Eighteen year weight trajectories and metabolic markers of diabetes in modernising China: which timescale is most relevant?

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To the Editor: Although obesity is a major risk factor for type 2 diabetes, the relationship between body weight changes and diabetes development is not well understood. In the China Health and Nutrition Survey, information on body weight and height was collected in seven survey rounds from 1991–2009 (1991, 1993, 1997, 2000, 2004, 2006 and 2009) [1]. Gordon-Larsen et al performed latent class trajectory analysis to characterise different longitudinal patterns of weight change in order to study whether individuals with different weight change trajectories also differed in diabetes-related factors measured at the last survey round in 2009. The authors concluded that the levels of diabetes-related factors (fasting glucose and insulin concentrations, HbA_{1c} and HOMA-IR) were lower in groups of individuals who maintained weight, lost weight or switched from weight gain to weight loss compared with those who gained weight.

Use of latent class trajectory analyses to identify heterogeneity in patterns of longitudinal changes of risk factors over time is interesting and novel. This type of statistical method is a useful tool for detecting both typical and atypical courses of development which would not be identified by use of conventional methods, e.g. pre-defined categories of weight changes. However, the choice of timescale used to fit the trajectory models is crucial for the interpretation of the results. Multiple biologically relevant timescales can be used in epidemiological studies, and there is no consensus on one particular

timescale being superior to the others. The choice of timescale depends predominantly on the research question. Age can be used as the timescale when the aim is to study patterns of weight changes over a life course [2], whereas calendar time is relevant for assessing secular trends [3]. On the other hand, time since diagnosis would be the appropriate timescale when studying the prognosis of a disease [4], and time until diagnosis most meaningful when studying the aetiology of disease development, e.g. latent class trajectories of BMI prior to diagnosis of diabetes [5].

In addition to the research question, the structure of the collected data should be taken into account when deciding on which timescale to use. In the study by Gordon-Larsen et al [1], time since entry (years from inclusion) into the study was used as the timescale. Diabetes-related outcomes were only measured in 2009, but study participants entered the study at different time points in the period 1991–2006. This means that time 0 in the weight change trajectory figures represents calendar times between the years 1991 and 2006. Thus, the diabetes-related outcomes measured in 2009 have been collected 3 years from the start for some participants and 18 years from the start for others (illustrated in Fig. 1a, b). Accordingly, on a group level, it is difficult to conclude whether the predicted weight changes precede elevated levels of diabetes-related markers or whether they are secondary to the changes in glucose metabolism. Time since entry would be a relevant timescale if the diabetes-related markers were measured at the same time relative to the time of study entry, e.g. 10 years from the start. However, in this particular study [1], analyses of weight changes based on a retrospective timescale from time of glucose measurements and backwards (in this case equal to calendar time) seem more clinically meaningful [5], because the timing of the weight change trajectories in relation to the measurements of diabetes-related markers would then be the same for all participants (illustrated in Fig. 1c, d). To ease the interpretation of the results even more (Fig. 1d), relative

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Fig. 1 Example of a data set sorted by the participants' entry into the study (a) and the corresponding weight change trajectory curves (b), and the same data set sorted by calendar year (c) and the corresponding weight change trajectory curves (d). Data are simulated. A circle illustrates the time of measurement of diabetes-related outcomes

weight changes (in %) from 2009 and backwards or absolute levels of BMI could be modelled instead of absolute weight changes (in kg) during the study. Using calendar time in the

trajectory analysis would also take into account the secular trends in obesity, as previously documented in the China Health and Nutrition Survey [6].

Duality of interest The authors declare that there is no duality of interest associated with this manuscript.

Contribution statement DV and KF were responsible for the conception and design of the manuscript, drafting the article and revising it critically for important intellectual content. DV and KF approved the version to be published.

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