DIABETES RESEARCH AND CLINICAL PRACTICE 116 (2016) 123–126

Contents available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

Does area of residence influence weight loss following a diagnosis of type 2 diabetes? Fixed effects longitudinal analysis of 54,707 middle-to-older aged Australians

Xiaoqi Feng [a,b,*], *Thomas Astell-Burt* [a]

[a] School of Health and Society, University of Wollongong, Wollongong, NSW 2522, Australia
[b] Early Start Research Institute, University of Wollongong, Wollongong, NSW 2522, Australia

ARTICLE INFO

Article history:
Received 12 January 2016
Received in revised form
7 March 2016
Accepted 16 April 2016
Available online 23 April 2016

Keywords:
Body mass index
Weight status
Type 2 diabetes
Longitudinal analysis
Fixed effects models

ABSTRACT

Reductions in body mass index and reduced overweight/obesity risk among participants in the 45 and Up Study diagnosed with type 2 diabetes mellitus (T2DM) were relatively large in rural areas compared to those in urban environs. Further research is needed to explain why where people reside influences optimal management of T2DM.

1. Introduction

Cardiovascular disease (CVD) is the leading cause of death among Australians living with type 2 diabetes mellitus (T2DM) [1]. Moreover, even if mortality is avoided, the experience of a myocardial infarction can result in disability, diminished life quality and various unfavourable social and economic penalties [2] that contribute significantly to the estimated $15 billion annual cost of T2DM [3]. Preventing CVD among people living with T2DM is paramount. A modest weight loss of 5–<10% among people living with T2DM helps to reduce the risk of CVD, as well as improving other aspects related to diabetes control [4]. This can be achieved using pharmacotherapy [5] and bariatric surgery [6], though optimal management of T2DM requires a multifactorial approach that incorporates lifestyle change [7]. It seems like we know the answer, but as many scientists point out, stumbling blocks remain [8].

A major, yet somewhat underplayed factor not only in the prevention of CVD among people living with T2DM, but also

* *Corresponding author at:* School of Health and Society/Early Start Research Institute, University of Wollongong, Wollongong, NSW 2522, Australia. Tel.: +61 2 4221 4038.
E-mail address: xfeng@uow.edu.au (X. Feng).

http://dx.doi.org/10.1016/j.diabres.2016.04.022
0168-8227/

in the prevention of T2DM *per se*, is that the places where people reside shape lifestyle choices. Parks and green spaces promote physical activity [9,10] and healthy weight status [11]. Food outlets of particular types, such as fast food takeaways, can influence the types of food people purchase [12]. These are but some of many examples. A key problem, therefore, is that the efforts of a person living with T2DM to lose weight and the support of their clinician may be undercut by unsupportive built environment. Only one study has examined the impact of the area of residence on outcomes of T2DM care [13], but was restricted by cross-sectional data.

Accordingly, the purpose of this study was to investigate if the area of residence influences the degree of weight loss among a cohort of middle-to-older aged people just diagnosed with T2DM.

2. Method

Data for this study were extracted from the Sax Institute's 45 and Up Study [14]. Participants had initially been randomly sampled from the Medicare Australia database. Baseline data were collected via self-complete questionnaire between 2006 and 2009, achieving a response of 18%. The first 100,000 baseline participants were followed up with a second self-complete questionnaire between 2010 and 2011 for the Social Economic and Environmental Factors Study. A total of 28,057 men and 32,347 women participated at follow-up, with a response of 60.4% (3.4 ± 0.95 years follow-up time). Ethical approval for the 45 and Up Study was granted by the University of New South Wales Human Research Ethics Committee (HREC 05035/HREC 10186) and the SEEF Study by the University of Sydney Human Research Ethics Committee (ref No. 10-2009/12187).

Body mass index (BMI) was the main outcome variable. Self-reported height and weight was used to construct BMI at baseline and follow-up. Those with missing BMI data were omitted ($N = 5682$). World Health Organization criteria for defining overweight and obesity ($\text{BMI} \geqslant 25$) were used to define a second outcome variable. T2DM status was identified by responses to the question "*Has a doctor EVER told you that you have diabetes?*" The final sample was 25,777 men and 28,930 women.

Linear and logistic regressions were used to investigate the influence of T2DM diagnosis at follow-up on change in BMI and weight status. Separate models were fitted for men and women. A fixed effects strategy was implemented to eliminate all time-invariant sources of confounding [15]. By fitting a fixed intercept for every individual participant, all between-person variation is eliminated with each participant serving as their own control [16]. Consequently, only time-varying sources of confounding needed to be controlled, including age, economic status, annual household income and couple status. Models were fitted for the full sample first, then stratified by the Accessibility-Remoteness Index of Australia [17] measured at baseline to examine whether weight loss was different for participants in major cities compared those living in regional and remote rural areas. All analyses were conducted in Stata v.12 (StataCorp, College Station, TX).

3. Results

Mean BMI for men and women was approximately 26–27 kg/m^2 at baseline and follow-up (Table 1). Overweight/obesity and T2DM prevalence were higher among men. Income distributions shifted upwards over time, meanwhile the percentage identifying as retired or not in a couple also increased. The sample was slightly skewed towards regional, rural and remote. A total of 3735 participants who did not report T2DM at baseline did report in the affirmative at follow-up. In age-adjusted and full-adjusted models a T2DM diagnosis was associated with a significant reduction in BMI for men and women (Table 2). A reduced risk of overweight/obesity was also detected. In stratified models, BMI reduction was significant for men and women, but in relatively great magnitude among those living in regional, rural and remote areas. Reduced risk of overweight/obesity was statistically significant ($p < 0.05$) only in regional, rural and remote areas.

4. Discussion

Reduced BMI and overweight/obesity status demonstrated in this study reflects the necessity of weight reduction in most people diagnosed with T2DM. A key finding, however, is the differential weight loss aligned with area of residence. People diagnosed with T2DM living in regional, rural and remote areas experienced greater weight loss compared to their urban counterparts.

A key advantage of this study is the longitudinal approach and the 'fixed effects' strategy, which provides a more robust foundation for causal inference by eliminating time-invariant sources of bias. The study is restricted, however, with regard to explaining the differential weight loss between urban and regional/rural participants. The fixed effects identification strategy is also vulnerable to unmeasured sources of potential time-variant confounding. A further limitation is that the 45 and Up Study did not distinguish between T2DM and type 1 diabetes in its questionnaire, though the majority of new cases among people aged 45 years or older are likely to be the former. Plausible hypotheses for future investigation include differences in local built environment, such as variation in neighbourhood walkability, food and alcohol environment, access to green spaces and public transport. It is also important to consider counter-hypotheses, as geographic variation in primary care availability, pharmacotherapy and bariatric surgery are also important to consider. It may be, for example, that living in an urban or rural area plays a role in determining whether a person just diagnosed with T2DM receives metformin or incretins (treatments that may assist with weight loss), or sulphonylureas or insulin (which may promote weight gain). Future work will need to augment data with indicators of environment, health service use and treatment received to identify areas for policy intervention.

In conclusion, recognition that optimal T2DM management in most cases should include weight loss [7] must also lead to the acknowledgement that the environs where people live probably interfere with the best efforts of patients and the health sector as a whole. Primary and secondary prevention