

<u>Chien Huey, Teh</u>^{1,3}, Chee Cheong, Kee², Sanjay, Rampal³, Mohd Azahadi, Omar², Tahir, Aris¹

¹ Institute for Medical Research, National Institutes of Health, Ministry of Health, 40170 Setia Alam, Selangor, Malaysia

² Biostatistics and Data Repository Sector, National Institutes of Health, Ministry of Health, 40170 Setia Alam, Selangor, Malaysia

³ Centre for Epidemiology and Evidence-based Practice, Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia



KEMENTERIAN KESIHATAN MALAYSIA

Birth cohort effects on obesity among Malaysian adults: Generation X-ers and Y-ers are the high-risk subpopulations



NTRODUCTION & OBJECTIVES

Obesity is a complex health issue influenced by various factors such as diet, physical activity levels, socio-economic and environmental factors unique to individuals with similar historical, environmental and societal experience (cohort effect) (1). Besides, age-related physiological changes (age effect) and secular influences (period effect) (2) could also affect obesity trends in the population. Age-period-cohort (APC) analysis is commonly used to estimate cohort effects on health conditions/indicators while simultaneously controlling for the effects of age and period (2). In recent decades, Malaysia has seen a transition from traditional to westernised lifestyle (3). Therefore, it is timely to estimate the cohort effect on obesity in order to provide an additional understanding of the driving factors behind the obesity epidemic in Malaysia.



METHODOLOGY

The present study combined data from four population-based cross-sectional studies, the National Health and Morbidity Surveys (NHMS) 1996, 2006, 2011 and 2015 (n=94,537) and performed extended Hierarchical Age-Period-Cohort (HAPC) analysis to examine the BMI and waist circumference trajectories across birth cohorts as well as gender and ethnic variations in such trajectories while controlling for the confounding effects of age and period. Age and birth cohort were mean-centred at 40 and 1960, respectively, to reduce correlations between the linear and higher-order terms. These models were fitted using the mixed programme in STATA version 14 (StataCorp., College Station, TX, USA).

This study aims to illuminate BMI and waist circumference trajectories of Malaysia adults across the 20th and early 21st century and its variations by gender and ethnicity.





Consistent with those reported in previous studies (4-10), people born in the recent cohorts have higher BMI and waist circumferences than those born in the preceding cohorts. Exposures to the progressively more obesogenic environment, such as increased accessibility, availability and affordability of caloriedense food, the advent of automated devices for household chores and urbanisation, could be the driving factors for the monotonic increase in BMI and waist circumference across birth cohorts.

Generally, BMI (Figure 1) and waist circumference (Figure 2) increased with cohort recency.

There were significant gender differences (p<0.001) in waist circumference across birth cohorts, with a more pronounced increase among women of more recent cohorts.

In terms of ethnic differences, the Chinese have a less profound BMI (p<0.001) and waist circumference (p<0.001) increase across birth cohorts.



Figure 1: Cohort trajectories of BMI and waist circumference, by gender

There was a gender convergence in waist circumference. This trend could be attributable to a comparably lower mean total METs-minute/week among the females than males across birth cohorts (data not shown), which could be further compounded by greater likelihood of sedentary behaviours among the women as a result of increased women participation in white-collar jobs and advanced home technologies in these modern days (11).

On the other hand, ethnic gaps in BMI and waist circumference widened with cohort recency. The well-recognised ethnic variations in body fat composition at a given BMI (12), genetic predisposition (13) and differences in dietary habits among Malayians (12,14) are among the plausible factors for the observed ethnic heterogeneity.





Figure 2: Cohort trajectories of BMI and waist circumference, by ethnicity

ACKNOWLEDGEMENT

We thank the Director General of Health Malaysia for the permission to publish this paper. We would also like to thank the data collection team and central coordinators of the Institute for Public Health for their dedicated efforts. The present study was registered under the National Medical Research Registry (NMRR-18-3790-44039), and ethical approval was granted by the Medical Research and Ethics Committee (MREC).

- Yang, Y., Fu, W. J., & Land, K. C. (2004). A methodological comparison of age-period-cohort models: the Intrinsic estimator and conventional generalized linear models. Sociological Methodology, 34, 75-110. Retrieved from <u>http://www.jstor.org.ezproxy.um.edu.my/stable/3649370</u>
 Bell, A. (2014). Life-course and cohort trajectories of mental health in the UK, 1991-2008--a multilevel age-period-cohort analysis. Soc Sci Med, 120, 21-30.
- doi:10.1016/j.socscimed.2014.09.008
- Shyam, S., Khor, G. L., Ambak, R., Mahadir, B., Hasnan, M., Ambu, S., . . . Aris, T. (2020). Association between dietary patterns and overweight risk among Malaysian adults: evidence from nationally representative surveys. Public Health Nutrition, 23(2), 319-328. doi:10.1017/s1368980019001861
 Taylor AW, Shi Z, Montgomerie A, Dal Grande E, Campostrini S. The use of a chronic disease and risk factor surveillance system to determine the age, period and cohort effects on the
- raytor Arry sin 2, montgomente A, Datorande E, Campostrini S. The use of a chronic disease and risk factor surveitlance system to determine the age, period and cohort effect prevalence of obesity and diabetes in South Australian adults--2003-2013. PLoS One. 2015;10(4):e0125233.
 Robinson WR, Utz RL, Keves KM, Martin CL, Yang Y, Birth cohort effects on abdominal obesity in the United States: the Silent Generation. Baby Boomers and Generation X. Inte
- b. Robinson WK, Utz RL, Reyes KM, Martin CL, Yang Y. Birth conort effects on abdominal obesity in the United States: the Silent Generation, Baby Boomers and Generation X. International Journa of Obesity 2013;37(8):1129-34.
 6. Nooyens ACJ, Visscher TLS, Verschuren WMM, Schuit AJ, Boshuizen HC, van Mechelen W, et al. Age, period and cohort effects on body weight and body mass index in adults: the Doetinchem
- Rougens Acay resoluted resoluted
- Okui L. An age-period-cohort analysis of biomarkers of lifestyle-related diseases using the National Health and Nutrition Survey in Japan, 1973-2018. International Journal of Environmental Research and Public Health. 2020;17(21).
- Yang YC, Walsh CE, Johnson MP, Belsky DW, Reason M, Curran P, et al. Life-course trajectories of body mass index from adolescence to old age: Racial and educational disparities. Proceedings of Academy of Sciences of the United States of America. 2021;118(17).
- Barzin M, Aryannezhad S, Bagheri M, Mahdavi M, Valizadeh M, Azizi F, et al. The association of the age, period, and birth cohort with 15-year changes in body mass index and waist circumference in adults: Tehn lipid and glucose study (TLGS). BMC Public Health. 2022;22(1):418.
- Lewis CE, Jacobs DR, Jr., McCreath H, Kiefe CI, Schreiner PJ, Smith DE, et al. Weight gain continues in the 1990s: 10-year trends in weight and overweight from the CARDIA study. Coronary Artery Risk Development in Young Adults. Am J Epidemiol. 2000;151(12):1172-81. Zang, J., & Ng, S. W. (2016). Age, period and cohort effects on adult physical activity levels from 1991 to 2011 in China. International Journal of Behavioral Nutrition and Physical Activity, 13, 40.
- Zang, J., & Mg, S. W. (2010). Age, period and conort effects on addit physical activity levels from 1991 to 2011 in China. International Journal of Denavioral Nutrition and Physical Activity, 15, 40. doi:10.1186/s12966-016-0364-z
- Misra, A., & Khurana, L. (2011). Obesity-related non-communicable diseases: South Asians vs White Caucasians. International Journal of Obesity, 35(2), 167-187. doi:10.1038/ijo.2010.135
 Schlauch, K. A., Kulick, D., Subramanian, K., De Meirleir, K. L., Palotás, A., & Lombardi, V. C. (2019). Single-nucleotide polymorphisms in a cohort of significantly obese women without cardiometabolic disease International Journal of Obesity, 43(2), 253-262. doi:10.1038/s41366-018-0181-3
- . Abdullah, N. F., Teo, P. S., & Foo, L. H. (2016). Ethnic Differences in the Food Intake Patterns and Its Associated Factors of Adolescents in Kelantan, Malaysia. Nutrients, 8(9). doi:10.3390/nu8090551

The increasing BMI and waist circumference among those born in more recent cohorts, particularly the late Generation X-ers (born between 1970-1979) and Generation Y-ers (born between 1981-1996), is alarming. Future studies to identify risk factors that are associated with such high cohort-specific susceptibility to obesity among these sub-populations are necessitated to help in the planning of interventions and obesity-related policies in preventing excess weight gain among the future generations.

REFERENCES