**Causal effects of later-eating rhythm on adiposity in children through the comparison of two cohorts in the UK and China: a cross-cohort study**

*Mengxuan Zou, Kate Northstone, Sam Leary*

**National Institute for Health and Care Research Applied Research Collaboration Wessex, University of Southampton, Southampton, UK** (M Zou PhD)**; Faculty of Health Sciences, University of Bristol, Bristol, UK** (Prof K Northstone PhD, S Leary PhD)

*\**Correspondence to:

Dr Mengxuan Zou, School of Health Sciences, University of Southampton, Southampton, SO16 7NP, UK

**m.zou@soton.ac.uk**

**Abstract**

**Background:** Later-eating rhythm (LER) refers to a later timing, greater energy intake, and higher meal frequency in the evening. The role of childhood LER in obesity development is emerging, but most evidence is cross-sectional. Cross-context comparison allows the improvement of causal inference in observational studies by comparing cohorts with different confounding structures. This method is applied to assess the causal effects of LER on adiposity, by exploring the likelihood of residual confounding due to socioeconomic status.

**Methods:** In this cross-cohort analysis, we used ongoing birth cohort data from the UK Avon Longitudinal Study of Parents and Children (ALSPAC) established in 1991, and the nationally representative China Health and Nutrition Survey (CHNS) collected in 1989–2011. Children with available data at age 7 years were eligible. We applied indices of inequality for assessing confounding structure by regressing LER/adiposity on the standardised score of socioeconomic status in each cohort. We used multivariable linear and binary logistic regressions to model cross-sectional and prospective associations between LER at 7 years of age and body-mass index (BMI) at ages 7 and 9 years in both cohorts. Analyses were adjusted by age, sex, ethnicity, residency, and socioeconomic status. We used a p value for the Cochrane Q-test obtained from meta-analysis to test for heterogeneity between cohorts.

**Findings:** We analysed data from 4019 children (2170 [54·0%] female; 1849 [46.0%] male) in ALSPAC and 1749 (788 [45·1%] female; 961 [54.9%] male) in CHNS. The associations between socioeconomic status and LER or adipositydiffered between ALSPAC and CHNS (socioeconomic status and energy intake for evening main meal: b=1·81 [95% CI 0·81 to 2·81] *vs* –3·02 [–4·76 to –1·27]; socioeconomic status and frequency of evening snacks: odds ratio [OR]=0·51 [95% CI 0·41–0·63] *vs* 5·71 [3·54–9·22]; socioeconomic status and BMI: b=–0·42 [–0·65 to –0·18] *vs* 1·29 [0·75 to 1·84]). Positive associations between frequency of evening snacks (number of recorded days consuming evening snacks) and BMI were seen in both cross-sectional and longitudinal analyses in both cohorts (mean change of BMI with 1 day increase of consuming evening snacksb=0·09 [0·02 to 0·15]; 0·13 [0·03 to 0·22] kg/m² per dayin ALSPAC, and b=0·11 [–0·07 to 0·28]; 0·30 [0·07 to 0·52] kg/m² per dayin CHNS). No associations were found for energy intake. p values for heterogeneity ranged from 0·107 to 0·932.

**Interpretation:** Both cohorts showed consistent results despite varied dietary cultures and socioeconomic status patterning of LER or adiposity. Energy intake in the evening or night was not associated with adiposity, whereas evening snacking was. More recent, high-quality cohorts are warranted to enhance the strength of the conclusions.

**Funding:** None.

**Contributors**

MZ contributed to the design of this study, data analysis, and wrote the Abstract. KN and SL are responsible for the conception of the study and abstract reviewing. All authors have seen and approved the final version of the Abstract for publication.

**Declaration of interests**

We declare no competing interests.

**Acknowledgments**

The UK Medical Research Council and Wellcome (Grant ref: 217065/Z/19/Z) and the University of Bristol provided core support for ALSPAC. MZ acknowledges the Chinese Scholarship Council (CSC) and also the University of Bristol for their support of her PhD study. This work was supported by the Nutrition Theme of the National Institute for Health and Care Research (NIHR) at the Biomedical Research Centre at the University Hospitals Bristol, Weston NHS Foundation Trust, and the University of Bristol. The views expressed in this publication are those of the authors and not necessarily those of the NHS, the NIHR, or the Department of Health and Social Care. We thank all the families who took part in this study, the midwives for their help in recruitment, and the whole ALSPAC team. This research also uses data from CHNS. We are grateful to research grant funding from the National Institute for Health (NIH), the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) for R01 HD30880 and R01 HD38700, National Institute on Aging (NIA) for R01 AG065357, National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) for R01 DK104371 and P30 DK056350, National Heart, Lung, and Blood Institute (NHLBI) for R01 HL108427, the NIH Fogarty grant D43 TW009077, the Carolina Population Centre for P2C HD050924 and P30 AG066615 since 1989, and the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009, Chinese National Human Genome Centre at Shanghai since 2009, and Beijing Municipal Centre for Disease Prevention and Control since 2011.