Editorial

Trajectory Modelling: A Novel Approach to Dig Value of Longitudinal Cohort Studies

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Cohort studies are important epidemiological methods to investigate associations between environmental factors, individual characteristics, and disease or other health outcomes. As a paradigm of cohort studies, the Framingham Heart Study (FHS) is the longest-running cardiovascular epidemiological study, starting in 1948. Over 70 years, FHS not only firstly proposed the concept of risk factor in 1961, but also successively reported the roles of age, blood pressure, cholesterol, smoking, and obesity. It has contributed to developing clinical diagnostic criteria for heart failure, promoting the clinical development of atrial fibrillation antiarrhythmic and anticoagulant therapy, establishing a 10-year and lifelong risk prediction scoring tool for coronary heart disease, and extending the research scope to multiple disease fields[1]. A number of longitudinal cohort studies have also been established in China since 1970s. Especially, the China Kadoorie Biobank (CKB) with 510,000 participants, was established in 2004, as the largest scale cohort in China. Research based on CKB data has consistently produced high-quality evidence, including studies demonstrating the association between healthy lifestyles and major chronic diseases in the Chinese population[2]. In order to share multi-cohort data, the China Cohort Consortium (CCC) was initiated in October 2017[3] and the general and variable information of 159 cohorts, including natural population cohorts, birth cohorts, occupational and disease-specific cohorts, have been displayed in CCC website (https://cohortconsortium.com/).

Traditional cohort studies typically focus on the relationship between baseline exposure and outcomes[4,5]. In this issue, Shuanghua Xie et al. reported a prospective birth cohort study to investigate the association between ABO blood types and gestational diabetes mellitus (GDM) risk[6]. As an inherent characteristic of individuals, ABO blood types are not varied with time. The GDM occurrence was defined yes or no in this study. Thus, this fix cohort is similar with cross-sectional study. The investigators do not need to consider the dynamic changes in exposure factors and disease progress. So logistic regression was applied to calculate the Odds Ratios (*OR*s) and 95% Confidence Intervals (*CI*s) between ABO blood types and GDM risk. With the development of longitudinal cohorts, Individual-level longitudinal data on biological, behavioural and social dimensions are becoming increasingly available. In many studies, measured health outcomes are averaged out and their evolution across the entire study sample or pre-specified observed subgroups is analyzed. However, in most cases, unknown or unexpected subgroups of individuals share similar patterns of clinical symptoms, behaviours, or healthcare utilization. Thus, describing populations of individuals using averaged estimates amounts to oversimplifying the complex intra- and inter-individual variability of the real-life clinical context. Therefore, trajectory modelling approaches have been developed to address this challenge.

A trajectory describes the course of a measured variable over age or time. Individuals can be assigned to homogeneous subgroups (distinct trajectories) that are interpreted as representing similarities on given outcomes. In healthcare research, trajectory approach is helpful for improving our understanding of disease severity, interference, management, and evolution over time. For example, Song M et al. used a trajectory approach to identify distinct subgroups of participants with similar evolution of body shape over the life course in two large cohort studies, finding that heavy body shape from age 5 up to 50, especially midlife weight gain, was associated with higher mortality[7].

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Investigators in epidemiology and other fields are often interested not only in the trajectory of variables over time, but also in how covariates may affect their shape. Traditionally, hierarchical modeling and latent curve analysis have been used to measure these relationships, but in recent years, a group-based approach known as group-based trajectory modeling (GBTM) has increased in popularity as an alternative. Whereas hierarchical modeling and latent curve analysis estimate the population average trajectory and use covariates to explain variability about this average, GBTM assumes that the population is composed of distinct groups, each with a different underlying trajectory.

In this issue, two cohort studies apply novel GBTM to identify frailty trajectories[8] and fasting blood glucose (FBG) trajectories[9], respectively. Yang Liu et al. explored the relationship between solid cooking fuel use with frailty trajectories in middle-aged and older Chinese adult[8]. While Mingxia Zou et al. investigated FBG trajectory patterns in male steelworkers, showing that elevated exposure to occupational hazardous factors increased FBG trajectory levels[9].

In summary, it is crucial to pay attention to trajectory approach in longitudinal cohort studies, as it can reveal the dynamic changes in exposure factors, disease development, or health outcomes, rather than just static “starting points” and “endpoints”.

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REFERENCES

1. Andersson C, Johnson AD, Benjamin EJ, et al. 70-year legacy of the Framingham Heart Study. Nat Rev Cardiol, 2019; 16, 687−98.
2. Guo Y, Yu CQ, Lyu J, et al. Progress and achievements of large natural population cohort demonstration study. Chin J Epidemiol, 2023; 44, 1−6.
3. Yixin Sun, Zhengcun Pei, Houyu Zhao, et al. Data Resource Profile: China Cohort Consortium (CCC). Int J Epidemiol, 2020; 49, 1436−1436m.
4. Yang JZ, Shen H, Wang SC, et al. Prospective Cohort Investigation on Physical Activity of Osteoporosis Outcomes (PAOPO) in Jidong: Objectives, Study Design, and Baseline Characteristics. Biomed Environ Sci, 2024; 37, 1067−79.
5. Liu S, Liu FC, Li JX, et al. Association between Fruit and Vegetable Intake and Arterial Stiffness: The China-PAR Project. Biomed Environ Sci, 2023; 36, 1113−22.
6. Shuanghua Xie, Shuangying Li, Shaofei Su, et al. Association between ABO Blood Types and the Risk of Gestational Diabetes Mellitus: A Prospective Cohort Study. Biomed Environ Sci, 2025; 38, 678−92.
7. Song M, Hu FB, Wu K, et al. Trajectory of body shape in early and middle life and all cause and cause specific mortality: results from two prospective US cohort studies. BMJ, 2016; 353, i2195.
8. Yang Liu, Bingjie Wu, Bingbing Fan, et al. Association between Solid Cooking Fuel Use and Frailty Trajectories: Findings from a Nationwide Cohort in China. Biomed Environ Sci, 2025; 38, 653−65.
9. Mingxia Zou, Wei Du, Qin Kang, et al. Occupational Hazardous Factors and the Trajectory of Fasting Blood Glucose Changes in Chinese Male Steelworkers Based on Environmental Risk Scores: A prospective Cohort Study. Biomed Environ Sci, 2025; 38, 666−77.