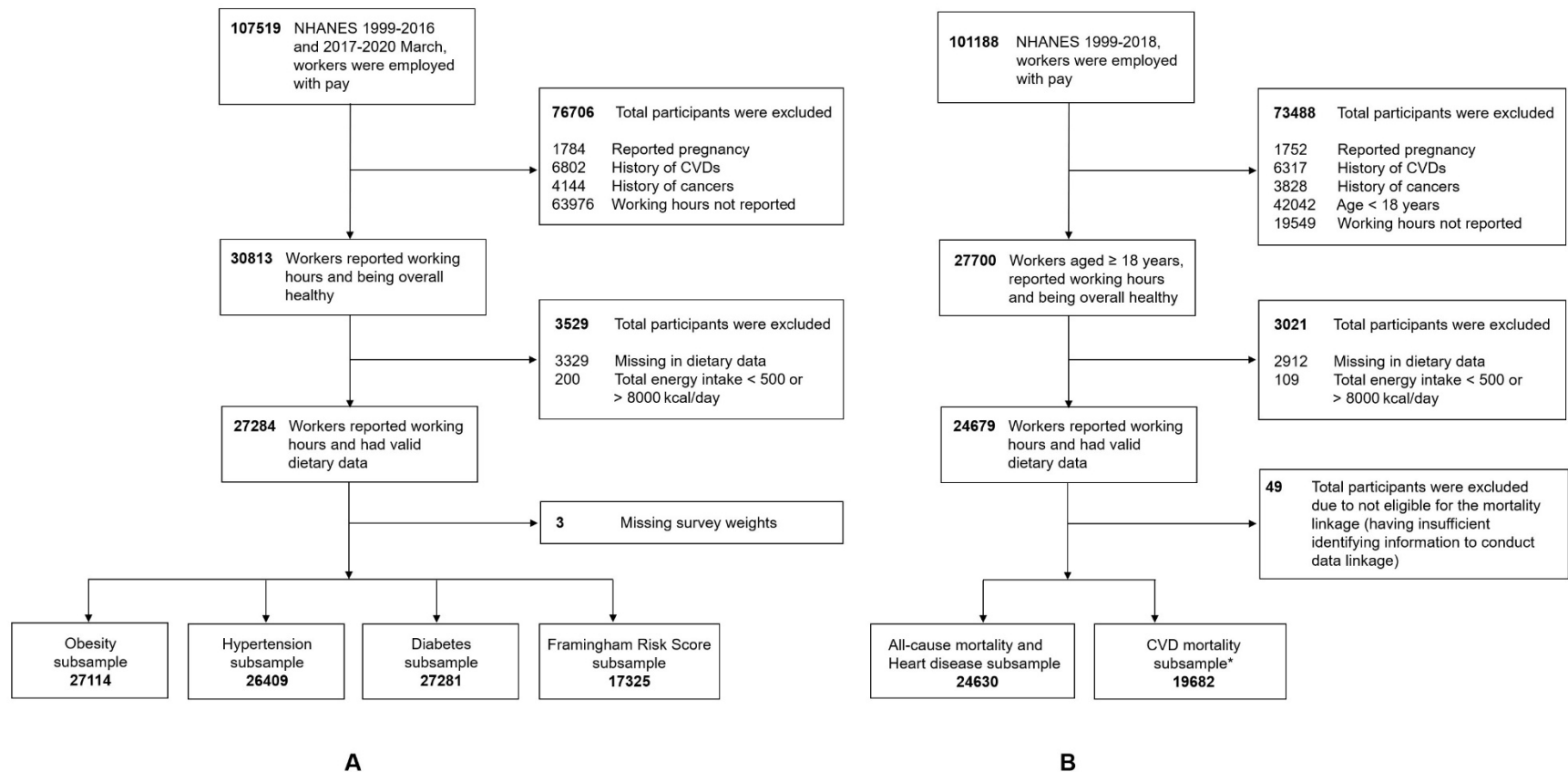


Manuscript title: The Associations of Long Working Hours and Unhealthy Diet on Cardiometabolic Outcomes and Mortality in US Workers

Supplementary Materials



S Figure 1. Sample selection flow diagram for the US workers from the National Health and Nutrition Examination Survey 1999-2020.

Abbreviations: NHANES, The National Health and Nutrition Examination Survey; CVD, cardiovascular disease.

A, subsamples for cardiometabolic outcomes in NHANES cycles 1999-2020 March; B, subsamples for mortality outcomes in NHANES cycles 1999-2018 for all-cause mortality and heart disease mortality.

Heart disease mortality, defined by the International Classification of Diseases codes I00–I09, I11, I13, I20–I51.

*, CVD mortality, cardiovascular disease mortality, defined by the International Classification of Diseases codes I00–I09, I11, I13, I20–I51, and I60–I69. Since deaths from cerebrovascular diseases (I60–I69) were not tracked after December 31, 2014, in the National Health and Nutrition Examination Survey, a subsample of participants from the 1999-2014 cycles was examined for CVD mortality only.

S Table 1. Sensitivity analyses for independent associations and joint associations between working hours, EAT-Lancet diet score, and cardiometabolic outcomes in US workers, the National Health and Nutrition Examination Survey 1999-2020 March.

	Independent associations ¹		Joint associations ²			
	LWH	EAT-Lancet diet score	LWH + EAT-Lancet diet score			
	Yes	Low	No + Low	Yes + High	Yes + Low	RERI (95%CI)
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	
Obesity						
Sensitivity analysis 1	1.15 (1.03, 1.29)	1.33 (1.21, 1.45)	1.31 (1.19, 1.43)	1.12 (0.98, 1.28)	1.56 (1.32, 1.85)	0.13 (0.03, 0.23)
Sensitivity analysis 2	1.25 (1.10, 1.42)	1.33 (1.17, 1.53)	1.33 (1.21, 1.48)	1.12 (0.99, 1.28)	1.58 (1.31, 1.86)	0.13 (0.02, 0.24)
Sensitivity analysis 3	1.17 (1.05, 1.31)	1.32 (1.22, 1.43)	1.31 (1.20, 1.42)	1.14 (1.00, 1.31)	1.59 (1.34, 1.88)	0.14 (0.07, 0.20)
Diabetes						
Sensitivity analysis 1	1.05 (0.86, 1.27)	1.31 (1.13, 1.52)	1.37 (1.15, 1.63)	1.15 (0.93, 1.44)	1.29 (0.97, 1.71)	-0.23 (-0.52, 0.06)
Sensitivity analysis 2	1.05 (0.85, 1.30)	1.22 (0.97, 1.55)	1.24 (1.05, 1.45)	1.16 (0.90, 1.48)	1.18 (0.87, 1.60)	-0.21 (-0.57, 0.04)
Sensitivity analysis 3	1.08 (0.90, 1.30)	1.34 (1.18, 1.53)	1.39 (1.20, 1.62)	1.20 (0.97, 1.49)	1.33 (1.01, 1.76)	-0.26 (-0.54, 0.02)
Hypertension						
Sensitivity analysis 1	0.99 (0.88, 1.11)	1.11 (1.01, 1.21)	1.19 (1.05, 1.34)	0.96 (0.77, 1.18)	1.14 (0.93, 1.39)	0.09 (0.02, 0.16)
Sensitivity analysis 2	1.00 (0.88, 1.13)	1.17 (1.04, 1.30)	1.12 (1.01, 1.24)	0.93 (0.80, 1.10)	1.21 (1.00, 1.48)	0.16 (0.13, 0.19)
Sensitivity analysis 3	0.99 (0.88, 1.11)	1.11 (1.03, 1.20)	1.10 (1.01, 1.19)	0.96 (0.83, 1.11)	1.13 (0.94, 1.35)	0.07 (0.01, 0.13)
Framingham 10-yr CVD risk ³						
Sensitivity analysis 1	1.10 (0.90, 1.34)	1.13 (0.94, 1.36)	1.16 (0.95, 1.42)	1.16 (0.88, 1.54)	1.21 (0.89, 1.63)	-0.14 (-0.35, 0.06)
Sensitivity analysis 2	0.90 (0.67, 1.18)	1.03 (0.79, 1.26)	1.16 (0.94, 1.38)	1.11 (0.82, 1.40)	1.14 (0.83, 1.45)	-0.13 (-0.38, 0.12)
Sensitivity analysis 3	0.96 (0.79, 1.18)	1.14 (0.98, 1.34)	1.16 (0.99, 1.36)	1.02 (0.77, 1.35)	1.05 (0.78, 1.41)	-0.13 (-0.31, 0.05)

Abbreviation: LWH, long working hours (≥ 55 hours/week) ; RERI, Relative Excess Risk Due to Interaction; CVD, cardiovascular disease.

¹ Working hours: working < 55 hours/week (reference); EAT-Lancet diet score: High diet score (≥ 24) (reference), ORs (95%CI) were adjusted for age, sex, race/ethnicity, marital status, poverty income ratio, education level, smoking status, alcohol drinking status, leisure time physical activity, total energy intake. Diet scores were further adjusted in models assessing long working hours, and working hours were further adjusted in models when assessing diet scores. Covariates (diet score/working hours) were retained in their original continuous form when adjusted for in models to maximize confounding control, while exposures were dichotomized for primary analyses.

² Working < 55 hours/week + High diet score (reference); ORs(95%CI) were adjusted for age, sex, race/ethnicity, marital status, poverty income ratio, education level, smoking status, alcohol drinking status, leisure time physical activity, total energy intake.

³ ORs(95%CI) were adjusted for race/ethnicity, poverty income ratio, educational level, alcohol drinking status, leisure time physical activity, total energy intake. Diet scores were further adjusted in models assessing long working hours, and working hours were further adjusted in models when assessing diet scores.

Sensitivity analysis 1: excluded participants working < 35 hours/week.

Sensitivity analysis 2: further adjusted for self-reported occupation types (i.e. white-collar and professional, white-collar semi-routine, blue-collar semi-routine, blue-collar high skill) which were only available in the National Health and Nutrition Examination Survey up to 2015.

Sensitivity analysis 3: missingness in covariates were coded as a separate category.

S Table 2. Sensitivity analyses for independent associations and joint associations between working hours, EAT-Lancet diet score, and mortality outcomes in US workers, the National Health and Nutrition Examination Survey 1999-2018.

	Independent associations ¹		Joint associations ²			
	LWH	EAT-Lancet diet score	LWH + EAT-Lancet diet score			RERI (95%CI)
	Yes	Low	No + Low	No + Low	No + Low	
	HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)	
All-cause mortality						
Sensitivity analysis 1	1.00 (0.73, 1.37)	1.18 (0.96, 1.46)	1.24 (1.02, 1.52)	1.00 (0.73, 1.38)	1.17 (0.77, 1.77)	-0.08 (-0.19, 0.03)
Sensitivity analysis 2	0.96 (0.71, 1.29)	1.22 (1.02, 1.46)	1.24 (1.01, 1.51)	1.01 (0.71, 1.42)	1.14 (0.74, 1.74)	-0.11 (-0.23, 0.01)
Sensitivity analysis 3	0.93 (0.69, 1.25)	1.25 (1.04, 1.49)	1.26 (1.04, 1.53)	0.97 (0.69, 1.38)	1.13 (0.74, 1.72)	-0.10 (-0.21, 0.01)
Heart disease mortality						
Sensitivity analysis 1	0.93 (0.54, 1.58)	1.57 (0.84, 2.91)	1.48 (0.79, 2.77)	0.79 (0.35, 1.82)	1.55 (0.61, 3.92)	0.28 (-0.79, 1.35)
Sensitivity analysis 2	0.97 (0.58, 1.61)	1.51 (0.90, 2.50)	1.42 (0.88, 2.32)	0.82 (0.36, 1.87)	1.57 (0.67, 3.70)	0.33 (-0.61, 1.27)
Sensitivity analysis 3	0.85 (0.50, 1.46)	1.59 (0.95, 2.66)	1.52 (0.92, 2.51)	0.73 (0.32, 1.66)	1.47 (0.63, 3.43)	0.23 (-0.72, 1.18)
CVD mortality						
Sensitivity analysis 1	0.96 (0.58, 1.57)	1.50 (0.88, 2.55)	1.54 (0.90, 2.63)	1.02 (0.49, 2.12)	1.79 (0.58, 3.30)	0.23 (-0.03, 0.49)
Sensitivity analysis 2	0.96 (0.60, 1.54)	1.44 (0.95, 2.18)	1.45 (0.97, 2.16)	1.00 (0.48, 2.07)	1.75 (0.61, 3.01)	0.30 (0.10, 0.56)
Sensitivity analysis 3	0.96 (0.59, 1.57)	1.43 (0.94, 2.19)	1.44 (0.95, 2.19)	0.99 (0.47, 2.09)	1.67 (0.60, 3.11)	0.24 (-0.01, 0.52)

Abbreviation: LWH, long working hours (≥ 55 hours/week) ; RERI, Relative Excess Risk Due to Interaction; CVD, cardiovascular disease.

CVD mortality, cardiovascular disease mortality, defined by the International Classification of Diseases codes I00–I09, I11, I13, I20–I51, and I60–I69. Since deaths from cerebrovascular diseases (I60–I69) were not tracked after December 31, 2014, in the National Health and Nutrition Examination Survey, a subsample of participants from the 1999-2014 cycles was examined for CVD mortality only.

Heart disease mortality, defined by defined by the International Classification of Diseases codes I00–I09, I11, I13, I20–I51.

¹ Working hours: working < 55 hours/week; EAT-Lancet diet score: High diet score (≥ 24) (reference), HRs (95%CI) were adjusted for age, sex, race/ethnicity, marital status, poverty income ratio, education level, smoking status, alcohol drinking status, leisure time physical activity, total energy intake. Diet scores were further adjusted in models assessing long working hours, and working hours were further adjusted in models when assessing diet scores. Covariates (diet score/working hours) were retained in their original continuous form when adjusted for in models to maximize confounding control, while exposures were dichotomized for primary analyses.

² Working < 55 hours/week + High diet score (reference); HRs(95%CI) were adjusted for age, sex, race/ethnicity, marital status, poverty income ratio, education level, smoking status, alcohol drinking status, leisure time physical activity, total energy intake.

³ HRs(95%CI) were adjusted for race, poverty income ratio, educational level, alcohol drinking status, leisure time physical activity, total energy intake. Diet scores were further adjusted in models assessing long working hours, and working hours were further adjusted in models when assessing diet scores.

Sensitivity analysis 1: excluded participants working <35 hours/week.

Sensitivity analysis 2: further adjusted for self-reported occupation types (i.e. white-collar and professional, white-collar semi-routine, blue-collar semi-routine, blue-collar high skill) which were only available in the National Health and Nutrition Examination Survey up to 2015.
Sensitivity analysis 3: missingness in covariates were coded as a separate category.

S Table 3. Sensitivity analysis for the independent association between working hours and cardiometabolic outcomes in US workers, with and without adjusting for work schedules, the National Health and Nutrition Examination Survey 1999-2020 March.

	Long working hours	
	No (< 55 hours/week) OR (95%CI)	Yes (≥ 55 hours/week) OR (95%CI)
Obesity		
Original fully adjusted model	1.00	1.20 (1.07, 1.34)
Further adjusted work schedule ¹	1.00	1.21 (0.97, 1.52)
Diabetes		
Original fully adjusted model	1.00	1.08 (0.90, 1.30)
Further adjusted work schedule ¹	1.00	1.03 (0.77, 1.39)
Hypertension		
Original fully adjusted model	1.00	1.01 (0.90, 1.13)
Further adjusted work schedule ¹	1.00	1.01 (0.88, 1.14)
Framingham 10-year CVD risk		
Original fully adjusted model	1.00	0.98 (0.80, 1.19)
Further adjusted work schedule ¹	1.00	0.97 (0.61, 1.57)

Abbreviations: CVD, cardiovascular disease.

Original fully adjusted model: adjusted for age, sex, race/ethnicity, marital status, poverty income ratio, education level, smoking status, alcohol drinking status, leisure time physical activity, total energy intake, and EAT-Lancet diet score.

¹ Work schedule status (any shift work versus non-shift work) was only surveyed in the National Health and Nutrition Examination Survey cycles from the year 2005 to 2010.

S Table 4 Sensitivity analysis for the independent association between working hours and mortality in US workers, with and without adjusting for work schedules, the National Health and Nutrition Examination Survey 1999-2019

	Long working hours	
	No (< 55 hours/week)	Yes ($\geq$ 55 hours/week)
	HR (95%CI)	HR (95%CI)
All-cause mortality		
Original fully adjusted model	1.00	0.93 (0.69, 1.25)
Further adjusted work schedule ¹	1.00	1.40 (0.82, 2.40)
Excluded shift workers	1.00	1.45 (0.78, 2.68)
Heart disease mortality		
Original fully adjusted model	1.00	0.86 (0.51, 1.46)
Further adjusted work schedule ¹	1.00	1.41 (0.55, 3.63)
Excluded shift workers	1.00	1.63 (0.61, 4.36)
CVD mortality		
Original fully adjusted model	1.00	0.97 (0.60, 1.56)
Further adjusted work schedule ¹	1.00	1.72 (0.77, 3.84)
Excluded shift workers	1.00	1.54 (0.62, 3.84)

CVD mortality, cardiovascular disease mortality, defined by the International Classification of Diseases codes I00–I09, I11, I13, I20–I51, and I60–I69. Since deaths from cerebrovascular diseases (I60–I69) were not tracked after December 31, 2014, in the National Health and Nutrition Examination Survey, a subsample of participants from the 1999-2014 cycles was examined for CVD mortality only.

Heart disease mortality, defined by defined by the International Classification of Diseases codes I00–I09, I11, I13, I20–I51. Original fully adjusted model: adjusted for age, sex, race/ethnicity, marital status, poverty income ratio, education level, smoking status, alcohol drinking status, leisure time physical activity, total energy intake, and EAT-Lancet diet score.

¹Work schedule status (any shift work versus non-shift work) was only surveyed in the NHANES cycles from the year 2005 to 2010.