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Long-term follow-up of self-reported mental health and health-related quality of life in adults born extremely preterm

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ABSTRACT

Background: Survival of extremely preterm (EP) birth is increasing, but long-term consequences are still largely unknown as their high survival rates are recent achievements.
Aims: To examine self-reported mental health, and health related quality of life (HRQoL) in a cohort of adults born EP in the early 1990s and individually matched term-born controls, and to describe development through the transition from teenager to adults.
Methods: Thirty-five eligible subjects were born at gestational age ≤ 28 weeks or with birth weight ≤ 1000 g during 1991–1992 in this population-based cohort from Western Norway. We assessed mental health using Youth Self-Report (YSR) at 18 years of age, and Adult Self-Report (ASR) at 27 years, and HRQoL by RAND-36 at 27 years. Data were analysed by unadjusted and adjusted mixed effects models with time by group as interaction term.
Results: At 27 years, 24 (69 %) EP-born and 26 (74 %) term-born controls participated. Scores for internalising problems, and syndrome scale anxious/depressed and withdrawn were higher among EP-born compared to term-born controls. For HRQoL, scores were similar in EP-born and term-born groups, except the domain physical functioning where EP-born scored lower. Development over time from 18 to 27 years showed increasing (i.e. deteriorating) scores for internalising, anxious/depressed, somatic complaints, and attention problems in the EP born group. For the term-born, scores for anxious/depression increased over time.
Conclusions: At 27 years of age, EP-born adults reported more internalising problems than term-born controls, while HRQoL was relatively similar except physical functioning. Mental health problems in the EP-born increased from adolescence to adulthood.

1. Introduction

More children born extremely preterm (EP) now survive due to vast improvements of perinatal care over the last decades, particularly to the benefit of those born most immature [1]. EP-born children now constitute nearly 1 in 200 individuals growing up in high income societies [2]. Survival of these infants implies that growth and development must take place in a neonatal intensive care unit (NICU) while receiving comprehensive and invasive lifesaving treatments; a demanding and even harmful scenario to the infants themselves as well as their parents. Preterm birth has long-lasting and possible life-long health effects with increased risk of a variety of impairments across the lifespan [3]. Thus, adolescents and young adults born EP have been found to be at increased risk of cognitive and social limitations, neurological deficiencies, mental health problems, metabolic disorders, respiratory disorders, and pulmonary and cardiovascular abnormalities [4]. Further, reduced educational qualifications and employment rates, and increased prevalence of social benefits have been found in EP-born adult populations [5,6]. In

Abbreviations: GA, gestational age; EP, extremely preterm; YSR, Youth Self-Report; ASR, Adult Self-Report; HRQoL, Health-related Quality of Life; VP, very preterm; VLBW, very low birthweight; BW, birthweight; TB, term-born; NICU, neonatal intensive care unit; ADM, assessment data manager.

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this context, subjective health, mental health, and health-related quality of life (HRQoL) are highly relevant issues. These measures are still not well described, particularly development throughout the important transitional phase from adolescence to adulthood [7].

The risk of mental health problems in preterm born adults is not fully understood. A meta-analysis from 2017 [8] reported that young adults born very preterm suffered from more internalising and antisocial problems, whereas externalising problems seemed less prevalent than in term-controls. A recent Norwegian study found higher levels of problems relating to attention, internalising and externalising issues at 26 years of age in subjects born with very low birthweight (VLBW) when compared to matched controls [9]. Particularly anxiety and depression seem to be areas of concern in preterm born [10,11]. However, the literature is not consistent, with conflicting data [10,11]. A systematic review from 2020 concluded that it remains undetermined whether VLBW/ EP adults are at increased risk of mental health disorders or symptoms [12]. Further, studies are few, particularly with a longitudinal design, which is pivotal to the understanding of developmental trends over time. Mental health is closely related to HRQoL, which examines the relationship between an individual's health and ability to function, and the perception of well-being [13]. HRQoL is multidimensional and includes physical, social and psychological functioning [14]. A recent systematic review could not conclude if HRQoL differed between adults born VLBW and at term [7].

In a cohort born EP in the early 1980s, we found that HRQoL deteriorated from 18 to 24 years of age, with scores below those of term-born controls at 24 [15]. In a cohort born similarly preterm in the early 1990s, we found that HRQoL and self-reported mental health did not differ from term-born controls at 18 years [16]. With this present study, we report new data from the 1990-cohort and their term-born controls, aiming to (1) investigate HRQoL and self-reported mental health a decade later, and (2) investigate longitudinal development during the age-span from 18 to 27 years.

2. Methods

2.1. Study design and participants

Longitudinal population-based follow-up study, enrolling adults born at GA ≤ 28 weeks or with BW ≤ 1000 g in 1991–1992 within a defined area in Western Norway. At the age of ten, eligible children were retrospectively identified through the admission protocols at the NICU at Haukeland University Hospital, Bergen Norway, which is the only hospital in the region which cares for infants born extremely premature. All infants born at GA ≤ 28 weeks or with BW ≤ 1000 g who were admitted alive to the NICU were considered eligible. Of 47 admitted infants, 12 (26 %) died, leaving 35 eligible subjects who all responded positively and provided consent to participate at first follow-up in 2001–2002. Neonatal morbidity data are presented in Table 1. This was the third examination of this cohort, performed at age 27 during 2018–2020.

Term-born controls, individually matched for each EP-born participant, had been recruited at 10 years of age. The temporally nearest term-born child of the same gender with BW between three and four kilograms (Norwegian 10th to 90th percentile) was approached. If the parents of that person declined, the following term-born subject was approached, and so on until one control had been recruited for each enrolled EP-born participant.

Assessments were performed at Haukeland University Hospital at 10 years of age (first follow-up, not described here), 18 years (second follow-up), and 27 years (third follow-up).

2.2. Measures

At this third follow-up, the participants completed questions covering socio-demographic data, self-report on mental health and quality of life, the same issues as at the follow-up at age 18. Results from the first two follow-ups have been published previously [16].

Table 1
Clinical characteristics, neonatal morbidity and demographics at 27 years follow-up of 24 participants born extremely preterm in Western Norway and their 26 term-born controls.[a]

	EP-born	Term-born controls	*p*-Value
	n = 24	*n* = 26	
Birth characteristics			
Male, *n (%)*[d]	10 (42)	8 (31)	0.42
Age at second follow-up, year, *mean (SD)*	17.7 (0.4)	17.9 (0.5)	–
Gestational age at birth, weeks, *mean (SD)*	26.7 (1.7)	–	–
Birthweight, grams, *mean (SD)*[b]	944 (224)	3,540 (270)	<0.001
Days on ventilator, *mean (SD)*	10.0 (13.4)	0	–
Days on oxygen treatment, *mean (SD)*	61.8 (51.5)	0	–
Bronchopulmonary dysplasia (BPD[c])	9 (38)	0	–
Intra-ventricular haemorrhage grade 1–2[d], *n (%)*	7 (29)	0	–
Necrotising enterocolitis	3 (13)		–
Retinopathy of prematurity	0 (0)		–
Patent ductus arteriosus, surgical closure, *n (%)*	13 (54)		–
Characteristics at 27 years' follow-up			
Cerebral Palsy, *n (%)*	0 (0)		–
Impaired hearing, *n (%)*	2 (8)		–
Reduced vision, *n (%)*	2 (8)		–
Age at third follow-up, year, *mean (SD)*[b]	26.6 (0.7)	26.6 (0.6)	0.96
College/university ≤4 years[d]	19 (79)	18 (69)	0.42
College/university >4 years	5 (21)	8 (31)	
Employment, n (%)			
Working or still in education[d]	18 (75)	26 (100)	0.007
Unemployed or disability pension	6 (25)	0 (0)	

EP = extremely preterm; SD = standard deviation.
[a] All information about demographic and clinical characteristics were obtained from a general questionnaire and medical chart. The subjects were born 1991–1992.
[b] Comparison between groups using Welch's *t*-test.
[c] BPD defined by oxygen supply and/or ventilator support at gestational age 36 weeks.
[d] None grade 3–4.

2.3. Socio-demographic and clinical data

Information on socio-demographic data, such as current educational level and employment, were obtained from a custom-made questionnaire used in Norwegian population studies (http://www.hunt.ntnu.no). Educational level five-point response choices were from (1) elementary school through (5) college/university exceeding 4 years; for the purpose of statistical analyses later dichotomized to 1–4 versus 5. Employment four-point response choices were (1) working, (2) student, (3) unemployed or (4) disability pension, later dichotomized to 1–2 versus 3–4. Clinical data were obtained from the participants themselves and from hospital records.

2.4. Self-reported mental health; Youth Self-Report (YSR) and Adult Self-Report (ASR)

Behavioral, emotional, and social difficulties were measured using Norwegian validated versions of Youth Self-Report (YSR) at 18 years and Adult Self-Report (ASR) at 27 years [17,18]. Correlation between YSR and ASR is found to be stable and acceptable in American and Dutch samples [19,20]. These questionnaires comprise 118 (YSR) and 120 (ASR) behavioral, emotional, and social problem items rated as "not

true" (0), "somewhat or sometimes true" (1), or "very true or often true" (2), based on the last 6 months. A sum score was calculated for each syndrome scale. Six of these sum scores are used to create two broadband scales: an *internalising score* (anxious/depressed, withdrawn and somatic complaints) and *externalising score* (rule-breaking behaviour, aggressive behaviour (and intrusive behaviour only in the ASR)). The *total score*, based on all problem items (including thought and attention problems (and social problems in the YSR)) represents the total problems score. Higher scores indicate more problems and poorer functioning.

These questionnaires are widely used measures of social-adaptive and psychological functioning in youth aged 11–18 [17] and adults aged 18–59 [21], and it is recommended measures in follow-up assessments of adults born preterm [22].

2.5. RAND 36-Item Health Survey (RAND-36)

HRQoL was measured by RAND-36 at age 27, a questionnaire developed by the RAND Corporation [23]. RAND-36 is equivalent to the 36-item SF-36, except minor differences in the scoring procedure for the two sub-scales of general health and pain which are slightly different, and the RAND-36 scores correlate highly (0.99) with the SF-36 scores [24]. It is a generic measure assessing self-perceived functional health and well-being through the following eight health domains: physical functioning (ten items), role-physical (four items), role-emotional (three items), bodily pain (two items), general health (five items), vitality (four items), social functioning (two items), and mental health (five items). Except for the two role-functioning scales, which have dichotomized response choices, the responses are rated along a three to six-point ordinal scale with the preceding four weeks as the recall period, except for physical functioning and general health, which pertain to the current status. The raw scores for each RAND-36 sub scales were based on the mean of valid items if at least half of the items in each scale were valid, and then linearly transformed into a score from 0 to 100, with higher scores indicating better functional health and well-being [13,23]. The questionnaire has demonstrated good reliability and validity [23], including in Norwegian populations [25]. Term-born controls were expected to represent the general population, and they were in line with normative Norwegian data [25] except for physical functioning and role physical, where the term-born scored 3 points higher compared to normative data.

2.6. Statistical analysis

Descriptive statistics are reported as mean with standard deviations (SDs). The statistical analyses were performed in three stages. First, we compared characteristics of the participating and non-participating eligible subjects using Welch's *t*-test and Person Chi-square, to discover potential selection bias. Secondly, we used assessment data manager (ADM) scoring software, and transformed raw data of YSR and ASR to SPSS. We then used Welch's *t*-test to examine characteristics and HRQoL differences between EP-born and term-born controls. Approximate normal distribution of scores in each group was assessed by visual inspection of Q-Q plots. Thirdly, to estimate longitudinal differences in mental health (YSR and ASR), we fitted linear longitudinal regression models with group (EP-born vs. term-born), age (18 vs. 27 years) and the group–age interaction as explanatory variables. For each individual, the two error terms (at ages 18 and 27) were modelled as correlated. The use of a longitudinal model with correlated error terms allowed us to include subjects with only partial follow-up data, which should reduce the effect of bias from missing data. There were some missing data, especially at the follow-up at 27 years. We report the number of patients each analysis is based on.

Since there were large differences in SDs, both between the two groups and between the two time-points, we used heteroscedastic error terms (different SDs for the four group–age combinations). We also fitted a similar model with gender as an additional predictor.

A p-value <0.05 is characterised as statistically significant, and 95 % confidence intervals (CI) are reported where relevant. For data analyses with Welch's *t*-test and Pearson Chi-square, the SPSS statistical package version 26 was used. The regression models were fitted using the 'nlme' package version 3.1-153 [26] in R version 4.1.1 [27].

2.7. Ethics

The study protocol was approved by the Regional Committee for Medical Research Ethics for Western Norway (Protocol no. 2017/628), and the study was performed in accordance with the Helsinki Declaration. All participants gave informed written consent at both follow-ups.

3. Results

3.1. Clinical characteristics

At 27 years, 23 (66 %) EP-born and 26 (74 %) term-born controls participated (Fig. 1). Clinical and sociodemographic characteristics are shown in Table 1. The mean age at the last follow-up was 26.6 years for both EP-born and term-born controls. There were no significant differences in gender or educational attainment between EP-born and term-born controls, but six of the EP-born participants were unemployed or on disability pension, compared to none in the term-born group ($p = 0.01$).

3.2. Participants vs. non-participants

There were no significant differences with regard to BW, GA, or days on ventilator between EP-born participants and those who did not participate. Also, between term-born participants and those who did not participate, no significant differences were found on gender and BW. Further characteristics are presented in Additional file 1: Table S1 and S2.

3.3. Self-reported mental health at 27 years; data from ASR

At 27 years, the scores for total problems, the broadband internalising problems, and the two syndrome scales "anxious/depressed" and "withdrawn" were significantly higher (i.e. more problems) in the EP-born group (Table 2). Three EP-born participants did not complete the ASR.

3.4. Health-related quality of life at 27 years; data from RAND-36

EP-born scored significantly lower than term-born on physical functioning, whereas scores were similar in the remaining 7 domains (Table 3).

3.5. Changes of self-reported mental health (YSR and ASR) from 18 to 27 years in EP-born and term-born

Longitudinal data are depicted in Table 4 and visualised in Fig. 2. In the EP-born group, scores increased over time for the broadband internalising, and syndrome scale anxious/depressed, somatic complaints and attention problems, indicating more mental health problems. Further, scores declined over time for aggressive behaviour and rule-breaking behaviour in the EP-born group, indicating less problems.

In the term-born group, scores for anxious/depression increased over time, whereas scores were declining for broadband externalising problems, and syndrome scale aggressive behaviour and rule-breaking behaviour.

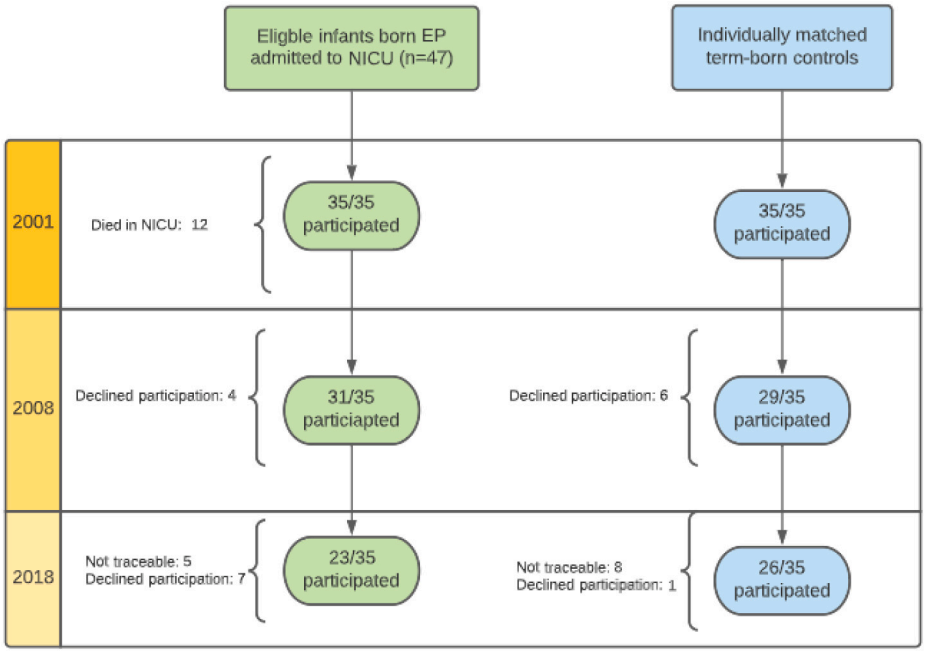

Fig. 1. Flow chart of the 35 extremely preterm (EP) born subjects and 35 matched term-born controls at the three follow-up time points. EP Extremely preterm, NICU neonatal intensive care unit.

Table 2
Self-report at 27 years of age in subjects born extremely preterm and term-born controls by Adult Self-Report (ASR).

ASR	EP-born (n = 21)[a]		Term-born controls (n = 26)		EP-born vs. term-born controls			
	Mean	SD	Mean	SD	Estimated mean difference	Lower CI	Upper CI	p-Value
Raw scores								
Anxious/depressed	10.5	7.7	5.6	5.5	4.9	1.2	8.6	0.01
Withdrawn	3.6	3.2	1.7	1.6	1.8	0.4	3.3	0.02
Somatic complaints	3.8	3.5	3.0	2.8	0.8	−1.1	2.7	0.41
Thought problems	2.2	2.5	1.2	1.5	1.0	−0.2	2.2	0.12
Attention problems	7.6	5.7	5.4	4.2	2.2	−0.6	4.9	0.12
Aggressive behaviour	3.9	4.1	2.1	1.9	1.8	−0.1	3.7	0.07
Rule-breaking behaviour	1.6	1.9	0.9	1.3	0.7	−0.3	1.6	0.17
Internalising problems	17.6	11.6	10.3	8.3	7.2	1.5	12.9	0.01
Externalising problems	6.8	5.6	4.7	3.2	2.1	−0.6	4.8	0.12
Total problems	43.3	28.0	28.4	18.9	14.8	1.3	28.3	0.03

EP = extremely preterm; SD = standard deviation; CI = confidence interval.
Raw scores are given for all scales. Higher scores indicate more problems.
Analysed performed with linear longitudinal regression models.
[a] Data missing for 3 EP-born.

3.6. Changes over time for self-reported mental health (YSR and ASR) compared for EP-born vs. term-born controls

As visualised in Fig. 2, the trend on all syndrome scales indicated that the EP-born group reported more problems compared to term-born controls, with significantly more broadband externalising problems and on the syndrome scale of anxious/depressed problems. Only minimal effects were found when adjusting for gender differences (data not shown).

4. Discussion

Adults born EP in the early 1990sreported more mental problems than term-born controls at 27 years of age, particularly internalising problems, and problems were increasing during the period from 18 to 27 years, specifically issues relating to anxiety and depression. The EP-born group scored poorer than term-born on the HRQoL domain physical functioning, whereas scores for the remaining seven domains were similar.

Our finding of more mental health problems in EP-born, particularly internalising problems, are in line with a meta-analysis from 2017 based on six cohorts of adults born VLBW [8], and a review by Mathewson et al. [28], both indicating more depression and anxiety in adults born ELBW. Internalising problems incorporate problems within the self, such as anxiety, depression and withdrawal from social interactions [19]. Interestingly, anxiety has been suggested to characterise the preterm born behavioral phenotype [29], which our results certainly support. The book *Preemie Voices* by Saroj Saigal, with personal narratives told by EP-born adults, highlights anxiety as a common concern [30].

It is of concern that 25 % of our EP-born participants were either unemployed or received disability benefits, compared to none in the term-born control group. This is in line with the findings of a meta-analysis reporting on unemployment rates in EP-born populations [5]. Interestingly, a European longitudinal study, reporting on data from the general population, found that depressive symptoms were associated with risk of unemployment [31]. We do not know if these features are

Table 3
Self-reported functional health and well-being at 27-years of age in 24 subjects born EP, and 24 matched term-born controls using the RAND-36 questionnaire[a].

RAND-36 domains	EP-born ($n = 24$)		Term-born controls ($n = 25$)		EP-born vs. term-born controls	
	Mean	SD	Mean	SD	Mean difference with 95 % CI	*p*-Value[b]
Physical functioning	93.1	8.6	98.0	4.8	−5.0 (−9.1, −0.8)	0.02
Role physical	84.8	29.9	92.0	17.3	−7.2 (−21.7, 7.3)	0.32
Bodily pain	80.7	19.8	86.9	18.9	−6.3 (−17.5, 5.0.8)	0.27
General health	68.5	21.8	75.6	21.5	−6.3 (−19.7, 5.5)	0.26
Vitality[c]	61.0	21.5	63.2	20.5	−2.3 (−14.7, 10.1)	0.71
Social functioning	78.8	27.3	88.0	18.6	−9.2 (−23.0, 4.6)	0.18
Role emotional	79.7	29.7	86.7	30.4	−7.0 (−24.4, 10.5)	0.43
Mental health[c]	75.6	16.0	78.9	18.7	−3.2 (−13.4, 7.0)	0.52

CI = confidence interval; EP = extremely preterm; SD = standard deviation.
[a] RAND-36, with possible domain scores from 0 to 100, where higher scores indicate better functional health and well-being.
[b] Analyses performed with Welch's *t*-test.
[c] Data missing for one EP-born.

causally related, and if they are, in which direction the relationship works; however, targeting depressive symptoms in EP-born populations will nonetheless contribute to a reduced burden of disease and social disadvantage. Gender has also been linked to mental health with more internalising problems for females [32], this was not the case in our study. This same lack of effect from gender was found also in another Norwegian low-birthweight study [33], but contrasts others which report more depression and anxiety in women born VLBW [34].

A better understanding of modifiable factors that may affect an increased risk of mental health problems linked to preterm birth is important, as it may point out avenues for intervention. Several studies have looked into this. Saigals group in Canada found that maternal anxiety disorder was associated with more internalising problems in adult offspring born ELBW [35]. Another study found high afternoon cortisol levels in EP-born adults, which led the authors to suggest that the neuroendocrine system may affect the development of psychopathology [36]. Yet another study pointed out gene–environment interactions that predicted internalising problems in the third and fourth decades of life [37]. Finally, a forth study suggested that smaller cerebellar volume in young adults born VLBW may be a biomarker of increased risk of psychiatric problems [38]. These findings and hypotheses may all represent possible associations that are involved in causal chains leading to internalising problems in preterm born adults, as observed in or our cohort. However, the scant volume of literature, as well as a tendency for arguments being built on somewhat weak evidence, display our lack of understanding of these issues, and the need for more research.

Developmental trends should be described in order to properly appreciate the life-long impact of preterm birth, with the transition from being a teenager living at home to independent adult life being particularly important. Most studies addressing this subject are done in groups born at very low birthweight; i.e. born more mature than the participants of the present study. We found that mental health problems increased from 18 to 27 years, in line with a Norwegian cohort born VLBW in the 1980s, reporting increasing mental health problems from adolescence to young adulthood [39]. A Canadian study [40] investigating a group born VLBW in the 1980s, found that internalising problems persisted in preterm born but decreased in term-born. These studies based on self-reports are supported by a study where depression and anxiety were diagnosed by interviews [41], as well as by a study suggesting that psychiatric hospital admissions increased with the degree of preterm birth [42]. A meta-analysis found higher odds for ASD, ADHD, anxiety disorder and Mood Disorders in adults born very preterm or at VLBW compared to controls born at term [43], and a systematic review found increased risk of use of any psychotropic medication in adults born very preterm or with VLBW during 1977–1995 [12].

Having a mental disorder while growing up is a potent risk factor for psychiatric problems later in life, but early interventions to ameliorate distress and access to treatment can reduce this risk [44]. EP-born children tend to be followed systematically only during their first few years of life [45], in Norway until the age of five years [46]. Our and other's findings pinpoint that preterm-born adults are at increased risk of mental and psychiatric problems, making surveillance and early interventions highly relevant in this group. This supports the cost-effectiveness of systematic follow-up of preterm born individuals, extending beyond early childhood, in line with suggestions proposed in a recent review [47]. The authors advocate a paradigm shift toward proactive interventions in this high risk group, rather than the reactive practice of waiting for aberrant tendencies becoming apparent.

Regarding HRQoL, the outcomes were good in all domains except physical functioning, which is in line with a recent study of young adults born VLBW in Canada [48]. Importantly, both the term-born and EP-born groups scored in line with normative data of the Norwegian

Table 4
Estimated changes from 18 to 27 years in scores of Youth Self-Report (YSR) and Adult Self-Report (ASR).

	EP-born ($n = 33$)[a]				Term-born controls ($n = 32$)[b]				EP-born vs. term-born controls			
	Estimate[c]	Lower CI	Upper CI	*p*-Value	Estimate[c]	Lower CI	Upper CI	*p*-Value	Estimate	Lower CI	Upper CI	*p*-Value
Raw scores												
Anxious/depressed	5.4	2.9	8.0	<0.001	2.4	0.8	4.1	0.005	3.0	0.0	6.0	0.05
Withdrawn	0.1	−1.2	1.4	0.85	−0.7	−1.5	0.1	0.08	0.8	−0.7	2.3	0.27
Somatic complaints	1.8	0.0	3.6	0.05	0.4	−1.0	1.8	0.54	1.4	−0.8	3.6	0.21
Thought problems	−1.0	−2.6	0.6	0.22	−0.5	−1.3	0.3	0.18	−0.4	−2.2	1.3	0.61
Attention problems	2.5	0.6	4.4	0.01	1.2	0.0	2.5	0.06	1.3	−1.0	3.5	0.26
Aggressive behaviour	−0.8	−2.9	1.3	0.42	−3.1	−4.4	−1.9	<0.001	2.3	−0.1	4.7	0.06
Rule-breaking behaviour	−2.2	−3.4	−1.1	<0.001	−3.7	−4.7	−2.6	<0.001	1.5	−0.1	3.0	0.06
Internalising problems	6.9	2.4	11.4	0.004	2.2	−0.6	5.0	0.11	4.7	−0.5	9.9	0.08
Externalising problems	−1.8	−4.5	0.9	0.18	−5.3	−7.3	−3.4	<0.001	3.6	0.3	6.8	0.03
Total problems	9.1	−1.6	19.9	0.09	−0.5	−6.9	5.9	0.87	9.7	−2.7	22.0	0.12

EP = extremely preterm, CI = confidence interval.
Raw scores are given for all scales. Higher scores indicate more problems.
Analysed performed with linear longitudinal regression models with group (EP-born vs. term-born), age (18 vs. 27 years) and the group–age interaction as explanatory variables.
[a] At 18 years 31 cases, and at 27 years 21 cases.
[b] At 18 years 29 term-born controls, and 27 years 26 term-born controls.
[c] Estimate of 27 years minus 18 years.

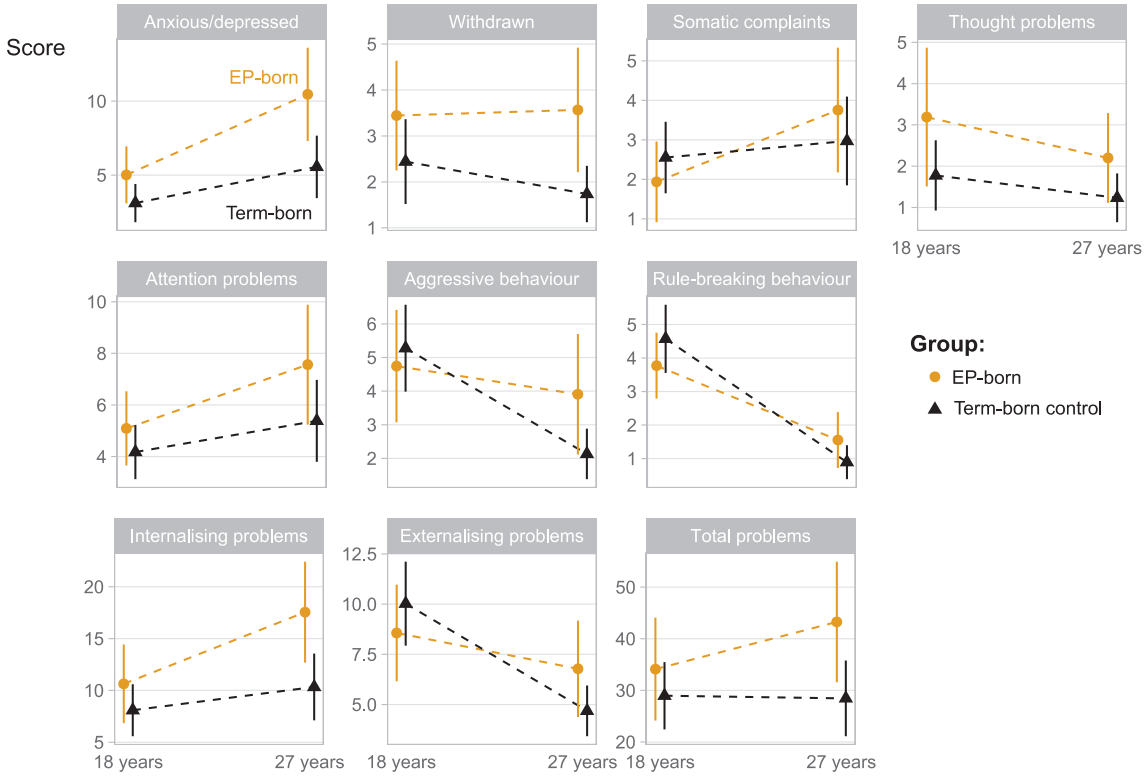

Fig. 2. Estimated change in mental health syndromes scales (YSR, ASR), with 95 % confidence internal, at 18 and 27 years for the EP-born and term-born controls. Increasing scores imply more mental health problem.

population [25]. This contrasts our previous study of a cohort born in the early 1980s [15], where EP-born had poorer HRQoL scores in almost all domains. This leads us to speculate if individuals born EP in the modern era of neonatal intensive care, after the introduction of surfactant (such as this present 1991–92 cohort), may fare better on HRQoL. Our data is difficult to interpret on this, as the 1980 and 1990 groups differed on disabilities like cerebral palsy, which will have an influence on HRQoL. Morbidity and disability data from this cohort are in line with similar cohorts of extremely preterm born infants [49].

4.1. Strengths and limitations

The major strengths of the study were the population-based design and the relatively high follow-up rate, and the fact that we have information about the non-participants. No subjects in this cohort had major impairments, therefore the results may not be representative to those with neurosensory impairments such as CP, severe hearing or visual deficits, or low IQ. Further, we used validated measurements for self-reported mental health and HRQoL.

The major limitation was the low number of participants, so the findings must therefore be cautiously interpreted, especially non-significant group differences. Attrition is a challenge in longitudinal studies, but the participation rate was comparable to other follow-up studies with similar study populations [50], and participants and non-participants were similar when compared by important background data. It has to be noted that our participants were born and raised in a country with universal access to health care for all, and therefore results may be seen most relevant to similar societies.

5. Conclusion

Mental health problems increased from 18 to 27 years age in EP-born adults and exceeded those of term-born controls, while HRQoL between groups was similar. The data suggest that extremely preterm birth should be considered a high-risk factor for poor mental health in adulthood, and support a proactive attitude to mitigate this during younger ages.

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CrediT authorship contribution statement

MB: Conceptualised, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Validation. **BV:** Conceptualised, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Validation. **JD:** Formal analysis, Writing – original draft, Writing – review & editing, Validation. **MV:** Funding acquisition, Investigation, Supervision, Writing – original draft, Writing – review & editing, Validation. **TH:** Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Validation. **KOH:** Supervision, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Validation.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.earlhumdev.2022.105661.

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