Supplementary material

Supplementary Table 1 Characteristics of studies included in the meta-analysis of shift work in relation to risk of diabetes mellitus

Study	Study design (time period)	Country	Population (age)	Population and occupation	Exposure assessment	Type of shift work	Study outcome and ascertainment	NO of cases	Adjustment for confounders	Quality assessment
Mikuni et al ,1983	Cross-sectional	Japan	2367 men aged mean=38.1	Factory laborers	Shift work was a three shifts	Rotating	Diabetes identified through self-report and confirmed by Japan Diabetes Society 1970 diagnostic criteria	37	No covariate adjustment	2
Kawakami et al, 1999	Prospective cohort (follow up at 8 years)	Japan	2194 men aged 18-60	Workers at a large electrical company	Shift workers engaged in two or three shift work schedules including night shift, with a weekly clockwise rotation	Mixed	Type 2 diabetes identified through self-report and confirmed by WHO criteria	34	Age, education, BMI, smoking, alcohol consumption, leisure time physical activity, family history of diabetes mellitus, job strain, social support, use of technology	8

| Nagaya et al, 2002 | Cross-sectional | Japan | 3650 men aged 30-59 | Blue-collar workers attending annual health check-ups | Shift workers were defined as the subjects with night work (at least once a week) | Night | Diabetes identified through medical records and confirmed by Fasting serum glucose ≥7.00mmol/l or patient under treatment for diabetes | 176 | BMI, job, drinking, smoking and exercise | 4 |
| Karlsson et al, 2005 | Retrospective cohort | Sweden | 5442 men aged 10-59 | Workers from two pulp and paper manufacturing plants | The shift workers worked a three-shift rota | Rotating | Diabetes mortality identified by medical records was confirmed by death certificate diagnosis in the primary or contributory cause-of death fields based on | 158 | Age, duration of employment | 7 |

| Morikawa et al, 2005 | Prospective cohort (follow up at 8 years) | Japan | 2860 men aged 19-49 | Blue collar workers in a sash and zipper factory | Rotating two-shift workers did day shifts and evening shifts, and three-shift workers did three-shift continuous (counterclockwise) and three-shift non-continuous | Evening and mixed | Diabetes identified through health examination and medical records and confirmed based on an HbA1c of $\geq$ 6.1 or clinical judgment of hospital physicians | 87 | Age, BMI, family history, health-related behavior(smoking, habitual drinking, lack of physical exercise) | 8 |

ICD-6～10 codes or Diagnosis Related Group codes

Suwazono et al, 2006	Prospective cohort (follow up at 6.69 years)	Japan	5629 men aged day shift mean=35.1(9.9) alternating shift mean=37.4(8.8)	Workers in a Japanese steel company	The alternating shift workers were working according to a four-team/three shift system with clockwise rotation	Rotating	Diabetes identified through medical records and confirmed based on an HbA1c of $\geqslant$ 6.1 or clinical judgment of hospital physicians	246	Age, BMI, total serum cholesterol, γ-GTP, uric acid, and absence of habitual exercise, drinking, smoking	8
De Bacquer et al,2009	Prospective cohort (follow up at 6.6years)	Belgium	1529 men aged 35-59 mean=46.54	Nine different companies and public administrations	Shift workers worked in two or three rotating shifts	Rotating	Type 2 diabetes identified through self-reports and confirmed by a modification of the criteria of the International Diabetes Federation	364	Age, waist circumference, diastolic blood pressure and HDL cholesterol at the initial examination	8

| Pan et al,2011 | Prospective cohort (follow up at 20 years) | United States | 62696 women aged 42-67 mean=53.9(7.1) NHS I | Nurses | Shift workers were people who had worked rotating night shifts (defined as at least three nights/month in addition to days and evenings in that month) | Night | Type 2 diabetes identified through self-report diagnosis and confirmed by supplemental questionnaire; National Diabetes Data Group criteria(before 1998)and Association Diabetes Association 1997(after 1998) diagnostic criteria | 6165 | Age, alcohol consumption, physical activity level, smoking status, race ,menopausal status and hormone use, family history of diabetes, current aspirin use, quintiles of total calorie, diabetes dietary score, updated BMI category | 8 |

| Pan et al, 2011 | Prospective cohort (follow up at 18 years) | United States | 107915 women aged 25-42 mean=34.3(4.7) NHS Ⅱ | Nurses | Shift workers were people who had worked rotating night shifts (defined as at least three nights/month in addition to days and evenings in that month) | Night | Type 2 diabetes identified through self-report diagnosis and confirmed by supplemental questionnaire；National Diabetes Data Group criteria(before 1998)and Association Diabetes Association 1997(after 1998) diagnostic criteria | 3961 | Age, alcohol consumption, physical activity level , smoking status, race ,menopausal status and hormone use, oral contraceptive use, family history of diabetes, current aspirin use, quintiles of total calorie, diabetes dietary score, updated BMI category | 8 |

Study	Design	Country	Sample	Population	Shift work definition	Shift type	Diabetes ascertainment	Cases	Adjustments	Score
Ika et al, 2013	Cross-sectional	Japan	475 men aged 19-70	Workers at a large manufacturing company	A shift worker was person whose work schedule includes hours day time (8:00 to 16:45 h) for 5-weekday and night shift (21:15 to 6:00 h) for 5-weekday	Night	Diabetes identified through medical records and confirmed by Japan Diabetes Society diagnostic criteria	21	Age, smoking status, frequency of alcohol consumption, and cohabitation status	7
Eriksson et al, 2013	Prospective cohort (follow up at 8-10 years)	Sweden	5432 men and women aged 35-56	Middle-aged persons from a population-based cohort	Did you do shift work?	Unspecified	Type 2 diabetes identified through self-report and medical checkup and confirmed by WHO criteria	149	Age sex educational level, psychological distress, family history of diabetes, BMI, physical activity, smoking, and civil status,	8

| Guo et al, 2013 | Cross-sectional | China | 26463 men and women mean=63.6 | Workers from Tongji-Dongfeng Cohort | Shift work was defined as any work schedule involving unusual or irregular working hours as opposed to a normal daytime work schedule: 8:00 AM to 17:00 PM. | Irregular | Diabetes identified through self-report, use of hypoglycemic drugs and repeated measuring fasting plasma glucose level ≥7.0 mmol/l | 3197 | Gender, age , race, marital status, tea consumption, life stress, current smoking status, passive smoking, current drinking status, physical activity and BMI | 8 |

Age presented the range with Mean (SD), Abbreviations: BMI, Body mass index; NHS, Nurses' Health Survey; WHO, World Health Organization; HDL, High-density lipoprotein—cholesterol; GTP, Glutamyl transpeptidase

Supplementary Table 2. Quality assessment of reviewed cohort studies on shift work in relation to diabetes mellitus*

Study	Selection				Comparability	Outcome			Overall quality score
	Exposed group represents average in community	The comparison groups from the same source population	Ascertain exposure through records or structured interview	Demonstration that outcome not present at study start	There was adequate adjustment for confounding in the analyses from which the main findings were drawn (comparability of cohorts on the basis of the design or analysis)	Ascertain outcome via independent blind assessment or medical records, physicians	Follow-up long enough for outcome to occur (> 5 years)	Loss to follow-up <20%	
Kawakami et al. 1999	0	1	1	1	2	1	1	1	8
Karlsson et al. 2005	0	1	1	1	1	1	1	1	7
Morikawa et al. 2005	0	1	1	1	2	1	1	1	8
Suwazono et al. 2006	0	1	1	1	2	1	1	1	8
De Bacquer et al.2009	1	1	1	1	1	1	1	1	8
Pan et al. 2011	0	1	1	1	2	1	1	1	8
Eriksson et al. 2013	1	1	1	1	2	1	1	0	8

*The study quality was assessed according to the Newcastle Ottawa Quality assessment scale for cohort studies. This scale awards a maximum of 9 points to each study: 4 for selection, 2 for comparability, and 3 for assessment of outcomes (for cohort study). 1 = "Yes", 0 = "No", "Unable to determine" or "Not available".

Supplementary Table 3. Quality assessment of reviewed cross-sectional studies on shift work in relation to diabetes mellitus*

Study	1. Define the source of information (survey, record review)	2. List inclusion and exclusion criteria for exposed and unexposed subjects (cases and controls) or refer to previous publications	3. Indicate time period used for identifying patients	4. Indicate whether or not subjects were consecutive if not population-based	5. Indicate if evaluators of subjective components of study were masked to other aspects of the status of the participants	6. Describe any assessments undertaken for quality assurance purposes (e.g., test/retest of primary outcome measurements)	7. Explain any patient exclusions from analysis	8. Describe how confounding was assessed and/or controlled	9. If applicable, explain how missing data were handled in the analysis	10.Summarize patient response rates and completeness of data collection	11. Clarify what follow-up, if any, was expected and the percentage of patients for which incomplete data or follow-up was obtained	Overall quality score
Mikuni et al. 1983	1	0	0	0	0	1	0	0	0	0	0	2
Nagaya et al. 2002	1	1	0	1	0	1	0	0	0	0	0	4
Ika et al. 2013	1	1	1	0	0	1	1	1	0	1	0	7
Guo et al. 2013	1	1	1	1	0	1	1	1	0	1	0	8

*The study quality was assessed according to the 11 items recommended by the Agency for Healthcare Research and Quality (AHRQ) for cross-sectional studies. 1 point if the item was contemplated in the study, 0 point if the item was not, and unable to determine. 1 = "Yes", 0 = "No", "Unable to determine", or "Not applicable"