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The Relationship Between Diet and Lifestyle Behaviours in a Sample of Higher Education Students; A Cross-Sectional Study

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Original article

The relationship between diet and lifestyle behaviours in a sample of higher education students; a cross-sectional study

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SUMMARY

Background & aims: Transitioning into higher education (HE) impacts health behaviours. Poor dietary and lifestyle behaviours may correlate and increase risk of co-morbidities. The introduction of the Okanagan Charter detailed the important role of health promotion within a HE setting. The aim of this study was to assess the relationship between dietary quality and lifestyle behaviours of students attending HE.
Methods: Full-time students, aged 18+, were eligible to participate in this online cross-sectional study. Self-reported questions were asked in relation to demographics, body mass index (BMI), smoking, and COVID-19. A food frequency questionnaire measured dietary quality along with tools assessing alcohol use, sleep quality, perceived stress, and physical activity. Statistical analyses were performed using chi-square, one-way ANOVA, independent sample t-tests, Pearson's correlation, and multivariate linear regression.
Results: Evidence of a correlation between poor diet quality and having a higher BMI ($p = 0.040$), higher alcohol consumption ($p = <0.001$), poorer sleep quality ($p = 0.003$), higher stress levels ($p = 0.006$) and smoking ($p = 0.001$) was found. Low fruit and vegetable consumption were associated with higher BMI ($p = 0.013$), higher alcohol consumption ($p = <0.001$), lower physical activity levels ($p = 0.006$), higher stress levels ($p = <0.001$), smoking ($p = <0.001$) and being male ($p = 0.002$).
Conclusions: This study provides data on the association between dietary quality and lifestyle behaviours among HE students and will inform healthy campus initiatives.

1. Introduction

An unhealthy diet is a contributor to higher BMI, increased NCDs risk, decreased productivity, and premature morbidity and mortality [1–6]. leading to obesity, diabetes, CVD and hypertenstion [6–8] through inflammation [6], and not consuming substantial amounts of micronutrients [7] and food compounds e.g., phytosterols [8]. In 2019, globally NCDs accounted for 7.9 million deaths and 187.7 million Disability-adjusted life years (DALYs) attributable to an unhealthy diet [9]. A healthy diet is defined as consuming food in a pattern that is beneficial to health, or at least not harmful [10,11], common features include a higher proportion of plant-based foods, F&V, whole grains, legumes, seeds, nuts, poly-unsaturated fatty acids; an unhealthy diet often contains high amounts of sodium, trans fats, and red meat [8–14]. Predictors of dietary change include health-related lifestyle behaviours [1] that can be defined as daily behavioural choices that affect one's overall health [15]. PA, diet, alcohol consumption and smoking remain the most studied modifiable lifestyle behaviours and are associated with all-cause mortality [16–19].

Many students do not achieve the RDA for whole grains [20] and over 82% do not adhere to F&V guidelines [21–23] increasing the likelihood of overweight and obesity (OWO) and other NCDs [24]. Among Irish students the median number of daily F&V servings was three, 38% were OWO, 9% reach PA guidelines, and 25–33% smoked tobacco [25,26]. Hazardous alcohol consumption is the main substance used by higher education (HE) students [27] with 54–66% of Irish students deemed hazardous alcohol consumers [25,27] and 25–34% are physically inactive [25,28]. Students eating behaviours are associated with poor sleep quality correlating with unhealthy lifestyle behaviours [29–31]. These behaviours affect the health of students, as does smoking, OWO and stress [32,33].

Happier students have been shown to be more active [34], and those stressed have a high BMI [35]. Students experience elevated levels of stress [36,37], which is associated with an unhealthy diet and poor academic performance [38,39]; increasing during HE [40]. Academic impairment increases college dropout rates, therefore, a

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Abbreviations

BMI	Body Mass Index
CVD	Cardiovascular Disease
F&V	Fruit and Vegetables
HE	Higher Education
HEI	Higher Education Institute
GDP	Gross Domestic Product
NCD	Non-Communicable Diseases
OWO	Overweight and Obesity
PA	Physical Activity
RDA	Recommended Daily Amounts

prominent issue for HE Institutes (HEIs) to consider [41]. An international study found that poorer dietary behaviours were associated with poorer sleep quality and less PA, but not alcohol misuse [34,42]. Globally among students a correlation between higher diet quality and both higher PA levels and lower alcohol consumption was found [43]. Smoking status has a more inconclusive relationship with diet; sleep appears to be trending towards a correlation [43].

Unhealthy lifestyle behaviours decrease the number of disease-free years a person has, and increases the risk of NCDs, mortality, and weight gain [1,2,6,19,44]. The life course approach to health has been supported in recent years [1,3,45]. Although healthy diet and lifestyle behaviour interventions of college students are understudied [43], their development is imperative for the improvement of student's health; their potential impact on subsequent stages of life can reduce the onset of NCDs improve health later in life [1,3,45]. There are 231,710 students enrolled in Irish HEIs which has been identified as a key setting to target and implement health-promoting programmes and research [46–48]. During the transition into HE lifelong health-related behaviours are established and are likely to continue throughout life, affecting future health status [49–51].

The association between diet and lifestyle behaviours of HE students is an area with little evidence in Ireland or globally and their relationship is unclear within this cohort [43,52]. This study aimed to identify the relationship between dietary quality and lifestyle behaviours of students and has the potential to shape the development and content of healthy campus policy in HEIs.

2. Methods

Data were collected as part of a cross-sectional web-based survey, hosted by Qualtrics®^{XM} during the 2020–21 academic year. A hyperlink was circulated through class representative systems, students' unions, social media, wellness officers and email. Students registered for full-time undergraduate or graduate programmes, aged 18 and over, were eligible to participate from three HEIs in the North-West of Ireland. Students provided informed consent and participation was voluntary and anonymous with the opportunity to exit the survey any time prior to submission. The median time for completion was 14 min, 52.5 s. A total of 956 students responded to the survey, with 682 (71.3% completion rate) used in the final analyses.

2.1. Measures and materials

The questionnaire consisted of forty-four questions and available in supplementary material 1. Demographic characteristics assessed included age, gender, year of study, area of study, living situation, current employment situation, dietary preferences (e.g., vegan, vegetarian, gluten-free, etc.) and dietary supplementation use (e.g., creatine, protein powder, multivitamins, etc.). A question was adapted from a previous Irish study of students [28] asking "How often do you prepare food from fresh ingredients rather than pre-prepared food?" with answers categorised on a Likert scale, as 'never', '1–2 times a week', '3–4 times a week', 'every day' or 'multiple times a day'. Self-reported general health and diet were measured using single item questions adapted from previous research of Irish students [25]. The questions were "In general, would you say your health/diet is:" with answers on a 5-point Likert Scale: 'very good', 'good', 'neither good nor poor', 'poor' and 'very poor'. BMI was estimated from self-reported height and weight with categories defined according to the World Health Organization criteria. Underweight, normal weight, overweight and obesity defined as a BMI of $\leq$18.4, 18.5–24.99, 25–29.99 and $\geq$30 kg/m^2, respectively [53]. Due to the unfeasibility of measuring anthropometric data during COVID-19, self-reported measures were used, a validated method for students [54]. Smoking status was assessed with one question "Which of the following best describes your smoking (cigarettes/vape) habits?" with four potential answers; 'non-smoker', 'ex-smoker', 'smoker' and 'social smoker (e.g., not every day).'

A Short-Form Food Frequency Questionnaire (SFFFQ) was used in this study which is reliable and valid in comparison to a longer FFQ [55] and has been previously used in a student population [56]. The SFFFQ measures five components: fruit, vegetable, oily fish, fat, and non-milk extrinsic sugar providing a total diet quality score (DQS) ranging from 5 to 15, with fifteen deemed optimum diet quality [55]. Daily F&V consumption was determined by calculating the total fruit, fruit juice, salad, and vegetables consumed, with fruit juice limited to 1.0 portion, as per recommendations [57]. Four validated and reliable tools were used to assess behaviours: Alcohol Use Disorders Identification Test (AUDIT-C) questionnaire [27,58], Pittsburgh Sleep Quality Index (PSQI) [59–61], Perceived Stress Scale-10 (PSS-10) [43,62], and International Physical Activity Questionnaire-Short Form (IPAQ-SF) [63–65]. Habitual sleep duration was extracted from the PSQI; participants were classified as meeting sleep duration guidelines if they slept a total of seven or more hours a night [61]. To coincide with previous Irish research, those that report 'high' activity levels (1500 MET vigorous or 3000 MET moderate minutes of activity a week) are deemed to be meeting Irish national PA guidelines [65,66]. Seven questions were adapted from previous research about the impact of the COVID-19 Pandemic [43].

2.2. Statistical analyses

Data was exported directly to Microsoft Excel (Microsoft Inc., Redmond, WA, USA) and then to IBM Statistical Package for the Social Sciences [SPSS] Version 26.0 (IBM Inc., Armonk, NY, USA). Descriptive statistics were performed, and data were presented as count (%) or mean ± standard deviations (SD). Chi-square tests of association (for categorical variables) and independent t-tests were used to check for associations between two categorical variables. All cells had an expected count of greater than or equal to five. Z-tests for differences in the two proportions determined if a statistically significant difference existed between the proportions of a column for each category. Pearson's product-moment correlations were run to assess the relationship between variables. A one-way ANOVA was performed to assess the relationship between smoking and both diet quality and F&V consumption. Multivariate linear regression was used to identify significant predictors of diet quality and F&V consumption. The significance levels for all tests were set at an alpha level of $P < 0.05$.

3. Results

The mean age of participants was *24.97 ± 8.90* and the majority were female *(n = 455, 66.8%)*. The mean BMI was *24.67 ± 4.49* with *(n = 355, 54.9%)* classified as a healthy weight, *40.2% (n = 260)* were OWO and *4.9% (n = 32)* underweight. Only *39.6% (n = 269)* of students reported being somewhat or very satisfied with their current weight, *45.2% (n = 307)* indicated they are not. Further demographic information can be found in Supplementary Material 2.

3.1. Dietary intake and lifestyle behaviours

The sample in this study had an overall diet quality score of 9.97 ± 1.89. A small number *(n = 147, 21.6%)* of students consume the RDA of at least five servings of F&V; the average daily F&V consumption was *3.17 ± 3.07 (253.6g)*. A total of *26.7% (n = 181)* outline that they have a dietary requirement/restriction and *52.5% (n = 355)* of participants use dietary supplements Hazardous alcohol consumption is seen in 39.0% *(n = 266)* of students surveyed. PSQI scores indicate that *45.2% (n = 304)* have poor sleep quality and *32.9% (n = 219)* do not meet sleep recommendations. Mean PSS-10 scores were *16.78 ± 5.37* with over two-thirds *(n = 500, 73.3%)* deemed moderate-highly stressed. Mean IPAQ scores were *2780.05 ± 2562.40* with *38.3% (n = 255)* meeting Irish PA guidelines. Over a quarter *(n = 182, 26.7%)* reported being smokers. Further diet and lifestyle behaviour information can be found in Supplementary Material 3.

3.2. The Impact of COVID-19 on Diet and Lifestyle Behaviours

When asked about the impact of COVID-19 on dietary behaviours *29.5% (n = 195)* reported that their diet is less healthy and *26.4% (n = 174)* reported eating more healthily. Almost half *(n = 332, 48.8%)* reported drinking less, and sleep was negatively impacted in *39.0% (n = 266)* of students. Most students *(n = 411, 62.1%)* feel more stressed than usual, and *54.8% (n = 372)* reported less PA, as seen in supplementary material 4.

3.3. Diet quality and lifestyle behaviours

A Pearson's product-moment correlation, as seen in Table 1, was run and found a statistically significant, small (weak) negative correlations between diet quality and BMI, alcohol consumption, sleep quality, and stress and none between diet quality and PA *(p = 0.101)*. A one-way ANOVA found a statistically significantly difference among the four smoking groups *(F(3, 677) = 5.592, p = 0.001)*. Tukey post hoc test analysis revealed a statistically significant increase in the diet quality of ex-smokers compared to non-smokers *(0.813, 95% CI (0.13 to 1.50), p = 0.012)*, as well as from ex-smokers compared to smokers *(1.34, 95% CI (0.49 to 2.19), p<0.001)*, but no other group differences were statistically significant (not in table).

Table 1
Diet quality and its association with lifestyle behaviours-correlation co-efficient.

	Mean	SD	Correlations	*p*-Value
Diet Quality	*9.97*	*1.89*		
BMI	*24.67*	*4.49*	*−0.081**	*0.040*
AUDIT-C Score	*3.85*	*2.70*	*−0.163****	*<0.001*
PSQI Score	*4.70*	*2.46*	*−0.115***	*0.003*
PSS-10 Score	*16.78*	*5.37*	*−0.104***	*0.006*
IPAQ Score	*2780.05*	*2562.40*	*0.064*	*0.101*

*Correlation Significant at 0.05 level (two tailed); **Correlation Significant at 0.01 level (two tailed); ***Correlation Significant at 0.001 level (two tailed).

Table 2
Multiple regression results for diet quality.

Diet Quality	*B*		*SE B*	*β*	R^2	ΔR^2
Model					*0.036*	*0.033****
Constant	*10.739****	*10.388*	*0.179*			
AUDIT-C	*−0.108****	*−0.162*	*0.027*	*−0.153****		
PSQI	*−0.075**	*−0.133*	*0.030*	*−0.097***		

*Correlation Significant at 0.05 level (two tailed); **Correlation Significant at 0.01 level (two tailed); ***Correlation Significant at 0.001 level (two tailed); B = unstandardized regression coefficient; CI = confidence interval; L = Limit; SE B = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination ΔR^2 = adjusted R^2.

Table 3
F&V consumptions association with lifestyle behaviours - correlation co-efficient.

Variable	Mean	SD	Correlation	*p*-Value
F&V Consumption	*3.17*	*3.07*		
BMI	*24.67*	*4.49*	*−0.098**	*0.013*
AUDIT-C Score	*3.85*	*2.70*	*−0.149****	*<0.001*
PSQI Score	*4.70*	*2.46*	−0.052	0.176
PSS-10 Score	*16.78*	*5.37*	−0.158***	<0.001
IPAQ Score	*2780.05*	*2562.40*	0.107**	0.006

*Correlation Significant at 0.05 level (two tailed); **Correlation Significant at 0.01 level (two tailed); ***Correlation Significant at 0.001 level (two tailed).

A multiple regression was run to predict diet quality from BMI, AUDIT-C, PSQI and PSS-10 scores. BMI *(p = 0.119)* and PSS-10 scores *(p = 0.083)* were removed from the model and all assumptions were met. The model statistically significantly predicted diet quality *(F(2, 669) = 12.580, p<0.001), adj. R^2 = -0.033)*, seen in Table 2. A higher diet quality is associated with having better sleep quality and lower alcohol use, accounting for *3.6%* variation. For every one-point increase in AUDIT-C and PSQI scores diet quality scores reduce by *0.108* and *0.075*, respectively.

3.4. F&V consumption and lifestyle behaviours

A Pearson's product-moment correlation, as seen in Table 3, was run and found a statistically significant, small (weak) negative correlation between F&V consumption and BMI, alcohol consumption, stress, and PA. There was no statistically significant correlation between F&V consumption and sleep quality *(p = 0.176)*. A one-way ANOVA found a statistically significant difference among the four smoking groups *(F(3, 671) = 7.839, p < 0.001)*. Games-Howell post hoc test analysis revealed a statistically significant increase in F&V consumption of non-smokers compared to smokers *(1.23, 95% CI (0.50 to 1.96), p<0.001)*, as well as from ex-smokers compared to smokers *(1.86, 95% CI (0.57 to 3.14), p = 0.002)*, but no other group differences were statistically significant (not in table).

A multiple regression was run to predict F&V consumption from gender, AUDIT-C scores, PSQI scores and PSS-10 scores. BMI *(p = 0.060)* and IPAQ scores *(p = 0.068)* were removed from the

Table 4
Multiple regression results for F&V consumption.

F&V Consumption	B		SE B	β	R^2	ΔR^2
Model					*0.055*	*0.050***
Constant	*2.889***	*2.081*		*0.411*		
Gender	*0.766***	*0.404*		*0.184*	*0.162***	
AUDIT-C	*−0.080**	*−0.142*		*0.032*	*−0.097***	
PSS-10	*−0.067***	*−0.099*		*0.016*	*−0.157**	

*Correlation Significant at 0.05 level (two tailed); **Correlation Significant at 0.001 level (two tailed); B = unstandardized regression coefficient; CI = confidence interval; L = Limit; SE B = standard error of the coefficient; β = standardized coefficient; R^2 = coefficient of determination R^2 = adjusted R^2.

model and all assumptions were met. The model statistically significantly predicted F&V consumption *($F(3, 642) = 12.390$, $p < 0.001$), adj. $R^2 = .05$),* as seen in Table 4. Consuming more F&V is associated with being female, having a lower AUDIT-C and PSS-10 score accounting for *5.5%* variation. For every one-point increase in AUDIT-C and PSS-10 score, F&V consumption decreases by *0.080* and *0.067* portions per day, respectively. Females consume *0.766* F&V portions more per day than males.

4. Discussion

This study found a higher prevalence of students consuming the RDA of F&V (22%) than others [21–23]. Although results are not directly comparable, other studies found that the mean results of students' diet quality were close to the midpoint of potential scores [29,42]. The mean BMI (*24.67 ± 4.49*) and the amount classified as OWO (40%) within this study is similar to the global range [67–69], but lower than the 60% of Irish adults deemed OWO [70]. This study found that BMI is associated with both diet quality and F&V consumption and a lower percentage of obese students met F&V guidelines, a trend well documented in studies of adults including students [43,71,72] Improving dietary behaviours could be a positive approach to reducing students BMI [47].

Irish studies previously found that 26–64% of students were classified as meeting PA guidelines [73–77], however, PA levels in this study sample (38.3%) were considerably lower. This could be due to the reduction of PA seen in students due to COVID-19 with the closure of facilities, sports being cancelled and lockdown measures [78,79]. In this study PA is associated with F&V consumption but not diet quality. Three studies that assessed overall diet quality in a recent SR did not find an association with PA, however, all eleven papers that assessed diet quality via F&V consumption found some form of a correlation [43]. This suggests F&V consumption is a good predictor of diet quality in students. Academic pressure and stress are predictors of PA [32]; the high level of stress among this cohort could be why PA levels are low [21,33,74].

The mean PSS-10 score of *16.78 ± 5.37* found is similar or less than recent studies [42,80–82]. However, 73% of participants are experiencing moderate to high levels of stress [83], much higher than the 17% in a study of 3440 Irish students [84]. Stress levels of students are higher than that of the general population impacting their academic performance and health [37,85]. This study found that stress is associated with both diet quality and F&V consumption, the strength of which can be seen in the regression model. Students have been found to both increase and reduce food consumption because of stress [38], causing weight change [37]. The association between stress levels of students and dietary habits has been well documented [38–40,86] Healthier diet and lifestyle behaviours are associated with lower levels of stress in students [33], including sleep [42].

Almost half of students within this study had poor sleep quality; similar to other studies deeming 30–64% as poor sleepers [42,82,87]. Poor sleep quality is a risk factor for adverse health outcomes [88]; adherence to a healthier diet is associated with higher sleep quality [89,90]. Six of ten papers identified in a recent SR found a significant association between diet and sleep [43]. This study found an association between sleep quality and diet quality, however, not between sleep and F&V consumption, despite a *"healthy"* diet, generally categorised as including high F&V consumption [89]. Di Benedetto et al., noted that theirs and other studies found no association between sleep quality and F&V consumption, however, they did find an association between overall diet and sleep quality [91]. This indicates that more thorough dietary assessment may yield more conclusive results, with the strength of association between diet and sleep quality seen in the regression model. Poor sleep is identified as a common health problem among students, impacted by academic demands [92] and lifestyle behaviours e.g., smoking [93].

Over one-quarter of students self-reported as smokers, a rate similar to the 17–33% in other studies [25–28,73,76] yet much higher than the 17% of Irish adults deemed smokers [70]. Smoking patterns among young Irish people differ from national rates with a high prevalence of social smokers, also seen in this study [94]. In a recent SR 39% of papers found a significant relationship between poor diet quality and being a smoker [43]. This study found a higher diet quality among ex-smokers, whereas high F&V consumption was found among both ex- and non-smokers. Many studies assessing overall diet quality find no association with smoking and potentially why F&V is more conclusive within this study [43]. Studies of the general population have found that non- or ex-smokers engage in healthier diet behaviours [95]. Although smokers tend to have a lower quality diet this relationship may be dependent on the amount of tobacco consumed [96]. A low number of students identified as smokers and ex-smokers and frequency was not assessed, potentially why associations were not found. Higher rates of alcohol consumption within a student cohort may be a reason for higher smoking prevalence [94].

In this study, 39% were deemed hazardous alcohol consumers, lower than the 61–84% previously found among Irish students [27,49], yet, similar to recent European research that found 37% of 2191 students are hazardous consumers [97]. Alcohol consumption among Irish adults varied since COVID-19 with some finding a decrease of 66% [98] and others finding an increase [99]. Studies of HE students have found a reduction in alcohol consumption during the COVID-19 pandemic [36]. Recent publications, found that poorer dietary behaviours were not correlated with alcohol misuse [35,42]. Studies finding no correlation between alcohol consumption and diet may be due to alcohol being a societal norm to the extent that it may be independent of other factors [100]. The association between alcohol and both diet quality and F&V in this study is strengthened by its inclusion in both multiple regression models. This association could be strengthened by the fact that although alcohol was reportedly consumed less than usual due to COVID-19 by almost half of students, there is still a high number of hazardous consumers, which has been found in other studies of students during COVID-19 measures [101].

4.1. Strengths and limitations

The high number of responses and the number of variables explored heighten the robustness of results, strengthened using validated measures. This study included students from multiple HEIs and both undergraduate and graduate students, increasing generalizability of results. Limitations must be considered, firstly, this study had a cross-sectional design, therefore, causal relationships could not be identified. Results cannot be generalized to all students as a convenience sample was used, however, results are important for informing local policies and initiatives. Variables were all measured using subjective, self-report tools, limiting the validity and reliability of the data e.g., PA questions were incorrectly completed by many participants, making analysing difficult. Although the SFFFQ is validated, the *'gold standard'* of dietary surveillance is a 7-day weighed food diary [102], however, it has been deemed a burdensome and impractical method [103].

4.2. Future use of findings

HE students are attending a setting that often has high-quality facilities, technology, and highly educated staff, therefore, ideal

for health promotion interventions and campaigns [104]. Recent SRs have been conducted to assess the effectiveness of health interventions in a HE setting with the majority focusing on a singular health outcome [52]. Several interventions are effective including in-person interventions, media approaches and nutrition labelling to improve dietary habits, face-to-face programs, internet-based approaches, personalised interventions and cognitive behavioural therapy to improve lifestyle behaviours [52]. The results from this study can be used to develop interventions that combine diet and lifestyle behaviours.

Future studies with a prospective design are needed to better understand these relationships and allow for the assessment of temporal sequence, eliminate recall bias and comparing multiple behaviours [105]. Future research could benefit from including objective measures, to reduce the likelihood of over- or under-estimation and misinterpreting behaviours [106]. Those who obtain a higher education level are more likely to have a healthier diet [107], therefore, maintaining their status as a student and targeting students is important for population health and can potentially improve a countries GDP [107]. HEIs should be proactive in their approach to the health of students and create an interdisciplinary health promotion team to create educational programmes that support a healthy lifestyle [35,42].

5. Conclusion

There is evidence of a correlation between diet quality and BMI, alcohol consumption, sleep quality, smoking and stress. F&V consumption is associated with BMI, smoking, alcohol consumption, PA, and stress. This study supports the need for healthy campus committees to plan interventions and educational programmes on diet, health, and lifestyle behaviours. These could help create healthier institutes and graduates, while improving supports and services for students. The results indicate that improving the diet quality of students may also improve their lifestyle behaviours and vice versa, with academic achievement potentially benefiting as a result.

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was received by [removed for blind peer review] prior to data collection.

Authors' contributions

SD, LK, JMM and JMK conceptualized and designed the study. SD and LK drafted the introduction section. SD conducted the survey, collected, extracted and analysed the data. SD and LK drafted the methods, results, discussion and conclusion section. All authors contributed to the writing and editing of the manuscript. All authors read and approved the final manuscript.

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Declaration of competing interest

Authors state no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2023.01.036.

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