

Abstract

Objectives

Obesity is a global pandemic, and its rise is associated with a higher risk of non-communicable diseases (NCD). The prevalence of obesity is rising faster in low- and middle-income countries (LMIC) contributing to an epidemiological transition from communicable to NCD. A life-course approach can give insight into critical periods during which increases in obesity incidence occur and changes in adolescent body composition may be associated with adult obesity. Therefore, the aims of this thesis in a cohort of South African urban children were, to (i) assess age-related changes in the prevalence of overweight and obesity and growth and comparing percentiles between race groups and international reference; (ii) characterise racial differences in height, weight and body mass index (BMI) during adolescence; (iii) assess the association between early childhood growth and the magnitude, timing and intensity of adolescent growth; (iv) assess the association between the magnitude, timing and intensity of adolescent growth and young adult body composition; (v) assess the association between adolescent BMI and adult body composition in relation to biological maturity.

Methods

This thesis analysed data from prospective longitudinal Birth to Twenty Plus (Bt20+) cohort. A total of 5449 children born in the City of Johannesburg municipal region of South Africa from the 23rd of April to the 8th of June in 1990 were screened for enrolment. A total of 3273 (78% black, 12% coloured, 4% Indian & 6% white) singleton newborns with no congenital defects, born to mothers who had permanent residence or continued residence for 6 months were included in the study.

Anthropometric data were collected from birth to 24 years using standard techniques. Dual x-ray absorptiometry (DXA) was used to measure body composition (whole body and abdominal fat mass and whole-body lean mass) from age 21 to 24 years. Data were converted to age and sex specific z-scores for height (height-for-age, HAZ), weight (weight-for-age, WAZ and weight-for-length, WHZ) and BMI (BMI-for-age, BMIZ) using the World Health Organisation (WHO) 2006 child growth standards to determine the prevalence of stunting, underweight and wasting using the cut-off of -2SDs, from birth to 5 years. Overweight and obesity from 2 to 18 years was determined using the age- and sex-specific cut-offs from the International Obesity Taskforce (IOTF). The lambda, mu and sigma (LMS) method was used to generate age- and sex-specific percentiles for height, weight and BMI from 2 to 19 years. Longitudinal changes in anthropometric characteristics (height, weight and BMI) were modelled using the superimposition by translation and rotation (SITAR) method from age 7 to 23 years. The model summarised growth using three random effects; size (magnitude), tempo (timing) and velocity (intensity). Associations between growth in early childhood and growth in adolescence, as well

as between growth in adolescence and body size & composition in adulthood, were assessed using linear regression models.

Results

There were ethnic and sex differences in the prevalence of early childhood undernutrition and overweight and obesity in adolescence. Black males had the highest prevalence of stunting (34.4%) at 2 years of age, compared to 16.7%, 24.9% and 0.0% in white males, black females and white females, respectively. Black females had the highest prevalence of overweight/obesity (46.5%) at 21+ years compared to 26.1%, 14.9%, and 29.4% in white females, and black and white males respectively. The 50th percentile for height for black males was similar to the 10th percentile for South African white males and CDC reference. The 50th percentile for waist circumference for black females approached the 10th percentile of the NHANESIII reference while the 50th percentile for BMI and weight for black females was similar to the 50th centile of CDC reference. Black males also experienced an 8-month delay in the timing of age of peak height velocity (APHV) compared to white males, while black females had a 3-month earlier APHV than white females. Early childhood growth explained a greater variance of the magnitude of the adolescent growth spurts for height, weight, and BMI (range: 19.3 to 52.3%) than it did for timing (range: 5.5 to 15.2%) and intensity (range: 2.1 to 10.8%). In turn, the magnitudes of adolescent weight and BMI gain were the strongest predictors of young adult BMI, fat mass, fat-free soft tissue mass, fat mass index (FMI) and fat-free soft tissue mass index (FFMI), than the timing and intensity of weight and BMI. Adolescent weight was also positively associated with young adult height. Achieving peak weight gain before APHV was associated

with greater fat mass and FMI than after APHV in females. Childhood onset overweight/obesity is associated with greater BMI, whole body and trunk fat mass percent than late adolescence onset overweight/obesity

Conclusion

This thesis used a lifecourse approach to address two important global health problems which are plaguing LMIC, the persistently high prevalence of undernutrition and the emerging obesity pandemic. There are additional periods of growth faltering and residual plasticity in black children. Thus, there are several windows of opportunity to influence growth: 1) in foetal/infancy and prepubertal periods to promote optimal linear growth, 2) childhood to early adolescence to prevent unhealthy and persistent body mass gain, and 3) late adolescence to prevent the resurgences of weight and BMI velocities in women. Long-term (childhood onset) obesity could have more adverse effects for cardiometabolic disease risk than late adolescent onset obesity.