ scores, with 13.57% of triplets displaying a discrepancy of at least 20 points, potentially indicating a risk for learning disabilities [25,35,36]. To the best of our knowledge, this finding has not been previously described in triplets. Interestingly, we observed a similar pattern in our twin cohort [15,37].

The analysis showed that TIQ in triplets was positively associated with maternal education level and gestational age, consistent with singletons' studies [38-44]. Lacalle et al. [45] reported lower IQ (95.68±10.96) in school-aged children (6 – 12 years) born preterm compared to full-term born children (106.09±8.06), with the lowest IQ scores in those born extremely preterm [45]. Parental education has also been shown to be associated with the IQ of preterm children [39,43], with maternal education identified as the most influential factor [46]. In our cohort, mothers of triplets conceived via ART were more likely to have higher education levels compared with those of naturally conceived triplets. This pattern reflects the demographic reality of the study population, given that the majority (93.6%) of triplets were conceived through ART.

Notably, there was no association between triplets’ TIQ and their birthweight. However, while birthweight and gestational age are strongly correlated, gestational age appears to be the key determining factor [47].

Behavioral abilities of triplets

In our cohort, mean CBCL scores fell within the normal behavioral range. Specifically, only 4 triplets (2.9%) scored in the borderline range, and 1 triplet (0.7%) met the criteria for clinical behavioral problems. Garel et al. [48] assessed behavioral functioning in triplets (aged 4–11 years) and singletons using the CBCL. Their study reported triplet scores within the normal range and, notably, significantly lower total CBCL scores compared to singletons, indicating that triplets exhibit fewer behavioral problems [48]. However, the authors caution that these lower CBCL scores may reflect maternal underreporting and should therefore be interpreted with care [48]. In this study, linear mixed model analysis found no clinically significant associations between behavioral outcomes and maternal education level, sex, gestational age, or birth weight, consistent with singletons' studies [49-51], but has not been previously reported in triplets.

Comparison of triplets and twins

The mean TIQ score (102.42 ± 14.80) observed in our twin cohort is consistent with findings from previous studies [52,53]. Van Soelen et al. [52] reported a mean IQ of 99.9 (±13.5) at age 9, and 100.3 (±14.1) at a mean age of 12.1 years [52]. Similarly, Kuiper et al. [53] found a mean IQ score of 103.5 (95% CI [99.8,107.3]) in twins at age four [53].

While no overall significant differences were found in intellectual or behavioral abilities between triplets and twins, triplets had significantly lower mean gestational age and birthweight but higher maternal age at birth. Given that birthweight and gestational age are widely described in association with cognitive development [38-44,54-56], triplets might be expected to have lower TIQ scores than

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twins. Mothers of triplets exhibited higher educational levels and higher rates of conception via ART compared to the twins cohort. Bilsteen et al. [57] confirmed that low parental education and short gestational age impact school performance, but higher parental education may mitigate these effects [57]. Consistent with this literature, our analysis identified a significant interaction between multiple birth type and maternal socio-economic status. Among highly-educated mothers, IQ did not differ significantly between triplets and twins. In contrast, within the subgroup of lower-educated mothers, triplets performed significantly worse than twins across all IQ domains (TIQ, PIQ, VIQ; $p < 0.05$). These findings suggest that higher maternal education may buffer the cognitive vulnerabilities typically associated with prematurity and low birthweight.

Furthermore, our findings align with Feldman et al. [8], who reported no significant cognitive differences between twins and triplets at age five. While cognitive delays were observed in triplets at age two, these delays disappeared over time, suggesting a developmental catch-up effect [8]. In our study, this developmental catch-up effect could also contribute to the lack of significant differences in IQ scores between the triplets and twins, considering the age of the multiples (6 – 16 years) during the study assessments.

Interestingly, Schneider et al. [58] found no link between gestational age and cognitive abilities in adults, with preterm-born and full-term-born individuals showing similar Iqs [58]. Studies on IQ in twins vs. singletons show mixed results, with some reporting lower IQ in twins during childhood [56,59-62], and others reporting no difference in young adulthood [55,63,64].

Regarding behavioral outcomes, Feldman et al. [65] previously reported increased internalizing problems in triplets at age two. However, by the age of five, no statistical differences in internalizing scores were observed between triplets, twins, and singletons [65]. In our study, no significant differences between twins and triplets were found in either total or internalizing or externalizing CBCL scores, which may be attributable to our larger sample size and the older age of the multiples (6 – 16 years) at the time of assessment.

Limitations

In this study, we have to acknowledge some limitations. The participation rate among East-Flanders triplets was 65% only, with 18.75% unreachable and 16.25% uninterested. Non-participants had significantly lower gestational ages and birthweights, potentially overestimating IQ scores in this study. The high maternal education among participants and the 1992–2002 assessment timeframe are additional limitations. Maternal IQ scores were not collected during the study and, therefore, could not be included in the analysis. However, the maternal education was used as a proxy for maternal IQ, and the analysis was adjusted accordingly [66].

Although the WISC-R is an older instrument, it remains a validated and widely used measure of intellectual functioning [67-69]. In the context of triplet research, where data are extremely scarce, the use of WISC-R provides valuable insights into cognitive development. The study represents a longstanding research effort in which data have been continuously curated, expanded, and carefully re-analyzed. Furthermore, the results of this study now serve as the basis for our follow-up study examining the same triplet cohort into adulthood.

Conclusion

Intellectual abilities in triplets were positively linked to gestational age and maternal socio-economic status, with 13.57% showing a ≥ 20-point VIQ-PIQ discrepancy. Although triplets were born with lower birthweights and shorter gestations than twins, their overall intellectual and behavioral abilities at 6–16 years were largely comparable. However, among children of low-educated mothers, triplets scored significantly lower in intellectual abilities than twins, underscoring the protective role of higher maternal socio-economic status in mitigating the effects of poor perinatal outcomes. Ongoing longitudinal follow-up of this triplet cohort will further clarify the development into adulthood.

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