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Childhood and adolescent multimorbidity and socioemotional competencies up to 18 years: Findings from the 2004 Pelotas Birth Cohort

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Abstract

Multimorbidity, the coexistence of two or more chronic physical and/or mental health conditions in the same individual, is increasingly common among children and adolescents, but its impact on socioemotional development remains poorly understood. We investigated this association in 2,977 participants of the 2004 Pelotas Birth Cohort, Brazil (70.4% of the original cohort). Multimorbidity (≥ 2 of asthma/bronchitis, hearing impairment, mental health problems, obesity, and blood pressure ≥ 95th percentile) was assessed at 6, 11, and 15 years. At 18 years we evaluated locus of control, emotional regulation, self-control, self-esteem, and peer relationships, using linear and Poisson regression adjusted for sociodemographic and perinatal covariates. Multimorbidity prevalence was 13.9%, 29.3%, and 12.8% at 6, 11, and 15 years, respectively. Emotional regulation and self-control were most consistently impaired, with negative associations at all three follow-ups, and peer relationship difficulties were most marked at 15 years. Unexpectedly, self-esteem was positively associated with multimorbidity at 11 and 15 years. Sensitivity analyses indicated that these associations were driven primarily by mental health problems rather than physical multimorbidity, except for self-control. These findings underscore the importance of integrated physical and mental health screening in pediatric and adolescent care.

INTRODUCTION

Multimorbidity is defined as the coexistence of two or more chronic physical and/or mental health conditions in the same individual, with no condition regarded as primary [1]. It differs from comorbidity, which assumes an index disease to which other conditions relate; this distinction supports a holistic, person-centered approach to care [2]. Multimorbidity is associated with increased mortality, polypharmacy, functional impairment, and poorer quality of life [3, 4]. Among adults, global prevalence has been estimated at 37.2%, with South America reporting the highest figure (45.7%) [5]. Despite its public health relevance, the literature remains methodologically heterogeneous: studies differ in the conditions included, in the threshold used to define multimorbidity, in what counts as a chronic condition, and in whether conditions are weighted by severity. Narrower condition lists and higher thresholds yield lower prevalence estimates, so the burden may be systematically underestimated and comparisons across studies remain difficult [6, 7].

Despite the rising prevalence of chronic conditions in younger populations, evidence in children and adolescents remains scarce [8, 9]. This stage of life is marked by profound physical, hormonal, and neurodevelopmental change, and the coexistence of multiple chronic conditions may adversely affect psychological, cognitive, and social development. The demands of chronic disease management, such as long-term medication use and frequent healthcare contact, may further heighten vulnerability, weaken interpersonal relationships, encourage risk behaviours, and interfere with identity formation [10, 11].

Socioemotional competencies are the skills that shape how individuals think, feel, and behave towards themselves and others, and are reflected in goal setting, coping with adversity, and conflict resolution [12, 13]. We operate them across five dimensions. *Locus of control* refers to whether individuals perceive the outcomes of their actions as resulting from personal effort (internal) or from external forces such as luck or fate (external); an internal locus has been associated with greater well-being and an external locus with poorer mental health [14, 15]. *Emotional regulation* refers to the management and expression of emotions and has been linked to stress, anxiety, and the quality of social relationships [16]. *Self-control* refers to the capacity to regulate one's own desires, behaviours s, emotions, and thoughts [17]. *Self-esteem* is the subjective evaluation of one's own worth; higher self-esteem has been associated with better mental health and well-being, and lower self-esteem with psychological distress and psychopathology [18]. Difficulties in these competencies may hinder relationships based on cooperation, mutual respect, and constructive conflict resolution, thereby affecting *peer relationships*, that is, the ability to establish and maintain positive interpersonal bonds [19].

Socioemotional competencies develop in early childhood, underpinned by maturing executive functions and brain development, which makes this period particularly sensitive to relational and contextual influences [20, 21]. Chronic conditions may therefore exacerbate developmental challenges and undermine well-being [22]. Children and adolescents living with multimorbidity often face recurrent hospitalizations, prolonged school absenteeism, and daily limitations, circumstances that may foster stigma, inadequacy, and a diminished sense of control, and that have been associated with a more external locus of control, poorer emotional regulation, lower self-esteem, and impaired interpersonal relationships [23, 24]. Given the limited and poorly comparable evidence on this topic, we assessed the frequency of multimorbidity among children and adolescents enrolled in the 2004 Pelotas (Brazil) Birth Cohort and examined its association with socioemotional competencies in early adulthood: locus of control, emotional regulation, self-control, self-esteem, and peer relationships.

METHODS

Participants

This study used data from the 2004 Pelotas Birth Cohort (Rio Grande do Sul, Brazil), which invited all mothers of infants born in the municipality's urban area between January 1 and December 31, 2004. A total of 4,231 live births were included, representing over 99.2% of all births that year. Participants were followed through home visits at mean (standard deviation [SD]) ages of 3.0 (0.1), 11.9 (0.2), 23.9 (0.4), and 49.5 (1.7) months, and clinic check-ups at 6.8 (0.3) and 11.0 (0.3) years, with follow-up rates above 90% through 11 years [25, 26]. The seventh follow-up, at 15.7 (0.2) years, began in November 2019 and was interrupted in March 2020 by the COVID-19 pandemic, by which point 1,949 adolescents and their caregivers had been interviewed (48.5% of the original cohort). The 18-year follow-up, conducted in 2022, reached 85% of the original cohort [27].

Multimorbidity

Multimorbidity was measured at ages 6, 11, and 15 years, and comprised five conditions: asthma/bronchitis, hearing impairment, mental health problems, obesity, and blood pressure ≥ 95th percentile. Asthma/bronchitis and hearing impairment were recorded as dichotomous (yes/no) parent/guardian-reported variables at 6 and 11 years; at 15 years, asthma/bronchitis was self-reported by the adolescent, while hearing impairment remained parent-reported. Obesity was defined as a BMI-for-age z-score ≥ + 2 (≥ 97th percentile), calculated from standardized weight/height measurements at each follow-up [28]. Blood pressure was measured with an automated sphygmomanometer (OMRON HEM-742) on the right arm after ≥ 5 minutes' rest, using the same protocol at all follow-ups [26, 27]. As hypertension is conventionally defined by SBP and/or DBP ≥ 95th percentile on three occasions [29] but only two measurements were available, we defined the outcome as blood pressure ≥ 95th percentile based on the age, sex and height-adjusted mean of both measurements. Mental health problems were assessed at all follow-ups with the Development and Well-Being Assessment (DAWBA) [30], a DSM-IV/DSM-5- and ICD-10-based instrument combining closed- and open-ended questions to identify psychiatric disorders; the validated Brazilian Portuguese version was administered to mothers/caregivers by trained psychologists [31]. We estimated the prevalence of each condition and categorized participants by number of conditions present (none, one, or two or more), with multimorbidity defined as two or more co-occurring conditions.

Socioemotional competencies

The primary outcomes were socioemotional competencies assessed at 18 years: locus of control, emotional regulation, self-control, self-esteem, and peer relationships. The first four were self-reported and analysed as discrete quantitative variables.

Locus of control was assessed with the shortened Children's Nowicki-Strickland Scale [32, 33], comprising 12 dichotomous (yes/no) items on everyday peer and individual situations, with higher scores indicating a more external locus of control. Emotional regulation was measured with the Emotional Regulation Index for Children and Adolescents (ERICA) [34, 35], including 16 items on a five-point Likert scale across three subscales: emotional control (7 items; socially inappropriate emotional responses), emotional self-awareness (5 items; recognition of one's own emotions), and situational responsiveness (4 items; empathy in social contexts). Total scores range from 16 to 80. Self-control was assessed with a four-item version of the Brief Self-Control Scale (BSCS) [17, 36], as administered in the cohort protocol, rated on a five-point Likert scale (total scores 4–20). Self-esteem was measured with the 10-item Rosenberg Self-Esteem Scale [37, 38], rated on a four-point Likert scale (six positively and four negatively worded items), with total scores ranging from 10 to 40. For these three latter scales, higher scores indicate greater levels of competency. Peer relationships were assessed with the five-item Peer Problems subscale of the Strengths and Difficulties Questionnaire (SDQ) [39, 40], completed by the mother or primary caregiver. Following the instrument's scoring guidelines, we operationalized this outcome as binary, with scores ≥ 4 indicating peer relationship difficulties.

Covariates

Covariates were drawn from the perinatal interview: family income in the month preceding delivery (quintiles), maternal education (0, 1–4, 5–8, and ≥ 9 completed years of schooling), maternal smoking during pregnancy (at least one cigarette per day in any trimester), child sex, race/ethnicity (White, Black, Brown [mixed-race], and other), gestational age (< 37 or ≥ 37 weeks), birth weight (< 1,500 g, 1,500–2,499 g, and ≥ 2,500 g), and the 1-minute Apgar score. Data collected at postpartum included breastfeeding status at 3rd month (exclusive, predominant, partial, or none) and at 12th months maternal depression using the Edinburgh Postnatal Depression Scale (EPDS) [41], which has been previously translated into and validated for use in Portuguese [42].

Data analysis

The analytic sample comprised participants who completed all five psychometric instruments assessing socioemotional competencies at 18 years. Participants who were ineligible or had missing data for any component condition at a given follow-up were assigned a missing value for multimorbidity at that follow-up. We first characterized the sample descriptively and then compared sociodemographic and perinatal characteristics between participants with and without multimorbidity at the 6-, 11-, and 15-year follow-ups, estimating crude odds ratios (OR) with 95% confidence intervals (CI) by logistic regression, and generated an UpSet plot to visualize the most frequent combinations of conditions.

In bivariate analyses, continuous outcomes were compared by multimorbidity status using Student's t-test, and the binary outcome (peer relationships) using the chi-square test. Multivariable analyses used linear regression for continuous outcomes and Poisson regression for the binary outcome, in three stages: Model 1 (crude), Model 2 (adjusted for sociodemographic variables), and Model 3 (additionally adjusted for perinatal variables). Covariates associated with the outcome at $p < 0.20$ in bivariate analysis were retained for adjustment.

Finally, sensitivity analyses examined whether associations were driven by mental health problems, comparing overall multimorbidity, physical multimorbidity only, and mental health problems only. Analyses used a two-sided significance level of 5% in Stata 14.1.

RESULTS

Sample description and loss-to-follow-up analysis

Of the 4,231 participants in the original cohort, 102 died during the first 15 years, leaving 4,129 eligible for follow-up. The analytic sample comprised 2,977 participants (70.4% of the original cohort) who completed all five instruments at 18 years. Multimorbidity could be classified for 2,538, 2,763, and 1,523 participants at the 6-, 11-, and 15-year follow-ups, respectively. Compared with the original cohort, those included were disproportionately from more favorable sociodemographic and perinatal backgrounds (Supplementary Table 1).

Prevalence of chronic conditions and multimorbidity

Asthma/bronchitis and obesity were the most prevalent conditions at age 6 (18.4% and 17.9%). All physical morbidities increased from ages 6 to 11, when elevated blood pressure became the most prevalent (33.9%), followed by asthma/bronchitis (32.4%). By age 15, obesity and elevated blood pressure had declined, while asthma/bronchitis and hearing problems returned to levels comparable to age 6. Mental health problems remained stable across the three follow-ups (12.6% at age 6, 12.1% at age 11, and 12.5% at age 15) (Table 1). Multimorbidity prevalence was 13.9%, 29.3%, and 12.8% at ages 6, 11, and 15, respectively, and most cases involved exactly two conditions (Supplementary Table 2). Combinations of physical morbidities, particularly asthma/bronchitis, obesity, and elevated blood pressure, predominated at all three follow-ups (Fig. 1).

Table 1. Prevalence of individual morbidities at the 6-, 11-, and 15-year follow-up assessments.

MORBIDITIES	**6 Years**		**11 Years**		**15 Years**	
	(n=2,538)		(n=2,763)		(n=1,523)	
	n	%	n	%	n	%
Hearing problems	68	2.68	115	4.16	39	2.56
Asthma or bronchitis	467	18.40	896	32.43	274	18.00
Mental health issues	319	12.57	335	12.12	190	12.48
High blood pressure*	358	13.48	936	33.88	163	10.70
Obesity**	453	17.85	617	22.33	223	14.64

*Mean blood pressure above the age- and sex-adjusted 95th percentile / **Participants with BMI-for-age z-scores ≥ +2 (BMI ≥ 97th percentile)

Sample characteristics by multimorbidity status

Boys had 34% and 44% higher odds of multimorbidity than girls at 6 and 11 years, respectively. Household income at birth was inversely associated with multimorbidity at all three follow-ups, and lower maternal education at 11 and 15 years, most markedly among mothers with 4 years or fewer of schooling. Maternal smoking during pregnancy was associated with 36% and 45% higher odds at 11 and 15 years, respectively, and maternal depression with 30%, 39%, and 57% higher odds at 6, 11, and 15 years, respectively. At 6 years, participants never breastfed had 63% higher odds than those exclusively breastfed. Race/ethnicity, gestational age, birth weight, and the 1-minute Apgar score were not associated with multimorbidity at any follow-up (Supplementary Tables 3–4).

Adjusted associations between multimorbidity and socioemotional competencies

Locus of control was not associated with multimorbidity at any follow-up, in either crude or adjusted analyses (Tables 2–4). Emotional regulation was inversely associated with multimorbidity at all three follow-ups, remaining significant after adjustment and strongest at 15 years (β = −0.686, − 0.465, and − 1.230 at 6, 11, and 15 years, respectively). Self-control was likewise inversely associated at all follow-ups, with scores lower among participants with multimorbidity after adjustment (β = −0.413, − 0.403, and − 0.525 at 6, 11, and 15 years, respectively). Self-esteem, by contrast, was positively associated with multimorbidity at 11 and 15 years, with higher adjusted scores among those affected (β = 0.256 and 0.454, respectively). Participants with multimorbidity were also more likely to have peer relationship difficulties, with 23% and 36% higher prevalence at 11 and 15 years, respectively, after adjustment for sociodemographic and perinatal characteristics. In sensitivity analyses, associations were mainly observed for mental health problems, except for self-control, which was also consistently associated with physical multimorbidity (Supplementary Tables 5–7).

Table 2
Associations between physical and mental multimorbidity at 6-years follow up assessments and socioemotional competencies at the 18-years

Socioemotional competencies	Model	β (95% CI)*	p-value
Locus of control	Model 1 = crude analysis	0.140 (− 0.054; 0.336)	0.158
	Model 2 = Model 1 + sociodemographic variables [a]	0.122 (− 0.071; 0.317)	0.215
	Model 3 = Model 2 + perinatal variables [b]	0.102 (− 0.092; 0.297)	0.301
Emotional regulation	Model 1 = crude analysis	−0.781 (− 1.364; −0.197)	**0.009**
	Model 2 = Model 1 + sociodemographic variables [c]	−0.773 (− 1.354; −0.193)	**0.009**
	Model 3 = Model 2 + perinatal variables [d]	−0.686 (− 1.271; −0.101)	**0.022**
Self-control	Model 1 = crude analysis	−0.393 (− 0.671; −0.114)	**0.006**
	Model 2 = Model 1 + sociodemographic variables [e]	−0.415 (− 0.693; −0.137)	**0.003**
	Model 3 = Model 2 + perinatal variables [f]	−0.413 (− 0.697; −0.129)	**0.004**
Self-esteem	Model 1 = crude analysis	0.009 (− 0.260; 0.280)	0.943
	Model 2 = Model 1 + sociodemographic variables [g]	0.058 (− 0.209; 0.327)	0.668
	Model 3 = Model 2 + perinatal variables [h]	0.048 (− 0.220; 0.318)	0.722
		PR (95% CI)*	**p-value**
Peer relationships	Model 1 = crude analysis	1.12 (0.98; 1.28)	0.072
	Model 2 = Model 1 + sociodemographic variables [c]	1.12 (0.98; 1.28)	0.071
	Model 3 = Model 2 + perinatal variables [d]	1.09 (0.95; 1.24)	0.182

**Linear regression / ** Poisson regression

[a] Sex; Child Race/Ethnicity; Wealth index (income quintiles); Maternal education

[b] Maternal smoking during pregnancy; Gestational age; 1-minute Apgar score

[c] Sex; Wealth index (income quintiles); Maternal education

[d] Maternal smoking during pregnancy; Maternal depression

[e] Sex

[f] 1-minute Apgar score; Maternal depression

[g] Sex; Child Race/Ethnicity

[h] Maternal smoking during pregnancy; 1-minute Apgar score

Table 3
Associations between physical and mental multimorbidity at 11-years follow up assessments and socioemotional competencies at the 18-years

Socioemotional competencies	Model	β (95% CI)*	p-value
Locus of control	Model 1 = crude analysis	0.134 (− 0.008; 0.276)	0.065
	Model 2 = Model 1 + sociodemographic variables [a]	0.115 (− 0.026; 0.258)	0.111
	Model 3 = Model 2 + perinatal variables [b]	0.115 (− 0.078; 0.309)	0.244
Emotional regulation	Model 1 = crude analysis	−0.629 (− 1.062; −0.196)	**0.004**
	Model 2 = Model 1 + sociodemographic variables [a]	−0.586 (− 1.020; −0.152)	**0.008**
	Model 3 = Model 2 + perinatal variables [c]	−0.465 (− 0.904; −0.026)	**0.038**
Self-control	Model 1 = crude analysis	−0.391 (− 0.594; −0.188)	**< 0.001**
	Model 2 = Model 1 + sociodemographic variables [d]	−0.416 (− 0.621; −0.210)	**< 0.001**
	Model 3 = Model 2 + perinatal variables [e]	−0.403 (− 0.612; −0.194)	**< 0.001**
Self-esteem	Model 1 = crude analysis	0.205 (0.006; 0.403)	**0.043**
	Model 2 = Model 1 + sociodemographic variables [f]	0.268 (0.069; 0.466)	**0.008**
	Model 3 = Model 2 + perinatal variables [g]	0.256 (0.057; 0.454)	**0.011**
		PR (95% CI)*	**p-value**
Peer relationships	Model 1 = crude analysis	1.23 (1.11; 1.35)	**< 0.001**
	Model 2 = Model 1 + sociodemographic variables [a]	1.22 (1.11; 1.34)	**< 0.001**
	Model 3 = Model 2 + perinatal variables [h]	1.23 (1.10; 1.33)	**< 0.001**

*Linear regression / ** Poisson regression

[a] Sex; Child Race/Ethnicity; Wealth index (income quintiles); Maternal education

[b] Maternal smoking during pregnancy; Gestational age

[c] Maternal smoking during pregnancy; Maternal depression

[d] Sex; Maternal education

[e] 1-minute Apgar score; Maternal depression

[f] Sex; Child Race/Ethnicity

[g] Maternal smoking during pregnancy

[h] Maternal smoking during pregnancy; Gestational age; Maternal depression

Table 4
Associations between physical and mental multimorbidity at 15-years follow up assessments and socioemotional competencies at the 18-years

Socioemotional competencies	Model	β (95% CI)*	*p*-value
Locus of control	Model 1 = crude analysis	0.125 (− 0.136; 0.387)	0.347
	Model 2 = Model 1 + sociodemographic variables [a]	0.033 (− 0.225; 0.292)	0.802
	Model 3 = Model 2 + perinatal variables [b]	0.047 (− 0.213; 0.307)	0.723
Emotional regulation	Model 1 = crude analysis	−1.367 (− 2.129; −0.605)	**< 0.001**
	Model 2 = Model 1 + sociodemographic variables [c]	−1.315 (− 2.079; −0.552)	**0.001**
	Model 3 = Model 2 + perinatal variables [d]	−1.230 (− 1.998; −0.462)	**0.002**
Self-control	Model 1 = crude analysis	−0.528 (− 0.902; −0.153)	**0.006**
	Model 2 = Model 1 + sociodemographic variables [e]	−0.531 (− 0.906; −0.156)	**0.005**
	Model 3 = Model 2 + perinatal variables [f]	−0.525 (− 0.905; −0.146)	**0.007**
Self-esteem	Model 1 = crude analysis	0.442 (0.078; 0.807)	**0.017**
	Model 2 = Model 1 + sociodemographic variables [g]	0.470 (0.107; 0.833)	**0.011**
	Model 3 = Model 2 + perinatal variables [h]	0.454 (0.092; 0.817)	**0.014**
		PR (95% CI)*	**p-value**
Peer relationships	Model 1 = crude analysis	1.52 (1.29; 1.78)	**< 0.001**
	Modelo 2 = Modelo 1 + variáveis sociodemográficas [i]	1.43 (1.22; 1.69)	**< 0.001**
	Model 3 = Model 2 + perinatal variables [b]	1.36 (1.15; 1.60)	**< 0.001**

*Linear regression / ** Poisson regression

[a] Child Race/Ethnicity; Wealth index (income quintiles); Maternal education

[b] Maternal depression

[c] Sex; Child Race/Ethnicity; Wealth index (income quintiles); Maternal education

[d] Maternal smoking during pregnancy; Maternal depression

[e] Sex

[f] Breastfeeding; Maternal depression

[g] Sex; Child Race/Ethnicity; Wealth index (income quintiles)

[h] Birth weight

[i] Sex; Wealth index (income quintiles); Maternal education

DISCUSSION

Multimorbidity during childhood and adolescence was differentially associated with socioemotional competencies at 18 years. It was consistently associated with lower emotional regulation and self-control scores at all three follow-ups, and with a higher prevalence of peer relationship difficulties at 11 and 15 years. Contrary to expectations, multimorbidity at 11 and 15 years was associated with higher self-esteem, a finding discussed below. No association was observed with locus of control at any follow-up. Sensitivity analyses indicated that these associations were driven primarily by mental health problems rather than by physical multimorbidity, except for self-control.

Multimorbidity prevalence varied substantially across follow-ups (13.9% at 6 years, 29.3% at 11 years, and 12.8% at 15 years), falling within the wide range reported in literature marked by methodological heterogeneity. Estimates of 5.4% in a Canadian cohort [43] and 7.8% in a Brazilian national survey [44] were considerably lower than ours, whereas the 1993 Pelotas Birth Cohort (26.3% and 31.3% at 11 and 15 years) and a Danish study of 14- to 26-year-olds (20.7%) are more consistent with our findings [22, 45]. Such discrepancies stem from the lack of standardization in how multimorbidity is operationalized, including the number and types of conditions considered and the threshold adopted [6, 7]. In our cohort, the higher prevalence at 11

years coincided with increases in elevated blood pressure and asthma/bronchitis, whereas the lower prevalence at 15 years may reflect both changes in clinical profile and selection bias from attrition during the COVID-19 pandemic. The predominance of physical combinations (asthma/bronchitis, obesity, and elevated blood pressure) is consistent with shared pathophysiological mechanisms, such as the low-grade systemic inflammation associated with obesity, which affects both the airways and the cardiovascular system [46], and with the clustering of behavioural risk factors at this developmental stage [45].

Our main finding concerns the impairment of self-regulation competencies. Emotional regulation, self-control, and peer relationships form a related set of skills governing how emotions and behaviour are regulated and how interpersonal relationships are established and maintained. All three were consistently affected by multimorbidity, with effect sizes increasing with age, suggesting a cumulative impact of chronic exposure. Recurrent hospitalizations, prolonged school absences, and restrictions in daily activities may progressively limit opportunities to practise emotional regulation strategies and to interact with peers, both fundamental to developing these competencies in childhood and adolescence [24]. This pattern is consistent with the lower levels of well-being reported among adolescents with physical–mental multimorbidity [22] and with evidence identifying emotional dysregulation as a predictor of tobacco, alcohol, and other substance use in adolescence [47]. The observed impairments may represent not only consequences of multimorbidity but also pathways through which vulnerability is amplified: difficulties in peer relationships may intensify risk through social isolation or through affiliation with peer groups that normalize health-risk behaviours [22, 45]. Considering the scarcity of longitudinal studies addressing these domains, our findings underscore the value of systematically monitoring emotional regulation and health-risk behaviours in the follow-up of children and adolescents with multimorbidity.

Contrary to our hypothesis, multimorbidity at ages 11 and 15 was associated with *higher* self-esteem at age 18, in contrast with evidence consistently reporting lower self-esteem among children and adolescents with chronic conditions [48, 49]. Several non-mutually exclusive explanations may account for this. Such a pattern may reflect psychological adaptation processes described by response shift theory, whereby prolonged exposure to chronic illness leads individuals to recalibrate their internal standards of evaluation, reconceptualize what constitutes a satisfactory life, and reprioritize their values, yielding more favorable self-assessments than their clinical condition alone would predict [50]. This is consistent with the disability paradox, whereby individuals living with chronic or disabling conditions report higher levels of well-being than external observers anticipate [51]. A second explanation involves social comparison and active coping: when confronted with the challenges of illness, individuals may engage in downward social comparison, which promotes more favorable self-evaluations [52], while the day-to-day management of a chronic condition may strengthen perceptions of competence and personal mastery [53]. Self-esteem was also assessed at 18 years of age, by which time some participants may have integrated the experience of illness into their identity. Alternatively, self-reporting may have favoured more positive self-appraisals among affected participants. Emotional regulation and self-control, however, were also self-reported yet moved in the opposite direction, arguing against a generalized positive-response bias. These processes warrant longitudinal studies designed to characterize their trajectories across the life course.

Sensitivity analyses showed weaker and less consistent associations for physical multimorbidity, whereas combined physical-mental multimorbidity and, most notably, mental health problems alone accounted for the strongest associations, particularly with emotional regulation and peer relationships. Self-control was the exception: it was associated with physical multimorbidity at all three follow-ups, and at 6 years the physical component was the only contributor. Locus of control also merits attention: although not associated with overall multimorbidity, mental health problems alone were consistently associated with a more external locus of control at all three follow-ups. Across most domains, therefore, mental health conditions rather than the coexistence of physical diseases appear to underlie the associations with socioemotional development. This is consistent with the limited literature explicitly distinguishing physical from combined physical–mental multimorbidity. Thomsen et al. [22] reported lower well-being among adolescents with combined physical–mental multimorbidity, whereas Ferro et al. [49] uncovered impairments in self-concept associated with physical–mental comorbidity. Clinically, these findings support integrating physical and mental health screening into routine pediatric care, particularly as mental health conditions remain substantially underdiagnosed in these age groups. The consistency of associations between family income, maternal education, maternal smoking during pregnancy, maternal depression, and multimorbidity indicates that both multimorbidity and its socioemotional consequences are shaped by inequalities accumulating from the perinatal period onward [54, 55].

This study has several limitations. The reduced sample at the 15-year follow-up, caused by the COVID-19 pandemic, may have introduced selection bias toward participants from more favorable socioeconomic and perinatal backgrounds; notably, the strongest associations were observed at this follow-up. Multimorbidity was operationalized using a restricted set of conditions without accounting for disease duration or severity, precluding any assessment of dose-response relationships. Four of the five outcomes were self-reported, and mental health problems and peer relationships were both reported by the mother, so part of their association may reflect shared informant variance. Finally, we stratified the exposure only into physical and mental morbidity, without analysing individual physical conditions, which differ substantially in clinical visibility: respiratory disorders and obesity are readily recognized by participants and caregivers, whereas elevated blood pressure is often asymptomatic and may go unnoticed. This distinction is not merely descriptive, since the coping and adaptation hypotheses proposed to explain the higher self-esteem scores presuppose awareness of one's own health condition. As we could not operationalize it, those explanations remain speculative.

Overall, the findings shed light on the association between multimorbidity during childhood and adolescence and poorer emotional regulation, lower self-control, and more peer relationship difficulties in early adulthood, driven primarily by mental health problems. The positive association between multimorbidity and self-esteem, contrary to expectations, suggests the involvement of adaptive processes that warrant further investigation in longitudinal studies. These findings stress the need for public policies integrating mental health screening and care into child and adolescent health services. Furthermore, future studies of pediatric multimorbidity should incorporate mental health conditions into their operational definitions, recognizing the potential impact of these early-life exposures on socioemotional development across the life course.

Declarations

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Ethics Approval

This study was approved by the Research Ethics Committee of the Federal University of Pelotas. The 6-, 11-, 15- and 18-year follow-ups were approved under protocols OF35/10 (6-year), 889753 (11-year), 3554667 (15-year), and 5210484 (18-year). The study was conducted in accordance with the principles of the 1964 Declaration of Helsinki and its subsequent amendments.

Consent to Participate

Written informed consent was obtained at all stages of the study. Prior to data collection, informed consent forms were signed by the participants' mothers or legal guardians. Beginning with the 11-year follow-up assessment, adolescents also provided written assent. At the 18-year follow-up assessment, participants provided written informed consent, ensuring the continuation of their participation as autonomous adults.

Consent for Publication

Not applicable. This manuscript does not contain any identifiable individual participant data or images.

Data availability

The data supporting the findings of this study are part of the 2004 Pelotas Birth Cohort and are available from the Graduate Program in Epidemiology at the Federal University of Pelotas upon reasonable request, subject to the ethical and confidentiality restrictions established to protect participant privacy.

Authors' contribution

Nathalia de Oliveira Silva: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing original draft. Andreas Bauer: Formal analysis, Methodology, Writing, review & editing. Luciana Tovo-Rodrigues: Conceptualization, Methodology, Supervision, Writing review & editing. Iná S. Santos: Conceptualization, Methodology, Writing, review & editing. Alicia Matijasevich: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing review & editing. All authors critically reviewed the manuscript, approved the final version, and agreed to be accountable for all aspects of the work.

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Figures

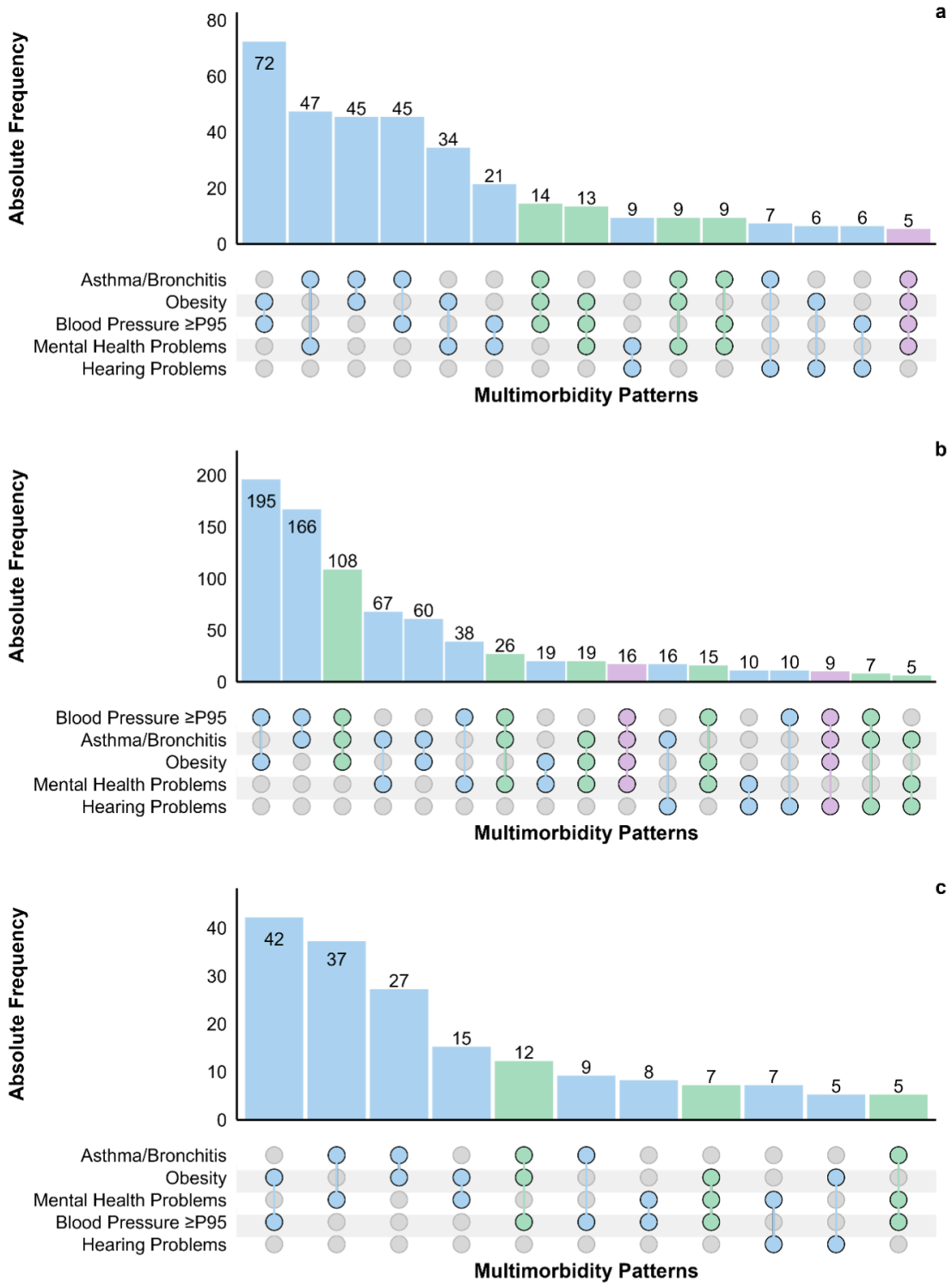


Figure 1

Frequency of multimorbidity combinations across the three follow-up assessments

Multimorbidity patterns at the 6-year (a), 11-year (b), and 15-year (c) follow-up assessments. Bars show the absolute frequency of each combination of conditions, identified in the matrix below. Bar colour denotes the number of co-occurring conditions: blue, two; green, three; purple, four. Only patterns with a frequency ≥5 are displayed.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryChildhoodandadolescentmultimorbidityandsocioemotionalcompetenciesupto18yearsFindingsfromthe2004PelotasBirthCohort.docx