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Lifestyle behaviors: Timing may be as relevant as quantity

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Lifestyle behaviors such as sleeping, eating, and physical activity, are the pillars of health. Components of all three behaviors are integral to the evaluation of cardiovascular health (CVH) according to the American Heart Association's Life's Essential 8 [1]. Life's Essential 8 is a multi-component scoring system comprising diet, physical activity, sleep, smoking and weight status, fasting plasma glucose, blood pressure, and total cholesterol, to track risk of heart disease. Unfortunately, few studies evaluate all components of this scoring metric within individuals and the score reduces lifestyle behaviors to quantity, with no consideration of the timing of behaviors or other qualitative measures. For example, within Life's Essential 8, diet is quantified as adherence to the Dietary Approaches to Stop Hypertension or the Healthy Eating Index; sleep as hours slept per night; and physical activity as minutes of moderate-to-vigorous physical activity accumulated per week [1]. However, we know that quantity is not the only metric on which to judge a lifestyle behavior's impact on health. Quality is important, and timing appears to be emerging as an important factor as well.

The review by Arab et al. [2] in this issue of the *Journal* illustrates how timing of sleeping behaviors can influence dietary quality. The authors conducted a systematic search of observational studies focused on the relation between social jetlag, defined as the difference in midpoint of sleep between free and non-free days, and eating behaviors, including adherence to dietary patterns and nutrient intake. Social jetlag often occurs due to a discrepancy between work schedules that are required during the weekdays, and the internal body clock that can be followed more naturally on the weekends. Social jetlag has been

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linked to numerous negative health consequences [3–7], possibly through diet, but there had been no previous systematic review conducted on the associations between social jetlag and diet, and the limited study findings that exist have been controversial.

Arab et al. [2] identified 17 studies that measured both social jetlag and diet, and of these, only ten were conducted in adults, half of which enrolled mostly college students, with mean ages ranging from 20 to 21.7 y. Moreover, none of the ten studies in adult populations were longitudinal and most used self-reported assessments of sleep patterns. Only one study in adults measured sleep objectively using wrist actigraphy and 4 studies in adults measured diet intake using 24-h recalls (n = 2) or food records (n = 2). These findings highlight a need for studies that evaluate quality and timing of sleeping and eating behaviors using objective, repeated measures, with appropriate sample sizes, over a long-term follow-up period to assess their influence on CVH in adults.

Arab et al. [2] found that data were mixed on the association between social jetlag and total energy intake with two studies showing a positive association, two showing no association, and one showing an inverse association between social jetlag and total energy intake in adults. Data were more consistent when food groups and dietary patterns were examined: nine out of ten studies reported some adverse association of social jetlag with a food group (e.g. lower fruits and vegetables intake or higher sugar-sweetened beverage intake); and four out of six studies showed an inverse association between social jetlag and diet quality (i.e. lower jetlag associated with better dietary quality). The other studies found no associations. All studies involving students found some adverse association of social jetlag with a food group while two studies found no association with overall dietary quality.

A major limitation of available research includes the lack of rigorous measures of dietary intakes, obtained over multiple days. Only two studies in adults assessed intakes over four days using dietary records [8, 9]. Since timing of sleep forcibly influences the timing of other lifestyle behaviors, obtaining more granular measures of diet, that match those of sleep assessments, is of utmost importance. Zeron-Rugerio and colleagues introduced the concept of eating jetlag, representing the variability in timing of meals between weekends and weekdays, analogous to sleep-timing-based social jetlag [10]. Of note is that the timing of breakfast consumption had the highest difference between weekends and weekdays, potentially reflecting differences in wake time across those days. Both chronotype and social jetlag were associated with overall eating jetlag and meal-specific jetlag, highlighting the need to measure chronotype and sleep timing and duration across multiple days of the week in epidemiological and clinical intervention studies. In their study, Zeron-Rugerio and colleagues noted an association between eating jetlag and weight status, independent of chronotype and social jetlag [10]. Similarly, our group also showed an association between eating jetlag and weight status [11]. In addition, we assessed variability in eating patterns using the standard deviation of eating start and end times in relation to health factors. We found that an increase in variability in eating times over a 1-y follow-up was associated with an increase in hemoglobin A1c and tended to be associated with an increase in diastolic blood pressure. Our group has further shown that eating jetlag was associated with higher C-reactive protein in models adjusted for age, socioeconomic status, weight status, and self-reported sleep duration [12].

Adding to this evidence, we recently showed that restricting sleep in adults with habitually adequate and good quality sleep leads to adverse eating behaviors associated with lower dietary quality [13]. Restricting sleep increased eating frequency, a behavior associated with higher energy intakes. Importantly, sleep duration influenced the association between variability in timing of eating and dietary quality, with adverse associations of higher eating variability with dietary quality particularly in the context of reduced sleep duration.

Another limitation of the reviewed literature by Arab and colleagues is the lack of assessment of sex differences. Despite all studies enrolling both males and females, information was only available from one study on sex-specific associations of social jetlag with dietary intakes [14] and that study was conducted in adolescents. Given the prominent role of females as informal caregivers for children, elderly parents, and/or ill family members, it is likely that more pronounced influence of social jetlag on dietary quality would be observed. Moreover, given that associations between poor sleeping behavior and worse CVH tend to be stronger among post-menopausal vs. pre-menopausal women [15], analyses of differences in social jetlag by reproductive life stage would also be an important addition to the evidence base on this topic.

Although the review by Arab et al. [2] did not specifically examine diet as a potential mechanism through which social jetlag may influence cardiometabolic health, it is thought that social jetlag is a maker of circadian disruption, which closely correlates with sleep disruption and possible short sleep, especially on weekdays due to imposed work schedules [5,16,17]. We have found that poor quality sleep is associated with greater food intake and lower-quality diet, which can increase risk of cardiovascular disease [18]. Specifically, poor sleep quality was associated with higher food weight and added sugar intake among women in our study. Similarly, Arab et al. found that social jetlag was consistently associated with greater intake of sugar-sweetened beverages, which have been strongly associated with higher cardiovascular disease incidence [19]. We have also found that having an evening chronotype was associated with poorer diet quality and higher energy density, and that higher energy density mediated the relation between evening chronotype and poor CVH [20]. Late or evening chronotypes often have greater social jetlag than morning or intermediate types [17], and the mechanisms underlying social jetlag and its influence on CVH should be investigated further.

Given the limitations highlighted above, Arab and colleagues provide recommendations for a research agenda, imploring the research community to perform longitudinal studies with objective and self-reported measures of sleep and multiple days of monitoring of dietary quality and to investigate mechanisms underlying the associations between social jetlag and diet quality [2]. We would like to add that studies should go beyond controlling for confounders such as sex and sociodemographic characteristics and empirically evaluate associations separately by sex and various sociodemographic groups. This is especially important given the underlying socio-economic circumstances that impact sleep and eating variability.

The public health implications of the review by Arab et al. may be far-reaching. Individuals experiencing social jetlag appear to have lower adherence to healthy dietary patterns.

Whether specific dietary recommendations could be made to help mitigate the negative health consequences of social jetlag is unknown. Future studies should test strategies to reduce social jetlag and their downstream impact on other lifestyle behaviors and overall CVH.

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References

[1]. Lloyd-Jones DM, Allen NB, Anderson CAM, Black T, Brewer LC, Foraker RE, et al. Life's essential 8: updating and enhancing the American heart association's construct of cardiovascular health: a presidential advisory from the American heart association. Circulation 2022;146(5):e18–43. [PubMed: 35766027]

[2]. Arab A, Karimi E, Garaulet M, Scheer F. Social jetlag and dietary intake: a systematic review. Sleep Med Rev 2023;71:101820. [PubMed: 37544031]

[3]. McMahon DM, Burch JB, Youngstedt SD, Wirth MD, Hardin JW, Hurley TG, et al. Relationships between chronotype, social jetlag, sleep, obesity and blood pressure in healthy young adults. Chronobiol Int 2019;36(4):493–509. [PubMed: 30663440]

[4]. Galeno DML, Peixoto HJA, Carneiro BTS, Leocadio-Miguel MA. Cardiometabolic risk factors and social jetlag in university professors. Braz J Med Biol Res 2023;56:e12539. [PubMed: 37403885]

[5]. Roenneberg T. How can social jetlag affect health? Nat Rev Endocrinol 2023;19(7):383–4. [PubMed: 37221400]

[6]. Im HJ, Chu MK, Yang KI, Kim WJ, Hwang I, Yoon JE, et al. The association between social jetlag and depression is independent of sleep debt. Sleep Breath 2023.

[7]. Cho SS, Chung BH, Lee HE, Kang MY. Association between social jetlag and chronic kidney disease among the Korean working population. Sci Rep 2023;13(1):5998. [PubMed: 37045895]

[8]. Al Khatib H, Dikariyanto V, Bermingham KM, Gibson R, Hall WL. Short sleep and social jetlag are associated with higher intakes of non-milk extrinsic sugars, and social jetlag is associated with lower fibre intakes in those with adequate sleep duration: a cross-sectional analysis from the National Diet and Nutrition Survey Rolling Programme (Years 1-9). Publ Health Nutr 2022;25(9):2570–81.

[9]. Almoosawi S, Palla L, Walshe I, Vingeliene S, Ellis JG. Long sleep duration and social jetlag are associated inversely with a healthy dietary pattern in adults: results from the UK national diet and nutrition survey rolling programme Y1(-)4. Nutrients 2018;10(9).

[10]. Zeron-Rugerio MF, Hernaez A, Porras-Loaiza AP, Cambras T, Izquierdo-Pulido M. Eating jet lag: a marker of the variability in meal timing and its association with body mass Index. Nutrients 2019;11(12).

[11]. Makarem N, Sears DD, St-Onge MP, Zuraikat FM, Gallo LC, Talavera GA, et al. Variability in daily eating patterns and eating jetlag are associated with worsened cardiometabolic risk profiles in the American heart association go red for women strategically focused research network. J Am Heart Assoc 2021;10(18):e022024. [PubMed: 34482703]

[12]. Makarem N, Zuraikat FM, Caceres B, Sears DD, St-Onge MP, Lai Y, et al. Variable eating patterns: a potential novel risk factor for systemic inflammation in women. Ann Behav Med 2023;57(1):93–7. [PubMed: 35815757]

[13]. Barragan R, Zuraikat FM, Tam V, RoyChoudhury A, St-Onge MP. Changes in eating patterns in response to chronic insufficient sleep and their associations with diet quality: a randomized trial. J Clin Sleep Med 2023. JCSM : official publication of the American Academy of Sleep Medicine.

[14]. Zhang K, Guhn M, Conklin AI. Association between social jetlag and sugar-sweetened beverages (SSBs) in adolescents in Western Canada. Eur J Publ Health 2023;33(2):287–92.

[15]. Makarem N, St-Onge MP, Liao M, Lloyd-Jones DM, Aggarwal B. Association of sleep characteristics with cardiovascular health among women and differences by race/ethnicity and menopausal status: findings from the American Heart Association Go Red for Women Strategically Focused Research Network. Sleep Health 2019;5(5):501–8. [PubMed: 31302068]

[16]. Gamboa Madeira S, Reis C, Paiva T, Moreira CS, Nogueira P, Roenneberg T. Social jetlag, a novel predictor for high cardiovascular risk in blue-collar workers following permanent atypical work schedules. J Sleep Res 2021;30(6):e13380. [PubMed: 33942925]

[17]. Wittmann M, Dinich J, Merrow M, Roenneberg T. Social jetlag: misalignment of biological and social time. Chronobiol Int 2006;23(1–2):497–509. [PubMed: 16687322]

[18]. Zuraikat FM, Makarem N, Liao M, St-Onge MP, Aggarwal B. Measures of poor sleep quality are associated with higher energy intake and poor diet quality in a diverse sample of women from the go red for women strategically focused research network. J Am Heart Assoc 2020;9(4):e014587. [PubMed: 32063123]

[19]. Kelly RK, Tong TYN, Watling CZ, Reynolds A, Piernas C, Schmidt JA, et al. Associations between types and sources of dietary carbohydrates and cardiovascular disease risk: a prospective cohort study of UK Biobank participants. BMC Med 2023;21(1):34. [PubMed: 36782209]

[20]. Zuraikat FM, St-Onge MP, Makarem N, Boege HL, Xi H, Aggarwal B. Evening chronotype is associated with poorer habitual diet in US women, with dietary energy density mediating a relation of chronotype with cardiovascular health. J Nutr 2021;151(5):1150–8. [PubMed: 33758908]