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Original Article

Age- and gender-specific associations of napping duration with type 2 diabetes mellitus in a Chinese rural population: the RuralDiab study

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ABSTRACT

Background: The consistency and strength of the relationship between napping duration and type 2 diabetes mellitus (T2DM) remained uncertain, especially in the rural population. The purpose of this study was to explore the relationship between napping duration and T2DM in a Chinese rural population.
Methods: A total of 12663 participants (4365 males and 8298 females) were derived from the RuralDiab study in China. Napping duration was obtained through a standardized questionnaire, and was divided into five categories: no napping (reference), 1~, 31~, 61~, and ≥91 min. Fasting blood glucose was measured. Logistic regression was used to estimate odds ratios (*ORs*) and 95% confidence intervals (*CIs*). A meta-analysis including seven studies was conducted to validate the result of the RuralDiab study.
Results: The crude and age-standardized prevalence of T2DM were 10.31% and 8.14%, respectively. Compared with no napping, the adjusted *OR* (95%*CI*) for napping duration ≥91 min was 1.23 (1.05–1.45). A similar relationship was found only in females aged 45–54 years, but not in males and other age group females. In addition, napping duration was associated with T2DM in a positive dose-dependent manner among females aged 45–54 years (*P* for trend <0.05). The meta-analysis demonstrated this association, and the pooled *OR* (95%*CI*) for the longest napping duration compared with no napping was 1.28 (1.22–1.35).
Conclusion: Longer napping duration is associated with higher risk of T2DM in the Chinese rural population, and this association varies across gender and age. Further multi-center prospective researches are needed to confirm the relationship and reveal underlying mechanisms.

1. Introduction

Type 2 diabetes mellitus (T2DM) has become one of the leading causes of disease burden and mortality, worldwide, and caused 1.3 million deaths in 2010; this disease is projected to have an estimated prevalence of 4.4% in 2030 [1,2]. The estimated number of adults with diabetes worldwide was 415 million in 2015 and will be 642 million in 2040 [3]. In 2010, the prevalence of diabetes was 11.6% in the Chinese adult population, which represents up to 113.9 million individuals [4]. Thus, finding out the determinants of T2DM is urgently needed to prevent this public health problem in China. It is well known that genetic and environmental factors (including diet and exercise) contribute to the prevalence of T2DM, while other behavioral factors might also be involved in the development of T2DM.

Daytime napping is a well-accepted habit in China especially in rural areas, and has been considered a healthy life style behavior for thousands years. Napping may help eliminate fatigue and improve

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mood. It particularly benefits the task performance, such as logical reasoning, response time, and symbol recognition [5]. One study showed that a daytime nap for less than 30 min could promote wakefulness and enhance performance and learning capacity, while long naps may be associated with higher morbidity and mortality of some diseases [6]. Other studies demonstrated that daytime napping was associated with an increased prevalence of metabolic syndrome, hypertension, and non-alcoholic fatty liver disease and might increase the risk of all-cause and cardiovascular disease (CVD) mortality [7–11].

Few prospective [12,13] and cross-sectional [14–17] studies concerning the association between napping duration and T2DM have been published. However, the definition of napping duration between studies was different and no population-based study focused on rural population. More important, the study exploring the relationship between napping duration and T2DM by combining epidemiological research and meta-analysis has not yet been reported. Therefore, we conducted an analysis in the Rural Diabetes, Obesity and Life style (RuralDiab) study combined with a meta-analysis to further explore the relationship between nap duration and T2DM.

2. Participants and methods

2.1. Study participants

The participants were screened from the RuralDiab study which included 16607 participants from Luoyang and Xuchang City of Henan province in China. Of these participants, only those aged between 35 and 74 years (15100 participants) were included in this part of study. Due to the potential influence of health burden on napping, those with diagnosed stroke, coronary heart disease or cancer (2396 subjects) were excluded. In addition, the participants who had varying work shifts that affected their sleep and napping patterns (and consequently, T2DM risk) were excluded (n = 8). The subjects with missing information regarding nap duration (n = 14) and diagnosis of T2DM (n = 19) were also excluded. Finally, a total of 12663 eligible participants were selected for the analysis in this study.

The protocol of this study was in accordance with the guidelines of the Helsinki Declaration, and was approved by the ethic committee of the Zhengzhou University Medical Ethics Committee. Informed consent was obtained from all respondents.

2.2. Assessment of potential covariates

A structured questionnaire survey was conducted by well-trained staff through face-to-face interviews in order to collect information on demographic characteristics (age, gender, educational level, socioeconomic status and marital status), life style (smoking, alcohol drinking and physical activity), history of disease and medication, and family history of disease (defined as parents or siblings of the respondents had a history of disease). Age was classified into four categories: 35–44, 45–54, 55–64, and 65–74 years. Education level was divided into elementary school or below, junior high school and high school or above. Socioeconomic status was assessed according to average monthly individual income (<500, 500~, and ≥1000 RMB). Marital status was divided into married/cohabitating and unmarried/divorced/widowed. Smoking was defined as at least one cigarette per day for sequential or cumulative six months. Alcohol use was defined as at least consuming alcohol 12 times per year. Physical activity was grouped into low, moderate and high level based on International Physical Activity Questionnaire (IPAQ) [18]. Night sleep duration was divided into four groups (<7, 7~, 8~, and ≥9 h) based on the quartile cut points.

Body weight and height were measured twice with the metric scale and the vertical weight scale followed a standardized protocol [19] and the readings were taken to the nearest 0.1 kg and 0.1 cm, respectively. Body mass index (BMI) was calculated based on the measured height and weight. Blood pressure (BP) was measured three times for each participant according to the American Heart Association's standardized protocol [20] with an electronic sphygmomanometer (HEM-770A Fuzzy, Omron, Japan). The average values were calculated for analysis. Venous blood samples were drawn from the participants after overnight fasting. Serum was separated by centrifugation at 3000 rpm for 10 min, 4 °C and stored at −20 °C for further tests. Fasting blood glucose was measured on the day of blood drawing using a modified hexokinase enzymatic method.

2.3. Determination of napping duration

Participants were asked to answer the question: “Did you take a nap usually over the past year?” Those who gave a positive answer were further asked to report the average duration of their nap per day. Based on the existing literature [13,14], the napping duration was categorized into five groups: no napping (reference), 1~, 31~, 61~, and ≥91 min.

2.4. Definition of T2DM

The definition of T2DM was on the basis of the American Diabetes Association (ADA) diagnostic criteria (2009) [21], participants were defined with T2DM if the fasting blood glucose ≥7.0 mmol/l or having a self-reported previous diagnosis of diabetes by a physician after excluding type 1 diabetes mellitus, gestational diabetes mellitus, and diabetes due to other causes.

2.5. Meta-analysis

Based on the guideline of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA), a meta-analysis was conducted by combining the results of current study and those of previous studies on association between napping duration and T2DM. PubMed, Web of Science, CNKI (China National Knowledge Infrastructure), Chongqing VIP and Wanfang databases were searched for studies, and the literature search was updated on April 6, 2016, using the following search terms: (diabetes or T2DM or T2D or DM) AND (nap or napping or noon break or midday rest or siesta). References listed by each original article were also searched to identify more studies. The included studies were those examining the association of napping duration and T2DM. The exclusion criteria were: (1) conducted in particular population (eg, pregnant women), (2) literature reviews, and (3) editorials. Two investigators independently extracted the searched data, if they had disagreements, then discussed with a third investigator. Information extracted from each article included title, the name of the first author, publication date, study location, study design, sample size, gender ratio and age range of the participants, covariates adjusted in the multivariable analysis, categories of napping duration, Definition of T2DM, and *OR* (95% *CI*) for the longest napping duration category. Cochran Q was used to examine heterogeneity among the studies. A random- or fixed-effects model was used to synthesize the pooled OR in the presence ($P < 0.10$) or absence ($P > 0.10$) of heterogeneity. Potential publication bias was evaluated by Begg's and Egger's tests.

2.6. Statistical analysis

Categorical variables were expressed in percentages and compared by Mantel- Haenszel test. Continuous variables were