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Original Article

Associations of work-family conflict with changes in metabolic risk factors: a four-year longitudinal study

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Abstract: Cardiovascular disease (CVD) is becoming prevalent among younger people who have dual roles at both work and home. A possible contributor to CVD is conflict between work and home life. Thus, this study investigated the impact of work-to-family conflict (WFC) and family-to-work conflict (FWC) on metabolic risk factors. We used longitudinal data with a 4-yr interval from the Midlife in Japan study. 152 participants who were employed at baseline without missing variables of interest were included. We assessed the associations of baseline WFC and FWC with changes in metabolic risk factors between baseline and follow-up using Generalized Estimating Equations. After adjusting for baseline sociodemographic, work and family-related, and lifestyle factors, the fully adjusted model showed WFC was significantly associated with changes in low-density lipoprotein cholesterol (LDL-C) and Total cholesterol (TC)/high-density lipoprotein cholesterol (HDL-C) ratio. However, FWC was not significantly associated with changes in any metabolic risk factors. Our findings indicated a significant impact of WFC on LDL-C and TC/HDL-C ratio but no significant impact of FWC on metabolic health. Since these metabolic risk factors cause CVD, understanding the physiological responses to occupational psychosocial stress could help create primary prevention interventions and assess their effects on workers' metabolic health.

Key words: Longitudinal study, Occupational stress, Work-family conflict, Cardiometabolic risk factors, Cholesterol

Introduction

As a most prominent contributor to global mortality[1)], cardiovascular disease (CVD) is notably becoming prevalent among younger people at economically active ages who have dual roles at work and home[2)]. Among people under the age of 70, CVD accounted for 38% of deaths

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globally, which was equivalent to 17 million deaths that occurred prematurely all over the world in 2019[1]. In particular, CVD is a leading cause of mortality in Japan[3]. In 2019, CVD was identified as the cause of death for 12,700 individuals in Japan under the age of 65[4]; among them, 936 claims were filed, with 216 cases of CVD-related deaths being compensated due to work-relatedness[5].

A stressful work environment, such as long work hours, job strain, and job insecurity[6, 7], is a significant factor affecting the productivity of working adults. Role conflicts between work and home are a common stressor for working-age adults given that they typically have responsibilities both in the workplace and at home. The concept of work-family conflict is the stresses individuals encounter when demands from their work and family roles interfere with fulfilling their obligations at home or in the workplace[8]. Specifically, work-to-family conflict (WFC) occurs when workers are unable to meet their obligations at home due to their commitments at work. In contrast, family-to-work conflict (FWC) arises when the responsibilities of the family interfere with their obligations at work. Work-family conflict often precipitates a wide range of responses across the physical, behavioral, and psychological domains of health. In particular, WFC has been reported to have significant associations with cardiometabolic risk, health behaviors, and mental health[9, 10].

There is only limited evidence regarding the impact of work-family conflict on CVD. A study in Germany observed a higher incidence of various CVDs such as myocardial infarction, stroke, atrial fibrillation, peripheral artery disease, coronary artery disease, chronic heart failure, and sudden cardiac death associated with WFC in women, as opposed to men; however, these associations did not reach statistical significance[11]. Four studies investigated WFC and biological risk factors associated with CVD[12–15]. Two of these studies had a cross-sectional design[13, 15], and the remainder had longitudinal designs over one or more years[12, 14]. Out of these studies, only one examined the relationship with both WFC and FWC, whereas the rest focused solely on WFC. These studies reported that WFC was positively associated with triglycerides (TG) cross-sectionally[15] and negatively associated with high-density lipoprotein cholesterol (HDL-C) cross-sectionally[15] and longitudinally[12]. On the contrary, WFC was not associated with total cholesterol (TC) longitudinally[12] and cross-sectionally[13], not associated with TG longitudinally[14], and not associated with low-density lipoprotein cholesterol (LDL-C) cross-sectionally[15]. Only one of these studies examined FWC and TC cross-sectionally, reporting that FWC was not associated with TC[13].

As these studies were conducted in Non-Asian countries: the U.S.[12, 14, 15] and Brazil[13], there is a lack of research evidence regarding the longitudinal relationship between work-family conflict and cardiovascular risk factors in Asian populations. Since work-family conflict is intricately linked to family responsibilities, it necessitates consideration of cultural differences between the Western, Latin American, and Asian populations. The most influential differences between these countries are that of individualistic and collectivist societies[16]. Workers in a collectivist society tend to receive higher social support than workers in an individualistic society[17]. Most Western countries adapt to individualism, while most Asian countries adapt to a collectivist society, although social norms are transitioning. Japanese work culture is shifting towards individualism while maintaining elements of collectivism, potentially leading to adverse effects[18]. This transitional phase and the coexisting of collectivist and individualist work cultures in Asian countries might influence metabolic risk factors prior to developing diseases among workers who perceive work-family conflict. Thus, the purpose of this study was to investigate the impact of conflict between work and home roles, using the concept of work-family conflict encompassing both WFC and FWC directions on metabolic risk factors, which are established risk factors for CVD[19], including TC, TG, LDL-C, HDL-C, and TC/HDL-C ratio among workers, using longitudinal data over four years from Japan, where WFC has been identified as a notable stressor in the workplace that affects mental health and well-being[20].

Methods

Study subjects

The analysis was conducted using survey and biomarker data from Waves I[21, 22] and II[23] of the Midlife in Japan (MIDJA) Study, which had a 4-yr follow-up period. MIDJA I biomarker project data was collected between 2009/2010, and MIDJA II biomarker project data was collected between 2013/2014. A two-stage stratified random sampling based on age and sex was employed according to the Basic Resident Register Book in Tokyo, Japan. Japanese people between the ages of 30 and 80 were recruited in MIDJA I.

The inclusion criteria for this study were participants who had paid work at the baseline and had complete data on variables of interest. A total of 1,027 individuals participated in the MIDJA wave I survey. Among those

participants, 735 individuals were working for pay at baseline. A total of 268 individuals participated in the wave I biomarker project and had full data on TC, LDL-C, HDL-C, TC/HDL-C ratio, WFC, and FWC; moreover, 235 had no missing data on covariates (see below) at the baseline. After a 4-yr follow-up period, 153 participants were available for the MIDJA II biomarker project. The follow-up rate for our study focusing on working adults was 65.11% (153/235). Furthermore, we excluded one participant who had missing data on lipids, so a total of 152 participants who had paid work, had a score for the WFC and FWC, and covariates at the baseline, and had TC, TG, LDL-C, HDL-C, and TC/HDL-C ratio at the baseline and follow-up were included in this analysis (Fig. 1).

Measurements

Work-to-Family Conflict (WFC) and Family-to-Work Conflict (FWC)

A validated 8-item scale assessed WFC and FWC at baseline[8]. Each component consisted of 4 items that asked about experiences within the past year. Examples of questions for WFC were, "How often have you experienced your job reducing the effort you can give to activities at home?" and "How often have you experienced stress at work makes you irritable at home?" Examples of questions for FWC were "How often do responsibilities at home reduce the effort you can devote to your job?" and "How often do personal or family worries and problems distract you when you are at work?" Both the WFC and FWC

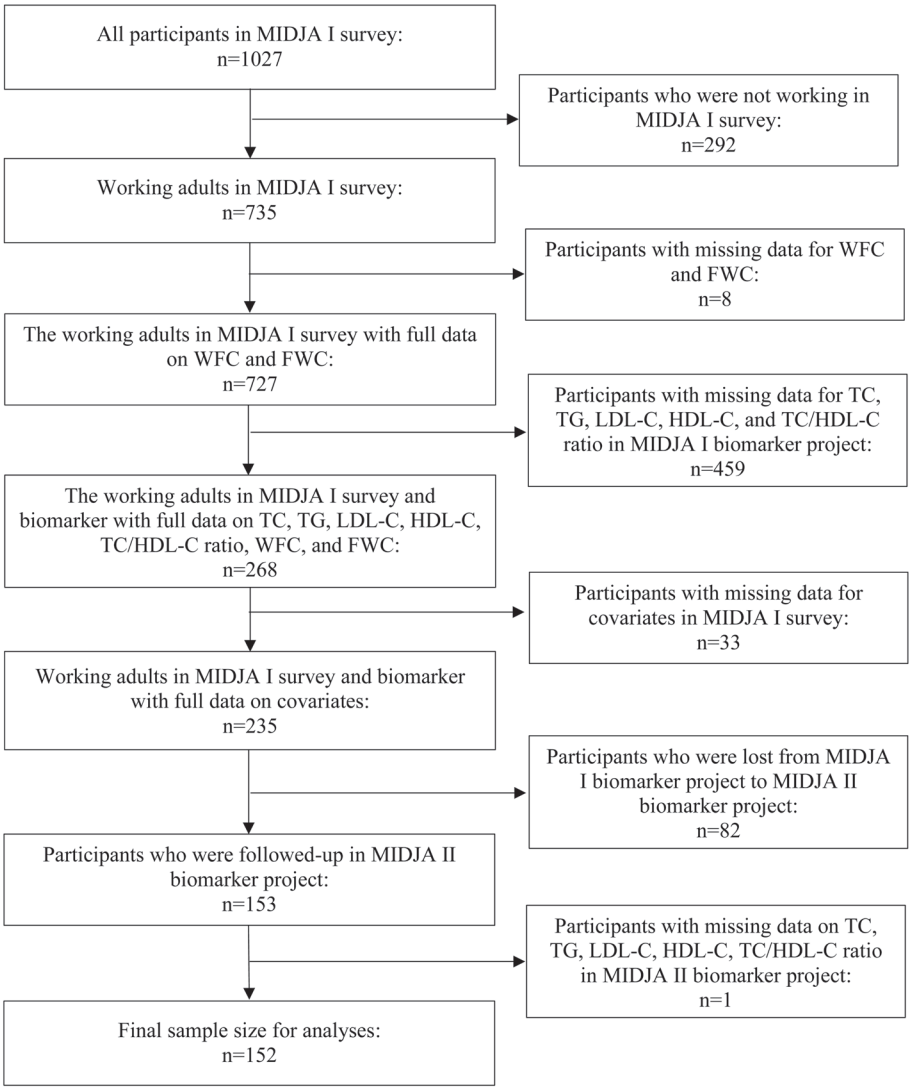

Fig. 1. Sample selection.

WFC: work-to-family conflict; FWC: family-to-work conflict; TC: total cholesterol; TG: triglycerides; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol.

scales in this study focused on strain-based experiences but also implied time and behavior-based experiences[24]. Participants responded on a 5-Likert scale (1=none of the time, 5=most of the time). Individual scores were added to calculate the total score of WFC and FWC. The range of total scores was from 4 to 20. A higher score indicated that the individual was experiencing greater conflict, and the continuous measure of WFC and FWC scores was used for our analysis. In the current study, Cronbach's α coefficients for WFC and FWC were 0.81 and 0.67, respectively.

Metabolic risk factors

Metabolic risk factors, including TC, TG, LDL-C, and HDL-C, were measured at baseline and follow-up. The blood samples were non-fasting samples and collected at any time of the day. However, the participants were instructed not to eat for at least one hour before visiting the clinic[21, 23]. Participants' blood was collected in three 8.5 ml serum separate tubes. After the blood was drawn, these tubes were placed in a standing position for 15 to 30 min (maximum of two hours) before the centrifuge to separate sera. The refrigerated centrifuge was set at 4°C, and the sera were centrifuged for 15 minutes at a speed of 2,000 to 3,000 revolutions per minute. Details of the protocol were available elsewhere[21, 23]. These lipid results were utilized as continuous variables in this study. The TC/HDL-C ratio was calculated by dividing TC by HDL-C.

Covariates

Covariates included in this study were baseline sociodemographic factors, including age (30–45, 46–55, and ≥56), sex (men and women), and educational attainment (high school or less, some college degree, and university degree or more), work and family-related factors, including management position (yes and no), job demands (which were derived from the Japanese version of the Job Content Questionnaire[25, 26] with range of 5 to 25), marital status (married, never married, and others), parental status (yes and no), and health-related lifestyle behaviors, including smoking status (current smoker, former smoker, and never smoker), alcohol consumption (number of drinks per week), and physical exercise (yes and no) in line with the previous publications of MIDJA study[27, 28].

Statistical analysis

Descriptive statistics were generated first. We calculated the means and standard deviations (SDs) for the continuous variables and relative frequencies and percentages for categorical variables. We also tested correlations between baseline and follow-up lipid metabolic risk factors. Due to the high correlation between baseline and follow-up of the lipid profile, advanced statistical modeling using generalized estimating equations (GEE) was applied to take into account the correlated structure of data from repeated measurements at baseline and follow-up[29]. Associations between baseline WFC and FWC with longitudinal changes in TC, TG, LDL-C, HDL-C, and TC/HDL-C ratio from baseline to follow-up were examined with three models. Model 0 was crude without adjustment. Model 1 was adjusted for sociodemographic factors, including age, sex, and educational attainment at baseline. Model 2 was additionally adjusted for work-related and family-related factors, including management position, job demands, marital status, and parental status at the baseline. Model 3 was additionally adjusted for health-related lifestyle behaviors, including smoking, alcohol consumption (which was logarithmically transformed due to right-skewed distribution), and physical exercise at baseline. The results were expressed as β coefficients and 95% confidence intervals (CIs). We utilized SAS 9.4 for statistical analysis.

Results

The characteristics of the participants are summarized in Table 1 (n=152). In general, 38.16% were in the age group of 30−45, 37.50% were in the age group of ≥56, and fewer individuals were in the age group of 46 and 55 (24.34%). This study sample had a relatively equal distribution of men (48.03%) and women (51.97%). The majority of them completed at least some college-level education and did not hold management positions (70.39%). Most participants (73.68%) were married and had child (ren) (72.37%). In addition, the median consumption of alcoholic drinks per week was 3.5, and more than half of individuals did not engage in smoking and physical exercise (56.58%). The mean scores with SDs of WFC and FWC were 9.30 ± 3.14 and 7.76 ± 2.38, respectively. These WFC and FWC scores were highly correlated with a correlation coefficient of 0.54 (p<0.001).

The means (SDs) of TC, TG, LDL-C, HDL-C, and TC/HDL-C at baseline were 210.76 (36.42), 148.26 (116.66), 121.16 (30.75), 66.68 (16.63) mg/dl, and 3.32 (0.90), and at follow-up were 213.82 (34.31), 138.12 (116.34), 123.01 (30.29), 63.69 (13.67) mg/dl, and 3.50 (0.94), respectively (Table 2). The correlations of lipid profiles at baseline and follow-up are also reported in Table 2. The correlation coefficients of TC, TG, LDL-C, HDL-C, and TC/HDL-C

Table 1. Characteristics of the study sample (*n*=152)

Variables		*n* (%)
Age at baseline	30–45 yr	58 (38.16%)
	46–55 yr	37 (24.34%)
	≥56 yr	57 (37.50%)
Sex at baseline	Men	73 (48.03%)
	Women	79 (51.97%)
Education at baseline	High school or less	48 (31.58%)
	Some college	43 (28.29%)
	University or more	61 (40.13%)
Management position at baseline	No	107 (70.39%)
	Yes	45 (29.61%)
Job demands at baseline	Mean ± SD	12.84 ± 3.44
Marital status at baseline	Married	112 (73.68%)
	Never married	25 (16.45%)
	Others	15 (9.87%)
Parental status at baseline	No	42 (27.63%)
	Yes	110 (72.37%)
Smoking at baseline	Current smoker	39 (25.66%)
	Former smoker	56 (36.84%)
	Never smoker	57 (37.50%)
Alcohol consumption (drinks per week) at baseline	Median (range)	3.5 (0.00–42.00)
Physical exercise at baseline	No	86 (56.58%)
	Yes	66 (43.42%)
Work-to-family Conflict at baseline	Mean ± SD	9.30 ± 3.14
Family-to-work Conflict at baseline	Mean ± SD	7.76 ± 2.38

SD: standard deviation.

Table 2. Means, standard deviations, and correlations of lipids at baseline and follow-up

Variables	At baseline	At Follow-up (four years later)	Correlation between Baseline and Follow-up
Total cholesterol (mg/dl)	210.76 ± 36.42	213.82 ± 34.31	0.68***
Triglycerides (mg/dl)	148.26 ± 116.66	138.12 ± 116.34	0.59***
Low-density lipoprotein (mg/dl)	121.16 ± 30.75	123.01 ± 30.29	0.74***
High-density lipoprotein (mg/dl)	66.68 ± 16.63	63.69 ± 13.67	0.73***
Total/HDL ratio	3.32 ± 0.90	3.50 ± 0.94	0.77***

Pearson Correlation Coefficients *p<0.05, **p<0.01, ***p<0.001.
HDL: high-density lipoprotein.

ratios were 0.68, 0.59, 0.74, 0.73, and 0.77, respectively (all p<0.001).

Table 3 demonstrates the findings of the longitudinal associations between WFC at baseline and the changes in metabolic risk factors between the baseline and follow-up. After taking the baseline sociodemographic information (age, sex, and education), work and family-related factors (management position, job demands, marital status, and parental status), and lifestyle factors (smoking, alcohol consumption, and physical exercise) into account, WFC at baseline showed significantly positive associations with LDL-C, and TC/HDL-C ratio in the fully adjusted model (β: 1.73, 95% CI: 0.13, 3.33), and (β: 0.04, 95% CI: 0.00, 0.09), respectively.

The findings from the longitudinal associations between FWC at baseline and the changes in metabolic risk factors between the baseline and the follow-up are shown in Table 4. No significant association between FWC and these lipid risk factors was observed.

The WFC and FWC interaction analysis in the fully adjusted models did not show any significant associations with lipid risk factors (Supplementary Table 1). Addi-

Table 3. Longitudinal associations of WFC at baseline with changes in lipid profile between baseline and follow-up

	Model 0	Model 1	Model 2	Model 3
TC	1.22 (−0.54, 2.99)	1.95 (0.26, 3.64)*	2.01 (0.06, 3.97)*	1.80 (−0.16, 3.76)
TG	0.95 (−4.34, 6.25)	2.53 (−2.90, 7.96)	0.69 (−4.90, 6.29)	0.95 (−4.78, 6.59)
LDL-C	1.41 (−0.13, 2.96)	2.18 (0.64, 3.72)**	2.16 (0.53, 3.80)**	1.73 (0.13, 3.33)*
HDL-C	–0.28 (−0.96, 0.40)	−0.67 (−1.28, −0.06)*	−0.42 (−1.14, 0.31)	−0.23 (−0.91, 0.45)
TC/HDL-C ratio	0.03 (−0.01, 0.07)	0.07 (0.03, 0.11)**	0.06 (0.01, 0.10)*	0.04 (0.00, 0.09)*

Results were reported as β coefficients and 95% confidence intervals.

Generalized Estimating Equations, *p<0.05, **p<0.01.

Model 0: no adjustment; Model 1: adjustment for age, sex, and education attainment at baseline; Model 2: Model 1 + additional adjustment for management position, job demands, marital status, parental status at baseline; Model 3: Model 2 + additional adjustment for smoking, alcohol consumption, and physical exercise at baseline. WFC: work-to-family conflict; TC: total cholesterol; TG: triglycerides; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol.

Table 4. Longitudinal associations of FWC at baseline with changes in lipid profile between baseline and follow-up

	Model 0	Model 1	Model 2	Model 3
TC	−1.86 (−4.30, 0.59)	−1.39 (−3.76, 0.98)	−1.82 (−4.04, 0.40)	−1.81 (−3.98, 0.37)
TG	−1.37 (−6.83, 4.10)	0.91 (−4.69, 6.51)	−0.18 (−6.27, 5.90)	−0.60 (−6.07, 4.86)
LDL-C	−0.87 (−3.11, 1.37)	−0.35 (−2.66, 1.95)	−0.81 (−2.95, 1.33)	−0.98 (−3.00, 1.05)
HDL-C	−0.37 (−1.39, 0.65)	−0.88 (−1.83, 0.07)	−0.77 (−1.83, 0.30)	−0.59 (−1.69, 0.50)
TC/HDL-C ratio	−0.02 (−0.08, 0.04)	0.02 (−0.05, 0.09)	0.01 (−0.05, 0.08)	0.00 (−0.05, 0.06)

Results were reported as β coefficients and 95% confidence intervals.

Generalized Estimating Equations, *p<0.05.

Model 0: no adjustment; Model 1: adjustment for age, sex, and educational attainment at baseline; Model 2: Model 1 + additional adjustment for management position, job demands, marital status, parental status at baseline; Model 3: Model 2 + additional adjustment for smoking, alcohol consumption, and physical exercise at baseline. FWC: family-to-work conflict; TC: total cholesterol; TG: triglycerides; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol.

tionally, no significant interaction effects were observed between sex and WFC/FWC on lipid risk factors (Supplementary Table 2).

Discussion

This study investigated the longitudinal associations of WFC and FWC at baseline with four-year changes in lipid metabolic risk factors, including TC, TG, LDL-C, HDL-C, and TC/HDL-C ratio, in randomly selected workers in Tokyo, Japan. Our results show effects of WFC on LDL-C and TC/HDL-C ratio over four years, although there were no effects on TC, TG, and HDL-C. Workers who were exposed to WFC presented apparent changes in LDL-C and TC/HDL-C ratio after four years of exposure to WFC. Unexpectedly, there were no significant associations between FWC and lipid risk factors.

Compared to earlier investigations, our findings revealed further implications on the impact of WFC and FWC on metabolic biomarkers. For TC, WFC was not significantly associated with TC cross-sectionally[13] and longitudinally[12]. Our findings were consistent with the literature. For TG, previous studies also reported that WFC was significantly associated with TG cross-sectionally[15] but not significantly associated longitudinally[14]. Our results aligned with the U.S. longitudinal study, indicating that change in TG was not significantly associated with baseline WFC. For LDL-C, our study showed a significant association between WFC at baseline and a change in LDL-C, although the U.S. cross-sectional study reported that LDL-C was not significantly associated with WFC[15]. For HDL-C, previous studies reported that WFC was negatively associated with HDL-C cross-sectionally[15] and longitudinally[12]. Our results showed similar patterns, though statistical significance was not reached. Finally, none of these studies reported associations between WFC and TC/HDL-C ratio. Our study shed light on their relationship and suggested a significant association between baseline WFC and change in TC/HLD-C ratio.

Our study also examined the associations between lipid risk factors and the opposite direction of work-family conflict, FWC. Among these previous studies, only a cross-sectional study from Brazil examined bidirectional work-family conflict (WFC and FWC). They reported that FWC

was not associated with TC cross-sectionally[13]. Our result aligns with this finding. In addition, our results filled the gap in the body of literature, suggesting that FWC was not associated with a change in other lipid risk factors, including TG, LDL-C, HDL-C, and TC/HDL-C ratio longitudinally.

A potential explanation of our results relates to differential perceptions of stress. The mean of the baseline WFC (9.30 ± 3.14) was higher than the baseline FWC (7.76 ± 2.38) (Table 1). Previous Japanese studies also reported a similar tendency to a smaller mean and standard deviation of FWC compared to WFC[30, 31]. These numbers suggest that it could be that Japanese workers feel more stressed when their work roles affect their obligations at home. Thus, WFC had a substantial effect on LDL-C, and TC/HDL-C ratio, although FWC did not significantly impact these lipid risk factors. Due to the fact that individuals prioritize their role at work over their role in the family[16], family members of workers are also supportive because they believe that a job is the main source of income for the whole family. Thus, employed individuals can prioritize their roles at work when there are conflicting demands between work and family, and family roles do not interfere with their roles at work like WFC. A study from Japan also reported a similar tendency that WFC had a stronger association with psychological distress compared to FWC among workers who had preschool children[9]. Accordingly, differences exist in the effects of WFC and FWC on health outcomes, i.e., the WFC had a significant impact on the cardiovascular health of workers. In contrast, the FWC did not have any associations with cardiovascular health in our study from Japan. Additionally, such differential effects induced by WFC and FWC were also supported by the non-significant interaction between them, indicating the independent role of WFC to explain changes in LDL-C and TC/HDL-C ratio. Further research and insights into the distinction between the impact of WFC and FWC on workers' health are needed.

To the best of our knowledge, this is the first to examine longitudinal associations of work-family conflict at baseline (WFC and FWC) with changes in lipid profiles across a 4-yr interval, including TC, TG, LDL-C, HDL-C, and TC/HDL-C ratio, which are well-established biomarkers of CVD[19]. Moreover, prior research evidence has been based in Western countries. Our study was the first study from Asia to make a significant contribution to the existing body of literature by demonstrating that WFC could affect Japanese workers' lipid risk factors, while FWC seemed not to exert similar effects. The findings of this present study could provide important policy implications on CVD prevention in the workplace. Particularly, a recent intervention study revealed beneficial effects on cardiometabolic biomarkers following work design remodel and supervisor support to improve work-family balance[32], prior to the development of CVDs. In 2019, the government of Japan encouraged workers to maintain a healthy work-life balance and reinforced the work style reform law. As a result, Japan's government reported a total of 194 cases of deaths caused by CVD that were legally recognized as work-related and compensated in 2020. This number dropped compared to the number of cases compensated in the previous year, which was 216 cases in 2019[5].

Several methodological strengths of this study deserved to be mentioned. First, the statistical approach in terms of GEE linear regression was used since longitudinal data were highly correlated. The change in LDL-C, and TC/HDL-C ratio between baseline and follow-up after full adjustment showed significant associations. The GEE modeling is widely applied for longitudinal data with repeated measurements from the same subjects that are not independent[29, 33]. One of the advantages of utilizing GEE modeling is that it considers not only the population average but also repeated observations made by the same individual over time, as repeated measures are typically correlated within individuals over time. Moreover, its ability to estimate population-average effects provides insights into the total impact of predictors on the outcome for the average individual in a population. Due to these advantages of GEE, it is guaranteed that further evaluation will be conducted using the GEE modeling to expand the scope of the analysis to other stressors at work, such as effort-reward imbalance and job strain. Second, we also intensively analyzed opposite directions of conflicting responsibilities between work and family in terms of FWC, in which the responsibilities in the family will negatively interfere with their work performance. Our study was the first study to explore the influence of FWC on lipid profile among Japanese workers. The findings of our study demonstrated that FWC was not associated with any changes in lipid profile. Lastly, we utilized objectively measured outcomes using metabolic biomarkers to examine their relationship with perceived workplace stresses through work-family conflict. The findings of our study filled a gap in the existing body of literature by demonstrating that WFC, and not FWC, had a longitudinal impact on the cardiovascular health of Japanese workers residing in Tokyo. The results of our study will also contribute to developing early detection and prevention strategies for individuals at

risk of CVD due to WFC. Furthermore, this suggests that the formulation of policies and the engagement of the government could minimize the risk of CVD among workers, especially those who suffer from WFC.

Although our study had several strengths, we also need to address some limitations of this study. First, the sample size was relatively small. Although the roles within the family may vary depending on sex, a sex-stratified analysis might be with insufficient statistical power because of the sample size. However, non-significant interaction terms between sex and work-family conflict on biomarkers also suggested sex did not moderate the associations of work-family conflict with lipids (Supplementary Table 2). Second, the follow-up rate of our study sample was relatively low (65.11%), but this number was compatible with the follow-up rate of the overall MIDJA biomarker project, 63.61% (243/382). Our additional analysis also suggested that retained and drop-out participants showed no significant differences in baseline variables, including sociodemographic characteristics, WFC, FWC, TC, TG, LDL-C, HDL-C, and TC/HDL-C ratio (Supplementary Table 3). Third, although a couple of work- and family-related factors were considered in the data analysis for purpose of improving predictive explanations of work-family conflict, independently from these work- and family-related factors, such analytic approach might run the risk of over-adjustment given alternative causal chain from work- and family-related factors towards health outcome via work-family conflict as mediator(s). Lastly, WFC and FWC scales were mainly strain-based, although they implied time and behavior-based experiences. Thus, the generalizability to time and behavior-based conflict between work and family would be limited.

Considering the crucial role of work to adults' health, investigations into the physiological changes are important to understand the pathophysiology of stress and to develop further preventative methods before disease conditions arise. The scope of future studies could broaden to incorporate additional biomarkers derived from multi-biological systems and the use of a wider range of psychosocial factors at work.

Conclusion

Our longitudinal study suggested a significant impact of WFC on changes over four years in LDL-C and TC/HDL-C ratio, which have been approved as well-established biomarkers of CVD. Further investigations on comprehensive physiological responses are warranted, such as using other neuroendocrine, cardiovascular, and immune biomarkers.

Author's Contributions

JL conceptualized this manuscript. JL and MS developed the methodology and conducted an analysis. MS and JL drafted the original manuscript, WR, DAT, PMM, and AN reviewed and edited it. All authors have read and approved the final manuscript.

Ethics Approval and Consent to Participate

The analytic project was conducted in accordance with the Declaration of Helsinki and approved for exemption by the Institutional Review Board of the University of California, Los Angeles (IRB#22-000836). Informed consent was obtained from all subjects involved in the study.

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Availability of Data and Materials

The datasets generated during and/or analyzed during the current study are available in the ICPSR repository, https://www.icpsr.umich.edu/web/pages/index.html. The statistical SAS syntax supporting the conclusions of this article will be made available by the authors, without undue reservation. Requests to access the statistical SAS syntax should be directed to the corresponding author.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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