

Regular Article

Very preterm birth and trajectories of domain-specific self-concept from childhood into adulthood

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Abstract

Self-concept refers to individuals' perceptions of themselves in specific domains and is closely related with their overall self-esteem. Lower self-esteem has been reported in those born preterm (<37 weeks gestation), but the development of self-concept has not been studied in this population. This study investigates whether differences in trajectories of domain-specific self-concepts are explained by premature birth or other risk factors, using the Bavarian Longitudinal Study ($N = 460$), a population-based study of very preterm (VP; <32 weeks gestation)/very low birth weight (VLBW; <1500 g) cohort and term-born controls. Trajectories of body and social self-concept from 6 to 26 years of age were estimated using latent class growth analysis. Regression models examined the effects of VP/VLBW and other individual, social, and family factors. Two trajectories – one stable and one decreasing – were identified for both self-concepts. VP/VLBW birth was associated with decreasing self-concept in both domains, although the effect of VP/VLBW on social self-concept was weakened in the adjusted analysis. Furthermore, mediated pathways were found from VP/VLBW to decreasing social self-concept via chronic bullying ($\beta = 0.05$, 95% CI [0.002, 0.12]) and motor impairments ($\beta = 0.04$, 95% CI [0.01, 0.07]), suggesting that negative self-concept in the VP/VLBW population is partially modifiable through improving peer relationships and motor impairments in childhood.

Keywords: bullying, longitudinal, low birth weight, preterm birth, self-concept

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Introduction

There has been an increasing interest in examining whether exposure to significant biological adversity, such as preterm birth, and subsequent developmental impairment affect the development of global self-esteem (Poole, Schmidt, Saigal, et al., 2018). However, less attention has focused on the development of domain-specific self-concept in these at-risk populations. Domain-specific self-concept can be differentiated from global self-esteem, as the former reflects multidimensional perceptions individuals hold on specific domains such as body satisfaction, social acceptance, and athletic competence, whereas the latter has been defined as the unidimensional evaluations of the self as a whole (Kernis, 2006; King, 1997). Both are associated with long-term outcomes in mental health, education, and employability, although domain-specific self-concept has been found to be a better predictor of specific behavioral outcomes such as academic achievements (Kernis, 2006; von Soest, Wichstrøm, & Kvaem, 2016). Although global self-esteem has been shown to be closely correlated with certain domain-specific self-concepts such as body satisfaction (von Soest et al., 2016), other self-concept domains may show different development over time and are also influenced by

different factors in the general population (Boulton, Smith, & Cowie, 2010; Cole et al., 2001; Schaffhuser, Allemand, & Schwarz, 2017). There is little research on the development of domain-specific self-concept over time in the preterm population, and the mechanism in which biological adversity may affect self-concept development remains to be investigated.

Self-concept development in the preterm population

Around 15 million infants, or 10.6% of all births around the world, are preterm births (Chawanpaiboon et al., 2019; Wolke, Johnson, & Mendonça, 2019). Of these, 15% are born very preterm (VP; <32 weeks gestation) or at very low birth weight (VLBW; <1500 g) (Chawanpaiboon et al., 2019). The majority of research on long-term outcomes following VP/VLBW birth has focused on mental health and neuro-cognitive outcomes, with consistent findings of increased psychiatric disorders and cognitive and motor impairments in both childhood and adulthood (Cheong, Spittle, Burnett, Anderson, & Doyle, 2020; Johnson et al., 2009; Spittle, Cameron, Doyle, & Cheong, 2018; Wolke et al., 2019). In recent years there has also been a focus on examining social development in this population, such as global self-esteem in childhood (Finnström, Gäddlin, Leijon, Samuelsson, & Wadsby, 2003; Gire et al., 2019; Islam et al., 2018) or adulthood (Lund et al., 2012; Roberts et al., 2013; Saigal et al., 2016). Mixed findings have been reported, with some finding lower global self-esteem in VP/VLBW compared

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to term-born controls and others showing no differences. Only two publications have reported on the longitudinal development of global self-esteem and found consistently low self-esteem from childhood to adulthood (14–35 years of age) in extremely low birth weight individuals (<1000 g) (Poole, Schmidt, Ferro, et al., 2018; Poole, Schmidt, Saigal, et al., 2018). However, to our knowledge, no studies have investigated the long-term development of domain-specific self-concept in the VP/VLBW population. Furthermore, not all those born VP/VLBW will develop in the same way. Thus, rather than examining mean differences between groups over time, a person-centered approach can be used to examine growth in the whole population and group individuals together based on similar developmental trajectories (Chow & Kennedy, 2014). This then allows the investigation of whether it is being born VP/VLBW *per se* or other risk factors in the population that are associated with or mediate the effect of VP/VLBW in the development of specific domains of self-concept.

One such risk factor to consider is peer bullying, which has been associated with negative self-concept in body satisfaction and social acceptance (Adams & Bukowski, 2008; Boulton et al., 2010). There is also strong evidence in the literature that VP/VLBW children are more likely to be bullied in school, as bullies tend to pick on those who are weaker, more emotionally reactive, and have fewer friends – all of which are more likely to be found in VP/VLBW children (Day, Van Lieshout, Vaillancourt, & Schmidt, 2015; Wolke, Baumann, Strauss, Johnson, & Marlow, 2015). Increased exposure to bullying may thus be associated with both VP/VLBW birth and self-concept development, and thus a potential mediator in particular for the domains of body satisfaction and social acceptance.

The association between VP/VLBW birth and domain-specific self-concept may also be explained by increased developmental impairments in childhood, such as cognitive and motor impairments, which are more prevalent in VP/VLBW children (Johnson et al., 2009; Spittle et al., 2018). There is evidence that motor impairments may be associated with negative self-concept in domains of social acceptance and athletic competence, suggesting that motor impairments not only affect individuals' perceptions of their physical abilities, but may also increase the risk of self-perceived peer rejection (Cocks, Barton, & Donnelly, 2009; Shields, Murdoch, Loy, Dodd, & Taylor, 2006). Childhood IQ has also been associated with reduced self-concept in cognitive competence (Paulus, Licata, Gniewosz, & Sodian, 2018), and lower cognitive abilities may also affect the acquisition of prosocial skills, which in turn can affect social competence and peer acceptance (Bellanti & Bierman, 2000). Thus, both IQ and motor impairments may account for associations between VP/VLBW birth and differences in domain-specific self-concept development over time.

As well as these risk factors, which are more prevalent in the VP/VLBW population, it is also important to account and control in analyses for risk factors previously reported in the general population. For example, one of the most consistent findings in the literature is that women have lower self-concept on physical appearance compared to men (Gentile et al., 2009). This gender gap appears to be largest during adolescence and has been found cross-culturally, suggesting the presence of universally shared social and cultural factors, such as increased exposure to unrealistic body standards portrayed in the media (Perry & Pauletti, 2011; Wilgenbusch & Merrell, 1999). A longitudinal investigation of the trajectories of self-concept development

further found that girls showed a steeper decline in their body self-concept compared to boys over a 2-year period in adolescence (Schaffhuser et al., 2017). Maternal sensitivity has also been associated with positive social self-concept, as positive parent–child interactions can provide the child with the first working model of a person who is loved and provide a template for all future social relationships (Harter, 2006; Paulus et al., 2018). Although sensitivity in interaction has not been shown to be overall lower in mothers of children born VP/VLBW (Bilgin & Wolke, 2015), it may still have an association with certain self-concept domains such as social acceptance. In addition, socioeconomic status (SES) will also be considered as a control variable as this has been shown to be associated with lower global self-esteem (Orth, Trzesniewski, & Robins, 2010), but research is sparse on its association with domain-specific self-concept.

The present research

The overall aim of this prospective study was to examine patterns and predictors of domain-specific self-concept development in VP/VLBW and term-born controls in the Bavarian Longitudinal Study (BLS) – a regionally defined population-based cohort followed from birth until 26 years of age. The aim was to identify distinct self-concept trajectories for each domain using a person-centered growth modeling approach and then to examine whether VP/VLBW birth explained differences between these trajectories after accounting for other individual, social, and family factors. Given that VP/VLBW birth has been associated with some of these risk factors, including peer bullying, IQ, and motor impairments, further investigations were then carried out to examine whether these factors mediated any relationship between VP/VLBW and different self-concept trajectories.

Method

Design and participants

The BLS is a prospective population-based study of children born in southern Bavaria, Germany, between January 1985 and March 1986, who required admission to hospitals within the first 10 days of birth (Wolke & Meyer, 1999). A detailed description of the sample has been reported previously (Eryigit Madzwamuse, Baumann, Jaekel, Bartmann, & Wolke, 2015). In total, 234 (57%) VP/VLBW and 226 (73%) term-born controls (>36 weeks gestation) completed self-concept assessments up to 26 years of age (see Figure 1). Ethical approval was obtained from the University of Munich Children's Hospital, the Bavarian Health Council and the Ethical Board of the University Hospital Bonn. Parents gave informed written consent in childhood and all participants gave informed written consent for the assessment in adulthood.

Measures

Self-concept at 6 and 8 years of age

Self-concept at 6 years of age was assessed using the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children, also known as the Harter Scale (Harter & Pike, 1984), on children's perception of their competence across four domains: cognition ("know the alphabet"), motor ("can climb"), social acceptance ("has friends to play with"), and maternal relationships ("mother plays with them"). There are six items in each domain, each scored on a 4-point scale (1 = *poor self-esteem*;

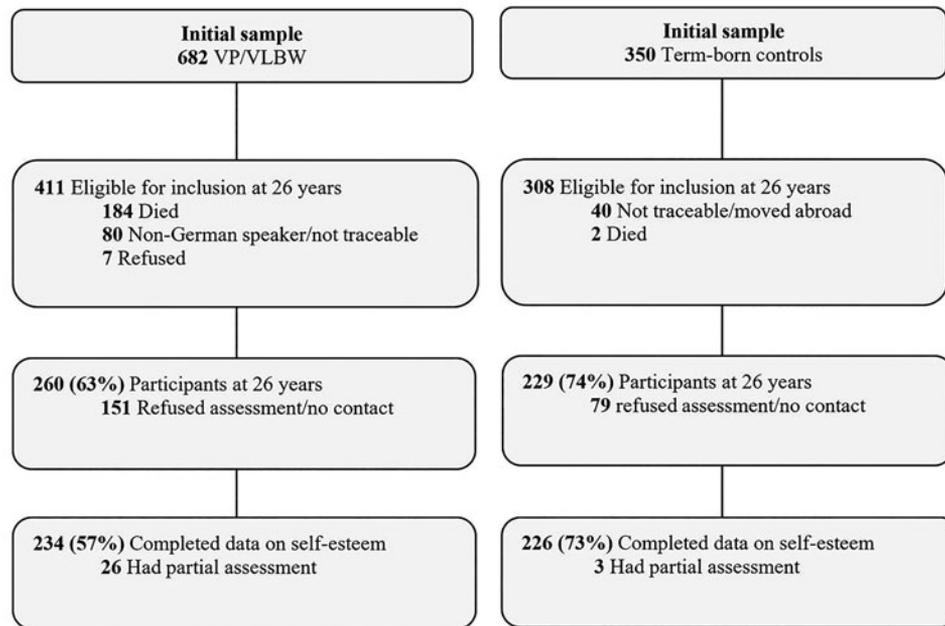


Figure 1. Participant flowchart.

4 = good self-esteem). Pictures representing different items were used due to the young age of the participants, and participants were interviewed to rate their competence in each item. The same assessment was repeated at 8 years of age, but included a fifth domain on body satisfaction (“happy with own looks”), which contained a further six items.

Self-concept at 13 and 26 years of age

Self-concept at 13 and 26 years of age was assessed with the German adaptation of Nicholls’ Self-concept of Attainment (Nicholls, 1978), which was designed to assess self-concept on the same five domains as the Harter Scale. Participants were presented with 25 faces in a vertical line, with a positive sentence (“happy with how I look”) at the top and a negative one (“not happy with how I look”) at the bottom. Participants were asked to tick the face that best represented how closely they identified with the sentence. Scores ranged from 1 to 25, with higher scores indicating higher perceived competence. There were 16 items at age 13 and eight items at age 26, representing the same five domains as the Harter Scale. The domains of body satisfaction and social acceptance showed acceptable reliability across all age points of assessment (Cronbach’s $\alpha > .70$; see Table S1 of the Supplementary Material), comparable to other studies that also used the Harter Scale (Eapen, Naqvi, & Al-Dhaheri, 2000; Gacek, Pilecka, & Fusińska-Korpik, 2014). The cognitive domain showed poor internal reliability across all ages (α (alpha) = 0.55–0.63), and motor and maternal relationships were only assessed using one item at 26 years of age; it was therefore not possible to calculate internal reliability. Only domains with at least three assessment points into adulthood were included for analysis, and only if they were assessed by more than two items; thus, motor and maternal relationships were excluded as they were only assessed by one item in adulthood, and the cognitive domain was also excluded due to the questionable internal reliability. The domains of body satisfaction and social acceptance were examined in subsequent analyses.

Predictors of self-concept

Individual factors

Sex. Biological sex was coded as male or female, with male being the reference group.

Cognition. IQ at 6 years of age was assessed using the Kaufman Assessment Battery for Children Mental Processing Component (Kaufman & Kaufman, 1983), which is a standardized test with a mean score of 100 and a standard deviation (SD) of 15.

Motor impairment. Motor impairment was assessed at 6 years of age using the Test of Motor Impairment (Stott, Moyes, & Headridge, 1968). Scores ranged from 0 to 16, with higher scores indicating more motor problems.

Peer relationships

Being bullied. Being bullied by peers at 6 and 8 years of age was assessed via a structured parent interview (Wolke et al., 2015), while being bullied at age 13 was reported by parents using one item from the Strengths and Difficulties Questionnaire (Goodman, 2001), both of which have been reported previously (Wolke et al., 2015). Any bullying at age 6 or 8 indicated being bullied in childhood, while bullying at age 13 was considered as being bullied in adolescence. Three groups were constructed: (a) not bullied, (b) bullied at one time period (childhood or adolescence), and (c) bullied at both time periods (childhood and adolescence).

Parenting (maternal sensitivity)

Parent–child interaction was assessed using the Assessment of Mother–Child Interactions with the Etch-a-Sketch at age 6 (Wolke, Jaekel, Hall, & Baumann, 2013; Wolke, Rios, & Unzer, 1995). Participants were observed and video-recorded during a collaborative play situation and two independent psychologists who were blind to group and family characteristics evaluated the sessions. There were five subscales – maternal verbal control,

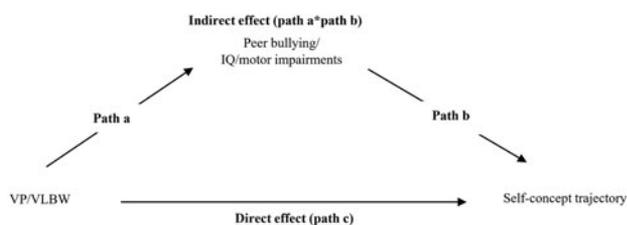


Figure 2. Conceptual model showing the direct and indirect effects of very preterm/very low birth weight (VP/VLBW) on self-concept via peer bullying, IQ, or motor impairments.

maternal nonverbal control, maternal criticism, harmony, and control of the session – with good inter-rater reliability (0.76–0.89) (Jaekel, Wolke, & Chernova, 2012). Using principle component and reliability analyses, these scales were combined into an index scale of maternal sensitivity (α ($alpha$) = 0.58).

Family context (SES)

SES at birth was computed as a weighted composite score of parents' education and occupation, grouped as low, middle, or high (Wolke & Meyer, 1999), with upper social class as the reference group.

Statistical analysis

Primary analysis

Latent class growth analyses (LCGA) were conducted in MPlus version 8 to examine trajectories of self-concept from childhood to adulthood. Analyses were conducted separately for each self-concept domain. Body self-concept was assessed at three time periods (8, 13, and 26 years of age) and social self-concept was assessed at four time periods (6, 8, 13, and 26 years of age). Standardized mean scores for each self-concept were used in the analyses. Criteria assessing model fit included the Bayesian information criterion (BIC), adjusted BIC (aBIC), parametric bootstrapped likelihood ratio test (BLRT), the Lo–Mendell–Rubin (LMR) test, and the Vuong–Lo–Mendell–Rubin ratio (VLMR) test. To handle missing data, the full information maximum likelihood approach was used in MPlus. The estimated trajectory classes of participants were saved and exported to R 3.6.0 for further analyses. This method has been shown to create some bias as the trajectory of each participant is considered as an observed variable rather than a latent variable with proportional likelihood taken into account (Vermunt, 2010). However, missing data on predictor variables and subsequent multiple imputation present a complex problem within Mplus (Lanza, 2016); further analysis were thus conducted in R.

Simple logistic regression models first examined whether being born VP/VLBW explained differences between the trajectories identified. Multiple logistic regression models were then used to examine whether other individual, social, and family factors explained differences between the trajectories. The possible interaction between VP/VLBW birth and sex was further explored. A correlation table showing the relationship between all predictors is provided in the Supplementary Material (Table S2).

Mediation analysis

Peer bullying, IQ, and motor impairments were examined as potential mediators if they were also significantly associated with differences in self-concept trajectories over time. Using the lavaan and semTools packages, path analysis was used to calculate standardized path estimates from VP/VLBW birth to peer bullying/IQ/motor impairments (path a), peer bullying/IQ/motor impairments to self-concept trajectories (path b), and VP/VLBW to self-concept trajectories (path c) (Figure 2). If multiple mediators were associated with self-concept trajectories, they were examined in the same model and covariance between the mediators was accounted for. The mediated effect was calculated as the product of path a and path b, and estimated using the RMediation package, which has been shown to generate reliable confidence intervals (CIs) using the Monte Carlo method and is comparable to results from bootstrapping (Tofighi & MacKinnon, 2011, 2016).

IQ/motor impairments (path a), peer bullying/IQ/motor impairments to self-concept trajectories (path b), and VP/VLBW to self-concept trajectories (path c) (Figure 2). If multiple mediators were associated with self-concept trajectories, they were examined in the same model and covariance between the mediators was accounted for. The mediated effect was calculated as the product of path a and path b, and estimated using the RMediation package, which has been shown to generate reliable confidence intervals (CIs) using the Monte Carlo method and is comparable to results from bootstrapping (Tofighi & MacKinnon, 2011, 2016).

Sensitivity analysis

To avoid the problem of common method variance with self-reported self-concepts (Tehseen, Ramayah, & Sajilan, 2017), only parent-reported measures and observations of parenting behaviors were included as predictors. However, self-reported bullying has been found to be more accurate as parents are often not aware of bullying in secondary school (Holt, Kaufman Kantor, & Finkelhor, 2008). As child-reported bullying was also available at 13 years of age in the BLS, and assessed using the same item from the Strengths and Difficulties Questionnaire, this was included in a sensitivity analysis to examine whether the effects of bullying varied with different data sources. The prevalence of bullying when child-reported data were used at 13 years can be found in the Supplementary Material (Table S3).

Missing data

Both IQ and motor impairments were assessed at 6 and 8 years of age. The data gathered at 8 years were used to substitute missing data at 6 years as there is a strong correlation in the scores between these two ages (see the Supplementary Material (Table S4) for details on numbers substituted as well as the correlation between the two ages). The proportion of missing data ranged from 0.2% to 10.7%, and data were deemed likely to be missing at random. Missing data for all predictors were handled using multivariate imputation by chained equations (“mice” package) in R with 40 imputed data sets.

Results

Sample characteristics

Drop-out analyses for the BLS have been described previously, with those dropping out more likely to be of lower SES or to have more neurodevelopmental and behavior difficulties (Eryigit Madzwamuse et al., 2015). The percentage of multiple births for the whole population was 9.3% ($N = 43$), where 16.7% of VP/VLBW participants and 1.8% of term-born controls had a sibling who was included in the study (Table 1).

A detailed description of the sample is provided in Table 1, along with the average gestational age and birth weight of each group. The VP/VLBW group was more likely to be from lower SES, more frequently bullied in both childhood and adolescence, had on average less sensitive mothers, and had more cognitive and motor deficits compared with the term-born controls. They also had lower social self-concept scores at 13 and 26 years of age.

Self-esteem trajectories

Model fit statistics for LCGA can be found in Table 2 and trajectory plots can be found in Figure 3. Overall, the classifications

Table 1. Sample characteristics

	VP/VLBW		Control		p-value
	n	%	n	%	
Multiple births	39	16.7%	4	1.8%	<0.001
Sex					0.161
Male	124	53.0%	105	46.5%	
Female	110	47.0%	121	53.5%	
SES					0.018
Upper class	52	22.3%	76	33.6%	
Middle class	110	47.2%	98	43.4%	
Lower class	71	30.5%	52	23.0%	
Bullying					0.023
Not bullied	58	30.7%	93	41.9%	
Bullied at one time period	90	47.6%	108	48.6%	
Bullied at both time periods	41	21.7%	21	9.5%	
	<i>M (SD)</i>		<i>M (SD)</i>		p-value
Birth weight (g)	1329.32 (318.90)		3362.26 (446.75)		<0.001
Gestational age (weeks)	30.59 (2.17)		39.65 (1.18)		<0.001
IQ (<i>M, SD</i>)	89.70 (13.95)		102.03 (11.39)		<0.001
Motor (<i>M, SD</i>)	3.08 (3.37)		1.24 (1.74)		<0.001
Maternal sensitivity	-0.05 (0.72)		0.18 (0.56)		0.001
Self-concept (z-score)					
Social 6 years	-0.10 (1.06)		0.09 (0.94)		0.051
Social 8 years	-0.80 (1.01)		0.07 (0.99)		0.117
Social 13 years	-0.14 (1.15)		0.13 (0.82)		0.005
Social 26 years	-0.14 (1.11)		0.14 (0.85)		0.002
Body 8 years	0.02 (1.01)		-0.01 (1.00)		0.755
Body 13 years	0.06 (0.95)		-0.06 (1.04)		0.198
Body 26 years	-0.03 (1.11)		0.03 (0.87)		0.559

Note: VP = very preterm; VLBW = very low birth weight; SES = socioeconomic status

showed high entropy and average class probabilities were high for both body (0.85–0.98) and social self-concepts (0.75–0.97), indicating good model fit.

The two-trajectory solution was found to be the best, given the model fit criteria for both body and social self-concepts. Furthermore, they both showed similar trajectories from childhood to adulthood. Those who belonged to trajectory 1 for body self-concept (84.8%) and social self-concept (84.6%) showed stable development over time (stable trajectory). Those who belonged to trajectory 2 for body self-concept (15.2%) and social self-concept (15.4%) showed decreasing levels over time (decreasing trajectory).

Primary analysis: predictors of self-esteem trajectories

VP/VLBW

Being born VP/VLBW was found to be a significant predictor for having decreasing body self-concept (odds ratio (OR) = 1.91, 95% CI [1.13, 3.25]) and social self-concept over time (OR = 2.28, 95% CI [1.33, 3.89]) (Table 3).

Individual, social, and family contextual risk factors

When adjusted for all other predictors, there was still an effect of VP/VLBW on body self-concept (OR = 2.00, 95% CI [1.07, 3.75]); however, the effect of VP/VLBW on social self-concept was reduced (OR = 1.82, 95% CI [0.96, 3.45]) (Table 3). Being female was predictive of having decreasing body self-concept (OR = 3.03, 95% CI [1.70, 5.42]) and social self-concept (OR = 2.23, 95% CI [1.28, 3.91]); however, no interaction effect was found between VP/VLBW birth and sex. Motor impairment in childhood was further associated with decreasing social self-concept over time (OR = 1.17, 95% CI [1.06, 1.29]) (Table 3).

Mediation analysis

Only motor impairment was examined as a mediator, as no associations were found from peer bullying or IQ to self-concept trajectories (Table 3). An indirect pathway was found from VP/VLBW birth to decreasing social self-concept over time via increased motor impairments ($\beta = 0.03$, 95% CI [0.01, 0.07]),

Table 2. Fit statistics for latent class growth analyses (LCGA) estimated within body self-concept and social self-concept in the Bavarian Longitudinal Study (BLS)

Indicator of model fit	Body satisfaction			Social acceptance		
	1-trajectory LCGA model	2- trajectory LCGA model	3- trajectory LCGA model	1- trajectory LCGA model	2- trajectory LCGA model	3- trajectory LCGA model
BIC	3709.717	3651.973	3624.419	4853.333	4817.707	4809.124
aBIC	3676.668	3606.530	3566.582	4816.152	4768.133	4747.156
BLRT (k vs. k-1 class)	n/a	$p < .001$	$p < .001$	n/a	$p < .001$	$p < .001$
LMR (k vs. k-1 class)	n/a	$p < .001$	$p = .075$	n/a	$p = .010$	$p = .075$
VLMR (k vs. k-1 class)	n/a	$p < .001$	$p = .066$	n/a	$p = .008$	$p = .067$
Entropy	n/a	0.840	0.790	n/a	0.769	0.788
Participants per trajectory (%)						
Trajectory 1	460	390 (84.8%)	351 (76.3%)	460	389 (84.6%)	284 (61.7%)
Trajectory 2	n/a	70 (15.2%)	62 (13.5%)	n/a	71 (15.4%)	150 (32.6%)
Trajectory 3	n/a	n/a	47 (10.2%)	n/a	n/a	26 (5.7%)

Note: BIC = Bayesian information criterion; aBIC = adjusted BIC; BLRT = parametric bootstrapped likelihood ratio test; LMR = Lo-Mendell-Rubin test; VLMR = Vuong-Lo-Mendell-Rubin ratio

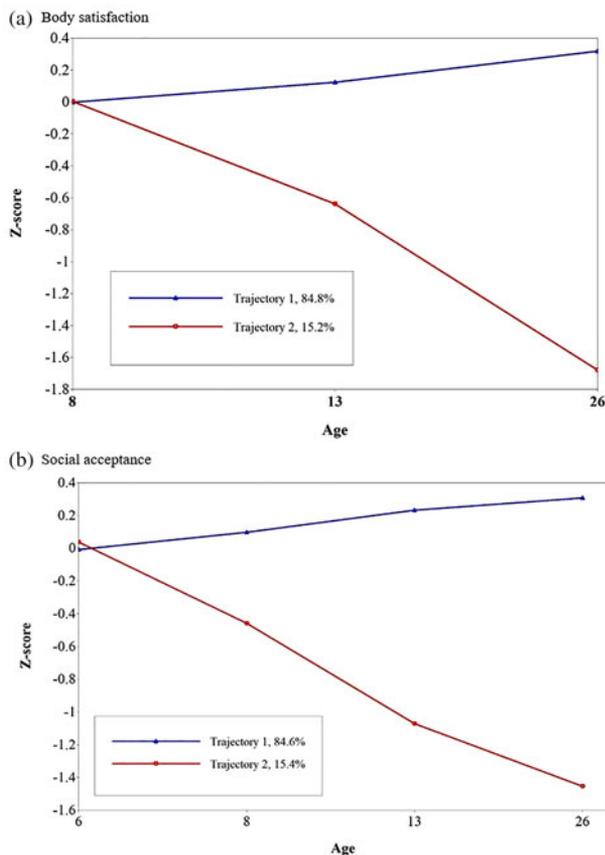


Figure 3. Trajectories for the development of (a) body self-concept from 8 to 26 years of age and (b) social self-concept from 6 to 26 years of age.

which accounted for 15.8% of the total effect of VP/VLBW birth on the social self-concept trajectory (Table 4; Figure 4).

Sensitivity analysis

When child-reported bullying data were used at 13 years of age, a stronger effect of chronic bullying (being bullied at both time

periods) emerged for both body self-concept ($OR = 2.21$, 95% CI [1.05, 4.69]) and social self-concept ($OR = 3.25$, 95% CI [1.52, 6.99]) trajectories (Table 5). As being bullied at one time period was not associated with increased risk of decreasing self-concept, only chronic bullying was examined in further analysis as a potential mediator (compared to not being bullied or bullied at one time period only). Although VP/VLBW birth was associated with increased risk of chronic bullying, and chronic bullying was also associated with decreasing body self-concept, the mediated effect was not statistically significant ($\beta = 0.04$, 95% CI [-0.001, 0.11]) (Figure 5a).

As both chronic bullying and motor impairments were associated with decreasing social self-concept, both were examined as mediators in the same model. Both mediated pathways were significant: chronic bullying mediated 23.8% ($\beta = 0.05$, 95% CI [0.002, 0.120]) and motor impairments 19% ($\beta = 0.04$, 95% CI [0.01, 0.07]) of the total effect of VP/VLBW birth on social self-concept trajectory (Figure 5b). No associations were found between motor impairments and chronic bullying.

Discussion

The current study aimed to identify trajectories and predictors of self-concept development in body satisfaction and social acceptance in the VP/VLBW population. Both self-concepts showed a stable trajectory and a decreasing trajectory from childhood to adulthood. VP/VLBW birth was associated with decreasing trajectories in both self-concept domains over time, although its association with decreasing social self-concept was weakened once other factors were taken into account. Being female was associated with the highest risk of having decreasing body and social self-concept from childhood to adulthood. Motor impairment was associated with decreasing social self-concept, while chronic bullying (being bullied at both time periods – in childhood and adolescence) was further associated with decreasing body and social self-concept over time, but only when child-reported bullying was used at 13 years of age instead of parent-reports.

Similar to the findings on global self-esteem development from a previous extremely low birth weight cohort (Poole, Schmidt, Ferro, et al., 2018; Poole, Schmidt, Saigal, et al., 2018), this

Table 3. Primary analysis: Simple and multiple logistic regression models on predictors of decreasing body and social self-concept trajectories (trajectory 2) (N = 460)

		Body		Social	
		Trajectory 2		Trajectory 2	
		OR [95% CI]	p-value	OR [95% CI]	p-value
Biological risk	VP/VLBW (unadjusted)	1.91 [1.13, 3.25]	0.016	2.28 [1.33, 3.89]	0.003
Biological risk	VP/VLBW	2.00 [1.07, 3.75]	0.031	1.82 [0.96, 3.45]	0.066
Peer relations	Bullying				
	Bullied at one time period	0.86 [0.45, 1.64]	0.643	0.91 [0.47, 1.75]	0.778
	Bullied at both times periods	1.70 [0.77, 3.76]	0.190	1.98 [0.92, 4.25]	0.080
Individual differences	Sex (reference: male)	3.03 [1.70, 5.42]	<0.001	2.23 [1.28, 3.91]	0.005
	IQ	1.01 [0.99, 1.04]	0.331	1.01 [0.98, 1.03]	0.607
	Motor	1.02 [0.92, 1.14]	0.694	1.17 [1.06, 1.29]	0.003
Parenting	Maternal sensitivity	0.74 [0.48, 1.14]	0.170	0.99 [0.64, 1.53]	0.962
Family context	SES (reference: upper class)				
	Middle class	0.56 [0.27, 1.14]	0.108	0.68 [0.36, 1.29]	0.236
	Lower class	1.86 [0.94, 3.65]	0.073	0.65 [0.31, 1.33]	0.238
Interaction term	VP/VLBW × Sex	0.69 [0.20, 2.43]	0.561	0.79 [0.24, 2.61]	0.694

Note: VP = very preterm; VLBW = very low birth weight; SES = socioeconomic status
 Bold/italic entries indicate the p value is significant at p<0.05.

Table 4. Standardized path estimates showing the direct and mediated effect of VP/VLBW on social self-concept via motor impairment (N = 460)

	Standardized estimate	95% CI
^a Motor impairment		
VP/VLBW	0.13	[0.03, 0.24]
^b Decreasing social trajectory		
VP/VLBW	0.16	[-0.01, 0.33]
Motor impairment	0.26	[0.14, 0.39]
^c Mediated effect		
VP/VLBW → motor impairment → decreasing social trajectory	0.03	[0.01, 0.07]

Note: VP = very preterm; VLBW = very low birth weight
^aAdjusted for sex and socioeconomic status (SES)
^bAdjusted for each other, as well as sex, SES, bullying, IQ, and maternal sensitivity
^cEstimate and 95% confidence interval (CI) calculated using Monte Carlo method in RMediation package

study found that VP/VLBW birth was associated with decreasing body and social self-concept from childhood to adulthood, although the association with decreasing social self-concept was weakened in the adjusted model. The effect of VP/VLBW birth on decreasing body self-concept remained even after adjusting for other factors, in contrast to a previous study which found no differences in body satisfaction between young adults born VLBW and controls (Lund et al., 2012). However, it has been reported previously that adults born VP (<32 weeks gestation) had three times increased risk of developing eating disorders and also showed higher eating disorder symptoms, including

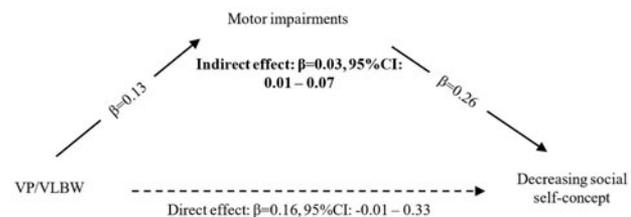


Figure 4. Indirect pathway from very preterm/very low birth weight (VP/VLBW) to decreasing social self-concept via motor impairments.

weight and shape concerns (Micali et al., 2015; Nosarti et al., 2012). This suggests that negative body self-concept may be specific to those born before 32 weeks gestation as no increased risk was observed for those born VLBW (Nosarti et al., 2012).

Chronic bullying was associated with both decreasing body self-concept and social self-concept from childhood to adulthood, but only when child-reported data were used at 13 years of age. The risk of chronic bullying on body self-concept is consistent with previous findings which showed reduced body satisfaction and increased desire for cosmetic surgery in adolescents who were bullied (Carbone-Lopez, Esbensen, & Brick, 2010; Lee, Guy, Dale, & Wolke, 2017). Chronic bullying was also the strongest predictor of having decreasing social self-concept from childhood to adulthood, consistent with findings that victims of bullying often have lower social status and are more isolated by peers who may be reluctant to associate with them for fear of losing their own social position (Guy, Lee, & Wolke, 2019). The effect of chronic bullying was not significant when parent-reported bullying was used at age 13 years. One explanation for this is that self-reported bullying tends to be more

Table 5. Sensitivity analysis using child-reported bullying at 13 years of age: Simple and multiple logistic regression models on predictors of decreasing body and social self-concept trajectories (trajectory 2) ($N = 460$)

		Body self-concept		Social self-concept	
		Trajectory 2		Trajectory 2	
		OR [95% CI]	<i>p</i> -value	OR [95% CI]	<i>p</i> -value
Biological risk	VP/VLBW (unadjusted)	1.91 [1.13, 3.25]	0.016	2.28 [1.33, 3.89]	0.003
Biological risk	VP/VLBW	2.01 [1.07, 3.79]	0.031	1.76 [0.92, 3.34]	0.086
Peer relations	Bullying				
	Bullied at one time period	0.89 [0.45, 1.75]	0.735	1.37 [0.68, 2.76]	0.382
	Bullied at both time periods	2.21 [1.05, 4.69]	0.038	3.25 [1.52, 6.99]	0.003
Individual differences	Sex (reference: male)	3.24 [1.80, 5.85]	<0.001	2.44 [1.37, 4.33]	0.003
	IQ	1.01 [0.99, 1.04]	0.406	1.01 [0.98, 1.03]	0.574
	Motor	1.02 [0.92, 1.14]	0.683	1.19 [1.07, 1.32]	0.001
Parenting	Maternal sensitivity	0.78 [0.50, 1.22]	0.270	1.08 [0.70, 1.68]	0.728
Family context	SES (reference: upper class)				
	Middle class	0.52 [0.26, 1.07]	0.077	0.63 [0.33, 1.21]	0.166
	Lower class	1.75 [0.89, 3.43]	0.106	0.61 [0.30, 1.27]	0.186
Interaction term	VP/VLBW × sex	0.74 [0.21, 2.63]	0.645	0.85 [0.25, 2.87]	0.800

Note: VP = very preterm; VLBW = very low birth weight; SES = socioeconomic status
 Bold/italic entries indicate the *p* value is significant at $p < 0.05$.

accurate, especially during adolescence, as parents are often not aware of bullying behaviors in secondary schools (Holt et al., 2008). This is shown by the higher prevalence of chronic bullying when child-reported data were used (19.2% vs. 15.1%). However, caution may be needed as there may be potential confounding due to systematic variance shared between self-reported bullying and self-reported self-concepts. Furthermore, there may be a bi-directional relationship where lower self-concept may have increased vulnerability to peer bullying, which has been shown previously (Boulton et al., 2010) and requires further investigation.

Although chronic bullying was associated with decreasing body self-concept, the mediated pathway from VP/VLBW birth was not statistically significant. However, a mediated pathway from VP/VLBW birth via chronic bullying was found for decreasing social self-concept from childhood to adulthood. This is consistent with evidence in the literature that VP/VLBW children are more likely to be exposed to bullying (Day et al., 2015; Wolke et al., 2015), and this increased exposure to chronic bullying also accounted for almost a quarter of the effect of VP/VLBW birth on the development of social self-concept over time. This highlights the importance of preventing bullying in schools, especially for high-risk populations such as VP/VLBW children who are more likely to be bullied.

Motor impairment was another risk factor associated with decreasing levels of social self-concept, consistent with previous findings in those with physical impairments (Cocks et al., 2009; Shields et al., 2006; Vedul-Kjelsås, Sigmundsson, Stensdotter, & Haga, 2012). This further mediated the relationship between VP/VLBW birth and decreasing social self-concept, independently from the mediated effect of chronic bullying. This is consistent with the evidence that VP/VLBW children have more motor impairments in childhood (Cheong et al., 2020; Johnson et al., 2009; Spittle et al., 2018) and those with poorer motor skills

have also been found to report more social rejection (Bejerot, Plenty, Humble, & Humble, 2013; Livesey, Lum Mow, Toshack, & Zheng, 2011; Øksendal, Brandlistuen, Holte, & Wang, 2019). Being active and participating in sports activities are important for gaining popularity among peers (Livesey et al., 2011). VP/VLBW children who are unable to participate in these activities due to their functional limitations may thus perceive themselves more negatively on social acceptance.

Being female was also identified as a consistent risk factor for decreasing body and social self-concept from childhood to adulthood, replicating findings reported across cultures that females have more negative perceptions of their physical appearance (Gentile et al., 2009). It has been suggested that women in many societies are valued more on body aesthetics and relational ties compared to men, and these thus become salient areas for self-evaluations (Bem, 1993; Walter et al., 2020). Furthermore, girls from a young age are exposed to unrealistic body imagery in the media and the discrepancies that arise from comparing themselves to these images can lead to shame and anxiety around their bodies and decrease body satisfaction (Calogero, 2012; Fredrickson & Roberts, 1997). Interventions should thus focus more on reducing social comparisons and challenging unrealistic body images (Halliwell, Easun, & Harcourt, 2011; Morton, Roach, Reid, & Stewart, 2012). Although no sex differences on social self-concept have previously been reported (Gentile et al., 2009), the current study showed that girls were more likely to report decreasing social acceptance. One explanation could be that girls report more jealousy in friendships than boys, and expect more exclusivity in friendships, which has been associated with increased loneliness and lower social acceptance (Parker, Low, Walker, & Gamm, 2005).

Maternal sensitivity and SES did not predict differences in the development of body and social self-concepts. Although SES has

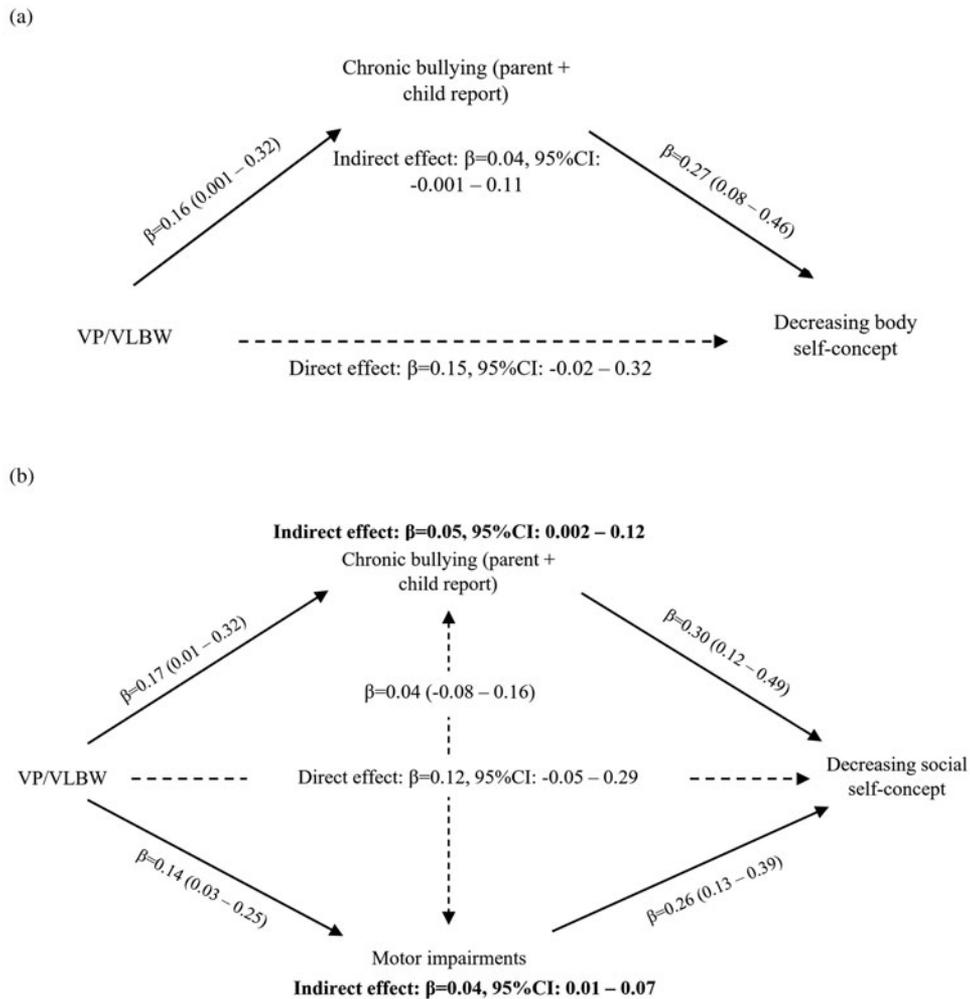


Figure 5. Indirect pathway from very preterm/very low birth weight (VP/VLBW) to decreasing (a) body self-concept via chronic bullying (parent- and child-reported) and (b) social self-concept via both chronic bullying (parent- and child-reported) and motor impairments. Indirect estimate and 95% confidence interval (CI) calculated using Monte Carlo method in RMediation package.

been associated with body dissatisfaction in previous studies (Orth et al., 2010; Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006), others have found that SES is more strongly associated with global self-esteem and behavioral conduct (Muldoon & Trew, 2000). Maternal sensitivity in previous research has also been associated with children's self-concept in childhood (Paulus et al., 2018), although differences in self-concept trajectories into adulthood were not examined. Thus, parenting behaviors may have a weaker role on the development of body and social self-concepts compared to other individual and social factors.

Strengths and limitations

To our knowledge, this is the first study to examine trajectories of body and social self-concepts from childhood to adulthood in a high-risk VP/VLBW population using a person-centered approach. This allowed the investigation of whether it is VP/VLBW birth *per se* or other individual, social, and family risk factors identified in the general population that affect the development of self-concepts. The inclusion of a secondary analysis to examine possible mediated pathways allowed further examination

of the mechanisms underlying any associations found between VP/VLBW birth and self-concept development. The study further addressed the issue of common method variance by including observer- or parent-reported measures as predictors, as the outcome measure of self-concept was self-reported.

There are also some limitations to this study. Firstly, loss to follow-up is inevitable over a 26-year period. Those dropping out were more likely to be of lower SES or to have more neurodevelopmental and social difficulties. Although previous simulations have shown that selective drop-out may not reduce the validity of predicting outcomes in longitudinal studies (Wolke et al., 2009), it may have affected the number or types of trajectories identified. Secondly, only the domains of body self-concept and social self-concept were assessed in the current study, as other domains showed either weaker internal reliability or were only assessed using one item in adulthood. Further longitudinal investigation is therefore needed with adequate items at all ages of assessment to examine the trajectories and predictors of self-concept in these domains. Thirdly, multiple births are more likely among those born preterm (Goldenberg, Culhane, Iams, & Romero, 2008). The prevalence of multiple births was 9.3% in the study population and the majority of them were born VP/VLBW. This may

violate the assumption that observations are independent of each other (Hibbs et al., 2010). Given the relatively small percentage of multiple births, analyses were repeated after excluding siblings, and there were no significant changes to the findings. Alternatively, other methods may be used to account for multiple births, such as multilevel modeling where clustering is taken into account (Marston et al., 2009). Finally, there may be bias associated with using the most likely trajectory membership in further analysis, as it does not take into account classification error (Vermunt, 2010). Despite the relative high probability participants had of being in each trajectory, caution may be needed to interpret the subsequent findings.

Conclusion

When investigating the development of body self-concept and social self-concept in the VP/VLBW population, we found that although the effect of VP/VLBW birth on decreasing body self-concept remained, its effect on decreasing social self-concept was reduced when other risk factors were taken into account. This suggests that rather than VP/VLBW birth *per se*, it was other risk factors commonly identified in the general population, which the VP/VLBW population were more frequently exposed to, that explained differences in social self-concept trajectories. In particular, VP/VLBW born were more frequently exposed to chronic peer bullying and reported more motor impairments in childhood, which in turn were associated with decreasing levels of social self-concept from childhood to adulthood. Thus, the risk is partially modifiable through preventing bullying in schools and increasing support for children with motor difficulties, in particular for VP/VLBW children. Interventions should also focus on girls, who are also more likely to have decreasing trajectories in both body and social self-concepts.

Supplementary Material. The Supplementary Material for this article can be found at <https://doi.org/10.1017/S0954579421000432>

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Conflicts of Interest. None.

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