

Lifetime overweight and obesity and body composition in adulthood: the 1982 Pelotas (Brazil) birth cohort study

Excesso de peso/obesidade no ciclo da vida e composição corporal na idade adulta: coorte de nascimentos de Pelotas, Rio Grande do Sul, Brasil, 1982

Exceso de peso/obesidad en el ciclo vital y composición corporal en la etapa adulta: resultados de la cohorte de nacimientos de Pelotas, Río Grande do Sul, Brasil, 1982

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Abstract

This study aimed to assess the association between overweight/obesity at different moments in the life cycle and body composition in early adulthood. Data were used from the 1982 Pelotas (Brazil) birth cohort study, which has followed live born children of families residing in the urban area of Pelotas at different ages. At 30 years of age, 3,701 cohort members were interviewed and body composition was assessed using Bod Pod, 2,219 cohort members had at least one weight and height measurement taken in the three periods (childhood, adolescence, and adulthood), 24% never presented overweight, and 68.6% were never classified as obese. Elevated body mass index (BMI) and percent body fat at 30 years of age were associated with individuals classified as overweight in all three periods or in adolescence and adulthood, while those with overweight/obesity only in childhood or adolescence showed mean BMI and percent body fat similar to those who had never presented overweight/obesity. The results indicate the benefit of early interruption of overweight/obesity.

Life Cycle Stages; Obesity; Overweight; Adiposity; Cohort Studies

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Introduction

Overweight was responsible for 3.4 million deaths in the world in 2010¹. Overweight is associated with increased risk of hypertension, diabetes, and cardiovascular diseases^{2,3}. Prevalence of overweight increased from 28.8% in 1980 to 36.9% in 2013 in men, and from 29.8% to 38% in women⁴.

Concerning the early determinants of overweight in adulthood, a systematic review of data from 25 longitudinal studies found that overweight in childhood is directly associated with overweight in adulthood^{5,6,7,8,9}, which in turn is a risk factor for hypertension, diabetes, and cardiovascular disease^{10,11,12}. Evidence also suggests that childhood body mass index (BMI) is associated with fat mass in adolescence or adulthood^{13,14}, and that body fat accumulated in adulthood is associated with type 2 diabetes mellitus, hypertension, and cardiovascular diseases^{15,16}. In addition, Howe et al.¹³ found that changes in BMI during childhood are associated with elevated fat mass at 15 years. Meanwhile, in the Helsinki (Finland) cohort, rapid gain in BMI before two years of age increased lean mass in adulthood without excess accumulation of fat, while rapid gain in BMI during late childhood, despite the increase in lean mass, resulted in relatively larger increases in fat mass¹⁸.

Previous studies have assessed the relationship between BMI or overweight/obesity at different moments in childhood and adolescence and BMI or prevalence of overweight/obesity in adulthood^{6,9}. Meanwhile, our literature review found no studies on the relationship between overweight/obesity in childhood and adolescence and body composition in adulthood, despite its importance for health effects¹⁹. The current study aimed to assess the association between overweight or obesity in childhood, adolescence, and adulthood and body composition at 30 years of age in members of the 1982 Pelotas (Brazil) birth cohort study.

Methods

In 1982, the maternity hospitals in the city of Pelotas, Rio Grande do Sul State, Brazil, were visited daily, births were identified, and newborns whose families lived in the urban area were examined and their mothers were interviewed (N = 5,914). These individuals have been followed several times at different ages. In 1984 and 1986, all households in the urban area of Pelotas were visited in search of the individuals born in 1982. Cohort members were weighed

and measured and the mothers were interviewed. In 1997, a census was conducted in a systematic sample of 27% of the census tracts in the city of Pelotas in search of adolescents belonging to the cohort, and 1,077 individuals were interviewed and examined. In 2000, during routine medical examination for military service, male cohort members were identified and interviewed. In 2001, a new census was performed in the same tracts visited in 1997, and 1,031 cohort members were interviewed. Finally, in 2012, a new attempt was made to follow the entire cohort, and the interviews were conducted in the research clinic. Details on the cohort study's methodology have been published elsewhere^{20,21,22,23}.

Birth weight was measured by the hospital team using pediatric scales calibrated weekly by the research team. In the childhood and adolescent follow-ups, anthropometry was done with portable equipment, by previously trained interviewers. Weight and height measurements taken in childhood were used to calculate BMI and were converted into z-scores using the World Health Organization (WHO) reference population²⁴.

As mentioned above, the 30-year follow-up was done at the research clinic between June 2012 and February 2013. At this visit, weight was measured with the scale coupled to Bod Pod (COSMED, Chicago, USA) – air displacement plethysmography –, and height was measured with a folding stadiometer (aluminum and wood), accurate to 0.1cm.

Body composition was assessed with Bod Pod. The equipment was assembled in a room with stable controlled temperature (21-24°C) and calibrated weekly by previously trained personnel. Pregnant or likely pregnant women (with more than two months in menstrual delay) were excluded. For taking measurements, the door to the room was kept closed to avoid sudden air flow. Subjects wore standard clothing (tight-fitting shorts and shirt/blouse), swimming cap, and no footwear or metal objects (bracelets, earrings, etc.). To measure body composition, subjects had to remain motionless inside the equipment (a closed chamber) for a few seconds. Having obtained body density, percent body fat was estimated by the equation for the general population²⁵. Fat-free mass was estimated by the difference.

Overweight and obesity in childhood and adolescence were defined by the specific cutoff points for sex and age (BMI/age), according to WHO values. At 30 years, overweight was defined as BMI \geq 25kg/m² and obesity as BMI \geq 30kg/m²²⁶. Based on these definitions, participants were divided into eight groups according to

presence of overweight or obesity in childhood, adolescence, and adulthood.

In the data analysis, the outcomes were measured continuously and linear regression was used to assess associations between different patterns of excess weight (overweight/obesity; obesity) and each outcome (weight, height, BMI, percent fat mass, and percent fat-free mass). Analyses were adjusted for birth weight, income at birth, maternal schooling, and maternal smoking during the pregnancy.

The study was approved by the Ethics Research Committee of the School of Medicine, Federal University of Pelotas (protocol: Of.16/12), and informed consent was obtained from participants in writing at each follow-up.

Results

Of the 2,219 cohort members with at least one weight and height measurement in childhood (at 2 or 4 years), adolescence (at 18 or 19 years), and adulthood (30 years), about one in four (24%) had never been overweight, and the majority (68.6%) had never been obese. Meanwhile, 11.9% had always been overweight, and 1.7% had always been obese, that is, in childhood, adolescence, and adulthood (Table 1).

Table 2 shows that the highest mean BMI values were in individuals that had always been overweight or had been overweight in adolescence and adulthood. Those who had been overweight only in childhood or in adolescence showed slightly higher mean BMI than the reference (never overweight), but the confidence interval included the reference value. We observed a similar result when analyzing the presence of obesity at different moments in the life cycle.

Concerning body composition, as with the observation for weight and BMI, individuals with overweight or obesity only in childhood or in adolescence showed percent body fat similar to that in individuals that had never been classified as overweight or obesity. Those with overweight at the three assessment points (childhood, adolescence, and adulthood) and those with overweight in adolescence and adulthood showed the highest percent body fat. Meanwhile, when we analyzed the presence of obesity, the percent body fat in those who had only been obese in adulthood, or in both childhood and in adulthood, was similar to that observed in the previous groups as having the highest percent body fat (Table 2).

In relation to fat-free mass, individuals that were overweight either at all three follow-ups or

in adolescence and adulthood had significantly lower fat-free mass than those who had never been overweight. The analyses on presence of obesity yielded similar results (Table 2).

Discussion

In a population that has been followed prospectively since birth, the highest BMI and percent body fat values at 30 years of age were observed in those who had presented overweight or obesity either persistently or in adolescence and adulthood, while the lowest BMI and percent body fat values were seen in those who had never been overweight or obese or had only been overweight or obese in childhood or adolescence. Regarding to fat-free mass, individuals that had always been classified as overweight or obese in their life cycles showed significantly lower percent fat-free mass levels.

Our results corroborate findings from previous studies. Guo et al.^{6,27}, in the Fels Longitudinal Study, reported that individuals with high childhood BMI showed increased risk of elevated BMI at 35 years. In addition, the earlier the child developed overweight, the higher the odds of continuing with overweight in subsequent periods, and the higher the BMI in childhood, the higher the BMI in adulthood. In the same sense, in the study by Field et al.⁹, children in the upper range of normal or healthy weight (i.e., children between the 50th and 84th percentile of BMI for age and sex) also showed increased risk of becoming overweight or obese adults, compared to those below the 50th percentile.

In relation to body composition, Howe et al.¹³ observed that changes in BMI in late childhood were heavily associated with increased body fat in adolescence. Other studies found that changes in BMI during adolescence and later were important in determining total body fat and percent body fat in adulthood^{5,28}. A recent review found evidence that weight loss in adulthood can lead to positive health-related changes. The review specifically found that obese adults were more likely to present metabolically healthy profiles if they had also been obese in childhood but reduced their BMI in adulthood¹⁸.

Considering the current study's findings, the evidence suggests that on-going exposure to overweight or obesity is associated with increased body fat in adulthood. Meanwhile, individuals that only had one episode of overweight in childhood or adolescence presented body composition (BMI and percent body fat) that was similar to those who had never been overweight or obese.

Table 1

Characteristics of 1982 cohort participants included in the present analysis. The 1982 Pelotas (Brazil) birth cohort study.

Variable	n	%
Sex		
Male	1,542	69.5
Female	677	30.5
Skin color		
White	1,669	75.2
Black/Brown	477	21.5
Other	73	3.3
Family income at birth (tertiles)		
1 (poorest)	717	33.3
2	786	33.4
3	716	33.3
Maternal schooling at birth (years)		
0-4	728	32.9
5-8	960	43.3
9-11	238	10.7
≥ 12	290	13.1
Birth weight (g)		
< 2,500	139	6.3
2,500-3,499	1,332	60.1
≥ 3,500	747	33.6
Gestational age * (weeks)		
Preterm (≤ 36)	98	5.5
Term (37-41)	1,503	84.0
Post-term (≥ 42)	188	10.5
Overweight at different moments in life cycle		
Never	534	24.0
Childhood or adolescence	337	15.2
Only adulthood	507	22.9
Childhood and adulthood	475	21.4
Adolescence and adulthood	102	4.6
Always	264	11.9
Obesity at different moments in life cycle		
Never	1,522	68.5
Childhood or adolescence	187	8.4
Only adulthood	328	14.8
Childhood and adulthood	75	3.4
Adolescence and adulthood	69	3.1
Always	38	1.7
Total	2,219	100.0

* For 430 individuals, it was not possible to obtain information on gestational age.

One limitation to the current study could be selection bias. However, the occurrence of such bias is unlikely, since family income and BMI were similar in individuals included in (versus excluded from) the analysis (data not shown). Some key methodological features were history

of overweight and obesity assessed at three moments in the life cycle and the use of an accurate measure of body composition in adulthood.

The current study's evidence suggests that on-going exposure to overweight or obesity is associated with high BMI and body fat and

Table 2

Body mass index (BMI), fat mass, and fat-free mass at 30 years of age according to overweight and obesity * at different moments in the life cycle. The 1982 Pelotas (Brazil) birth cohort study.

	n	BMI (kg/m ²)		Fat mass (%)		Fat-free mass (%)	
		Mean (95%CI)	Regression coefficient ** (95%CI)	Mean (95%CI)	Regression coefficient ** (95%CI)	Mean (95%CI)	Regression coefficient ** (95%CI)
Overweight at different moments in life cycle		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Never	534	22.0 (21.8; 22.1)	Reference	22.0 (21.2; 22.8)	Reference	78.1 (77.2; 78.7)	Reference
Childhood or adolescence	337	22.7 (22.5; 22.9)	0.7 (0.3; 1.1)	21.3(20.3;22.3)	-0.1 (-1.3; 1.2)	78.7 (77.7; 79.7)	0.1 (-1.2; 1.3)
Only adulthood ***	507	28.2 (27.9; 28.4)	6.2 (5.8; 6.6)	31.6 (30.9; 32.4)	9.8 (8.7; 10.9)	68.4 (67.6; 69.1)	-9.8 (-10.9; -8.7)
Childhood and adulthood ***	475	28.6 (28.3; 28.9)	6.5 (6.2; 7.0)	30.4 (29.7; 31.2)	8.7 (7.6; 9.9)	69.6 (68.8; 70.3)	-8.7 (-9.9; 7.6)
Adolescence and adulthood	102	33.7 (32.7; 34.6)	11.5 (10.8; 12.1)	38.1 (36.3; 39.9)	15.9 (13.9; 17.9)	61.9 (60.1; 63.7)	-15.9 (-17.9; -13.9)
Always ***	264	34.8 (34.1; 35.4)	12.7 (12.2; 13.2)	37.3 (36.2; 38.4)	15.5 (14.1; 16.8)	62.7 (61.6; 63.8)	-15.5 (-16.9; -14.1)
Obesity at different moments in life cycle		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Never	1,522	24.5 (24.4; 24.7)	Reference	25.3 (24.9; 25.8)	Reference	74.7 (74.2; 75.1)	Reference
Childhood or adolescence	187	25.9 (25.6; 26.3)	1.4 (0.9; 1.9)	25.8 (24.6; 27.1)	0.8 (-0.6; 2.2)	74.2 (72.9; 75.4)	-0.8 (-2.2; 0.6)
Only adulthood ***	328	33.4 (33.0; 33.7)	8.8 (8.4; 9.2)	38.1 (37.3; 38.9)	12.8 (-11.7; 13.9)	61.9 (61.0; 62.7)	-12.8 (-13.9; -11.7)
Childhood and adulthood ***	75	34.0 (33.3; 34.8)	9.4 (8.6; 10.1)	37.4 (35.5; 39.3)	12.2 (10.1; 14.3)	62.6 (60.7; 64.5)	-12.2 (14.3; -10.1)
Adolescence and adulthood	69	38.6 (37.4; 39.8)	14.0 (13.2; 14.8)	42.7 (40.8; 44.6)	16.9 (14.7; 19.2)	57.3 (55.4; 59.2)	-16.9 (-19.2; -14.7)
Always ***	38	39.1 (37.7; 40.5)	14.3 (13.2; 15.3)	39.9 (37.4; 42.4)	14.4 (11.4; 17.4)	60.1 (57.6; 62.6)	-14.4 (-17.4; -11.5)

95%CI: 95% confidence interval.

* Overweight/obesity (BMI/age) according to World Health Organization (WHO) curves ²⁴;

** Adjusted for birth weight, family income at birth, maternal schooling, and maternal smoking during the index pregnancy;

*** For adults, overweight $\geq 25\text{kg/m}^2$; obesity $\geq 30\text{kg/m}^2$.

lower fat-free mass in young adults. The findings highlight the benefits of early interruption of overweight or obesity to reverse the repercussions on body composition in adulthood.

Contributors

G. Callo participated in the project's elaboration, fieldwork, data analysis, and final version of the article. D. P. Gigante and F. C. Barros collaborated in the writing of the article. B. L. Horta contributed to the project's elaboration, data analysis, and writing of the article.

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Resumo

O presente estudo teve por objetivo avaliar a associação entre sobrepeso/obesidade em diferentes momentos do ciclo vital com a composição corporal em adultos jovens. Foram utilizados dados da coorte de nascimentos de Pelotas, Rio Grande do Sul, Brasil, 1982, que tem acompanhado, em diferentes idades, os nascidos vivos cuja família residia na zona urbana da cidade. Aos 30 anos, 3.701 participantes da coorte foram entrevistados, e a composição corporal foi avaliada usando-se o Bod Pod, 2.219 membros da coorte apresentavam, pelo menos, uma medida de peso e altura nos três períodos (infância, adolescência e vida adulta), 24% nunca apresentaram sobrepeso, e 68,6% nunca foram considerados como sendo obesos. Os maiores valores de índice de massa corporal (IMC) e de percentual de massa gorda aos 30 anos foram observados naqueles que foram considerados como tendo sobrepeso nos três períodos ou na adolescência e na idade adulta, enquanto que aqueles com sobrepeso/obesidade apenas na infância ou na adolescência tiveram médias de IMC e percentual de massa gorda similares daqueles que nunca apresentaram sobrepeso/obesidade. Os resultados indicam o benefício da interrupção precoce do sobrepeso/obesidade.

Estágios do Ciclo de Vida; Obesidade; Sobrepeso; Adiposidade; Estudos de Coortes

Resumen

Este estudio tuvo por objetivo evaluar la asociación entre el sobrepeso/obesidad en diferentes momentos del ciclo de vida con la composición corporal en adultos jóvenes. Se utilizaron datos de la cohorte de nacimientos de Pelotas, Rio Grande do Sul, Brasil, 1982 que acompañó en diferentes edades a los nacidos vivos, cuya familia vivía en la zona urbana de Pelotas. A los 30 años, 3.701 participantes de la cohorte fueron entrevistados y la composición corporal evaluada a través del Bod Pod, 2.219 miembros presentaban por lo menos 1 medida de peso y altura en los tres periodos (infancia, adolescencia, etapa adulta), un 24% nunca presentó sobrepeso y un 68,6% nunca fue considerado obeso. Los valores más altos de índice de masa corporal (IMC) y de porcentaje de masa grasa a los 30 años fueron observados en aquellos que fue considerados con sobrepeso en los tres periodos o en la adolescencia y adultez, mientras que aquellos con sobrepeso/obesidad sólo en la infancia o adolescencia tuvieron promedios de IMC y porcentaje de masa grasa similares de quien nunca tuvo sobrepeso/obesidad. Los resultados indican el beneficio de la interrupción precoz del sobrepeso/obesidad.

Estadios del Ciclo de Vida; Obesidad; Sobrepeso; Adiposidad; Estudios de Cohortes

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