


AUTHOR QUERY FORM

 ELSEVIER	Journal: ENFCLI	Please e-mail your responses and any corrections to:
	Article Number: 1743	E-mail:

Dear Author,

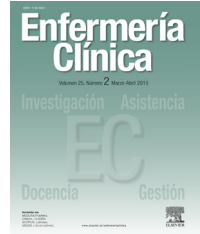
Please check your proof carefully and mark all corrections at the appropriate place in the proof (e.g., by using on-screen annotation in the PDF file) or compile them in a separate list. Note: if you opt to annotate the file with software other than Adobe Reader then please also highlight the appropriate place in the PDF file. To ensure fast publication of your paper please return your corrections within 48 hours.

For correction or revision of any artwork, please consult <http://www.elsevier.com/artworkinstructions>.

Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof. Click on the 'Q' link to go to the location in the proof.

Location in article	Query / Remark: click on the Q link to go Please insert your reply or correction at the corresponding line in the proof
Q1	Please check the short title that has been created, or suggest an alternative of fewer than 80 characters including spaces.
Q2	Please confirm that given name and surname are correctly identified. The different colors indicate whether tagged as first or last name. Please note that proper identification is key for correct indexing of the article.
Q3	Correctly acknowledging the primary funders and grant IDs of your research is important to ensure compliance with funder policies. We could not find any acknowledgment of funding sources in your text. Is this correct?
Q4	Have we correctly interpreted the following funding source(s) and country names you cited in your article:IIUM?
Q5	Please note that Refs. [8,18] were identical, and Ref. [18] has been deleted. The subsequent references have been renumbered.
	<div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> Please check this box or indicate your approval if you have no corrections to make to the PDF file <input type="checkbox"/> </div>

Thank you for your assistance.



Association between sitting time and high-sensitivity C-reactive protein level among obese women

Azlina Daud^a, Anis Fsehah Jamal^b, Siti Zuhaidah Shahadan^{a,*}

^a Department of Medical Surgical Nursing, Kulliyah of Nursing, IIUM, Kuantan, Malaysia

^b Kulliyah of Nursing, IIUM, Kuantan, Malaysia

Received 15 September 2020; accepted 21 September 2020

KEYWORDS

Obese women;
hs-CRP;
Sitting time;
Cardiovascular
disease

Abstract The objective of this study was to determine the time spent on sitting per day, level of serum High sensitivity C-reactive protein (hs-CRP), and the association between sitting time and level of serum hs-CRP among obese women. A descriptive cross-sectional study was conducted. Sixty eight (68) obese women were recruited. They were signed informed consent form prior to the questionnaire answered. Then, sample blood test was taken to check for hs-CRP level. Sitting time spent in hours was found to be not significantly associated with hs-CRP level ($p=0.391$) among obese women. Longer sitting time spent per day more than 4h is the factor of obesity and hs-CRP level will be higher in obese women compared to normal people. This study can be baseline data for healthcare professionals and may contribute to develop awareness platform on maintaining normal body mass index among women.

© 2020 Published by Elsevier España, S.L.U.

Introduction

The National Health and Nutrition Examination Survey (2015–2016), recorded the prevalence of obesity in United State adults was 39.8% and the prevalence of obesity was higher among middle-aged (40–59 years old) compared to young adults (20–39 years old) which were 42.8% and 35.7%

respectively.¹ The Asian countries followed the increasing trend of obesity in United States which it has reached epidemic proportions in many Asian countries.² These countries also faced with obesity-related disorder such as diabetes, hypertension and cardiovascular disease (CVD). These diseases also affect the clinical burden to health care provider and the country itself. Furthermore, Malaysia also faced with the same problem of rising of obesity like developed countries and other Asian countries. The latest statistic from Malaysia National Health and Morbidity Survey (NHMS),³ showing that the overweight and obese make up nearly half of the 30 million populace and indirectly lead Malaysia to be known as Asia's fattest country. According to NHMS, the prevalence of obesity has increased to 15.1 per cent in 2011 and continued to increase to 17.1 per cent in 2015.³

Peer-review under responsibility of the scientific committee of the 4th International Conference for Global Health (ICGH) in conjunction with the 7th Asian International Conference in Humanized Health Care (AIC-HHC). Full-text and the content of it is under responsibility of authors of the article.

* Corresponding author.

E-mail address: sitizuhaidah@ium.edu.my (S.Z. Shahadan).

<https://doi.org/10.1016/j.enfcli.2020.12.009>

1130-8621/© 2020 Published by Elsevier España, S.L.U.

Excessive calories intake or the calories are not fully utilized by physical activities, sedentary behavior practices also become a risk factor of obesity.⁴ According to Gomez-Cabello et al.,⁵ the most sedentary activity is sitting position. This study found that those spent more than 4 h sitting per day and walk less than 1 h per day will have higher risk of obesity compared to those spent less than 4 h sitting per day and walk more than 1 h per day. Therefore, changes in lifestyles behaviors such as lack of physical activities and increased sedentary behavior associated with rapid urbanization, may lead to an increasing prevalence of overweight and obesity.⁴

In obese people, adipocytes release cytokines into blood circulation, then it stimulate production of hepatic C-reactive protein (CRP) and a positive association between body mass index (BMI) and CRP has been observed.^{6,7} High sensitivity C-reactive protein (hs-CRP) is an inflammatory marker and it is the best predictor of cardiovascular disease.⁸ The previous studies were proved that hs-CRP level and sitting time was directly proportional with obesity, but they did not discuss either hs-CRP level influences by sitting time or not. Hence, the question arose on whether the sitting time has an association between hs-CRP levels among obese women.

Method

Study design

A cross sectional study was conducted among obese women in Kuantan, Pahang. A purposive sampling method was used. All obese women living in Kuantan, Pahang were invited to join as study participants.

Sample size

The prevalence of obesity class I and class II among adults in Pahang was 25% and 5.2%, respectively.³ The sample size was calculated using the Epi Info sample size calculator. A total of 123 participants are needed to represent 80% of the total distribution of obese Class I and II adults with 10% of drop-out rate. 55% ($n = 68$) of participants completed the data collection procedures.

Study tools

The research instrument used to measure the weight and height were Omron Digital Weighing Scale to the nearest 0.1 kg and standing height was measured without shoes using CHARDER MS3400 Adult Scale to the nearest 0.1 cm. The data was collected using a set of questionnaires adapted from National Health and Morbidity Survey (NHMS). The questionnaires consist of two parts. Part A was the socio-demographic data include age, body weight, height, BMI, race, marital status, educational level, employment status which denote the characteristics of the study participants. Part B was the sitting time spent per day. The set of questionnaires was put in an envelope and sealed, and information was kept anonymous. After completed the questionnaires, blood sample for hs-CRP was taken by a registered nurse.

Data collection

The data collection period was between January 2018 and April 2018. Advertisement for participation were done through health screening activities, flyers and social media network, invitation letter to government offices and WhatsApp broadcasting. Purposive sampling method was used. All obese women living in Kuantan, Pahang were invited to join as study participants. The obese women who met the inclusion criteria which were obesity type I (BMI: 27.50–34.99 kg/m²) and type II (BMI: 35.00–39.99 kg/m²), not diagnosed with cardiovascular disease or any non-communicable diseases, understand Malay or/and English language. The obese women who interested and met the inclusion criteria were ask for consent. The written inform consent was signed by the participant and the purpose of this study was explained to the participants. After obtaining an inform consent, the information sheet which explain about the study and the right of the participants has been provided. Height and weight were taken to determine the BMI.

Data analysis

Statistical analysis program, SPSS was used for data management and Kruskal–wallis test was used for analysis. p value < 0.05 was set as statistically significant.

Ethical aspects

Ethical approval was obtained from the Institutional Review Board (IRB) prior to data collection process and all participants provided written informed consent to participate in this study.

Results

Demographic characteristics

The sociodemographic background and total sitting time per day of the study participants are described in Table 1. A total of 68 obese women were recruited for this study, comprising four races which are Malay (94.1%), Indian (1.5%), Chinese (2.9%) and others (1.5%). The mean age of the participants was 28.5 years old (standard deviation = 10.5). According to the ethnicity, Malay recorded the highest frequency of sitting time more than 4 h per day with 70.59% ($n = 48$) followed by Chinese 2.94% ($n = 2$) and both Indian and Others 1.47% ($n = 1$). Majority of participants that spent their time in sitting for more than 4 h per day are single (57.35%). For educational level, most of the participants with Bachelor qualification (50%) spent more than 4 h per day for sitting. In term of occupation, participants who are unemployed recorded the highest number on sitting more than 4 h per day (51.47%), whereas government servant becomes the second highest with 14.71% ($n = 10$) then followed by private servant 7.35% ($n = 5$) and housewife 1.47% ($n = 1$). As for working time, participants who work at the regular time sat more than 4 h compared to others with 32.35% ($n = 22$) and 29.41% ($n = 20$). The median of hs-CRP level among the participants

Table 1 The socio-demographical background and total sitting time per day (n = 68).

Variables	Sitting time per day		
	<1 h n = 3	1-3 h n = 13	>4 h n = 52
Age*	28.5 ± 10.48		
Ethnicity			
Malay	3 (4.4)	13 (19.1)	48 (70.6)
Chinese	0	0	2 (2.9)
Indian	0	0	1 (1.5)
Others	0	0	1 (1.5)
Marital status			
Never married	1 (1.5)	9 (13.2)	39 (57.4)
Married	2 (2.9)	4 (5.9)	11 (16.2)
Separated	0	0	1 (1.5)
Widow	0	0	1 (1.5)
Educational level			
Primary School	0	0	2 (2.9)
Secondary School	1 (1.5)	5 (7.4)	9 (13.2)
Certificate/Diploma	1 (1.5)	0	6 (8.8)
Bachelor	1 (1.5)	8 (11.8)	34 (50.0)
Master/PhD	0	0	1 (1.5)
Occupation			
Unemployed	1 (1.5)	9 (13.2)	35 (51.5)
Housewife	0	0	1 (1.5)
Government Servant	0	4 (5.9)	10 (14.7)
Private servant	1 (1.5)	1 (1.5)	5 (7.4)
Self-employed	1 (1.5)	0	0
Working time			
Regular	1 (1.5)	5 (7.5)	22 (32.4)
Extended hours	0	0	5 (7.4)
Staggered days	1 (1.5)	2 (2.9)	2 (2.9)
Shift hours	1 (1.5)	2 (2.9)	2 (2.9)
Part-time	0	0	1 (1.5)
Others	0	4 (5.9)	20 (29.4)
Hs-CRP level	8.03 ± 8.17*	8.59 ± 7.83*	3.05 ± 6.90**

Note: All data is presented in frequency (percentage).

* Data is presented in mean (standard deviation).

** Data is presented in median (interquartile range).

147 that have sitting time more than 4 h was 3.05. Table 1 shows
148 the details of the socio-demographical background of parti-
149 cipants on their total sitting time per day.

150 The association between hs-CRP level and sitting 151 time per day

152 Table 2 showed the association between hs-CRP level and
153 sitting time per day by the participants. The non-parametric
154 test which is Kruskal-Wallis was used in order to determine
155 the association between hs-CRP level and total sitting time
156 per day. There was no significant association between the hs-
157 CRP level by different time spent on sitting with a mean rank
158 of 37.67 for sitting time less than 1 h, 40.92 for sitting time

Table 2 The association between hs-CRP level and sitting time per day.

Sitting time spent per day (h)	Level of hs-CRP (mg/L)		H(2)	p-Value
	Frequency (n)	Mean rank		
<1 h	3	37.67	1.878	0.391
1-3 h	13	40.92		
>4 h	52	32.71		

159 1-3 h and 32.71 for sitting time more than 4 h [H(2) = 1.878,
160 p = 0.391].

161 Discussion

162 This study explored the time spent on sitting position by
163 obese women regardless sitting in workplace, at home, or
164 by doing activities daily life. Sitting is one type of seden-
165 tary behavior which increase the risk of getting obesity.⁹
166 This study finding indicates that unemployed participants
167 spent more time in sitting which was 51.47% where they
168 spent more than 4 h in sitting position per day. Majority of
169 unemployed participants were students therefore they tend
170 to spend more time in surfing internet, use computer to
171 do assignment and television viewing. The government ser-
172 vants also spent more than 4 h in sitting per day, in addition,
173 they are working in regular time system. Therefore, they
174 are more likely to have longer period in sitting position in
175 the workplace. Moreover, increased screen-based behaviors
176 such as television viewing, computer or internet use, demon-
177 strated negative health outcomes.¹⁰ According to Rhodes,
178 Mark and Temmel,¹¹ increased television viewing is associ-
179 ated with an increase in sitting time and the consumption of
180 energy-dense foods which results in increased BMI and car-
181 diovascular risk. In addition, computer games, general and
182 internet use also leads to increased BMI and chronic disease
183 risk.¹² Besides, the previous study found that social media
184 use like television viewing, high computer use, playing video
185 games and internet use such as Facebook were associated
186 with sitting time.⁹ In addition, one research stated that high
187 levels of sitting outside of working hours affects health more
188 than sitting during working hours.¹³

189 Obesity is more prominent among retired people and peo-
190 ple who work from their home compared to those professions
191 that require activity because they spent more time in sitting
192 more than working people.¹⁴ According to Al-Qalah, Ghazim
193 Isa and Karim,¹⁵ women working in an urban of Malaysia
194 have low to moderate physical activity level. The above find-
195 ings can be related to the lifestyle practices of the women
196 themselves. One of strong contributory factor to obesity is
197 unhealthy lifestyle practices by Malaysian women.¹⁶ This
198 study finding support with previous finding where unem-
199 ployed women spent more time in sitting compared to those
200 who are working.

201 Most of previous studies found that the hs-CRP level in
202 obese people was markedly higher compared to normal peo-
203 ple. This study found that the number of serums hs-CRP
204 increased which the level is more than 3.0 mg/L in Malay
205 compared to other ethnicity. However, a study by Choi,

Joseph, & Pilote,⁸ support this study finding where obesity was positively associated with serum hs-CRP regardless of their age, sex and ethnicity. Moreover, the working time system of the participants who were regular working time was recorded the highest percentage of hs-CRP level of more than 3.0 mg/L with 25.0% ($n = 17$) compared to others with 16.18% ($n = 11$). Thus, based on the results, regardless their marital status, educational level, occupation and working system, the level of hs-CRP still higher once they are obese.

Total sitting time is positively associated with obesity which means women sit more than 4 h per day will become obese. Obesity also had positive association with level of hs-CRP which obese women will markedly having high level of hs-CRP. However, this study revealed that sitting time per day does not have any association with level of hs-CRP. Previous studies found that prolonged sitting time at work and also at leisure time and even during transportation were affects their health concern.¹⁷ Their study also shows that sedentary behavior is associated with cardiovascular disease that leads to mortality. Study conducted by Choi et al.,⁸ found that prolonged total sitting time per day at least 16 h will increase the risk of cardiovascular disease compared to less than 4 h sitting. Besides, the evidence on the association between sitting time and cardiovascular disease incidence is inconsistent.¹⁷ Thus, it means that sitting time cannot affects the level of CRP among obese people which can indicate risk of cardiovascular disease.

Conclusion

This study had proven that sitting more than 4 h per day will increase the BMI which led to obesity. Obese people are more likely to have higher level of hs-CRP compared to normal people. High level of hs-CRP will indicate the high risk of developing cardiovascular disease. Therefore, longer sitting time is the factor of obesity and increase in hs-CRP level which increased risk of cardiovascular disease. In order to improve the awareness and practice toward better lifestyle, health care providers such as nurses are crucial team to promote the healthy lifestyle and maintaining ideal body weight to prevent from future health disease.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

^{Q4} This work has been supported by IIUM under the Research Initiative Grant Scheme (RIGS) with project ID RIGS 16-283-0447.

References

1. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States, 2015–2016 key findings data from the national health and nutrition examination survey [Internet]. Hyattsville, MD: National Center for Health Statistics; 2017. Available from: <https://www.cdc.gov/nchs/data/databriefs/db288.pdf> [cited].

2. Ramachandran A, Snehalatha C. Rising burden of obesity in Asia. *J Obes.* 2010;2010:1–8, <http://dx.doi.org/10.1155/2010/868573>.

3. Institute for Public Health. National health and morbidity survey 2015, Vol 2: non-communicable diseases, risk factors & other health problems [Internet]. Kuala Lumpur: National Institutes of Health, Ministry of Health Malaysia; 2015. Available from: <http://iku.moh.gov.my/images/IKU/Document/REPORT/nhmsreport2015vol2.pdf> [cited].

4. Chan YY, Lim KK, Lim KH, Teh CH, Kee CC, Cheong SM, et al. Physical activity and overweight/obesity among Malaysian adults: findings from the 2015 National Health and morbidity survey (NHMS). *BMC Public Health.* 2017;17:733, <http://dx.doi.org/10.1186/s12889-017-4772-z>.

5. Gómez-Cabello A, Pedrero-Chamizo R, Olivares PR, Hernández-Perera R, Rodríguez-Marroyo JA, Mata E, et al. Sitting time increases the overweight and obesity risk independently of walking time in elderly people from Spain. *Maturitas.* 2012;73:337–43, <http://dx.doi.org/10.1016/j.maturitas.2012.09.001>.

6. Zimmermann E, Anty R, Tordjman J, Verrijken A, Gual P, Tran A, et al. C-reactive protein levels in relation to various features of non-alcoholic fatty liver disease among obese patients. *J Hepatol.* 2011;55:660–5, <http://dx.doi.org/10.1016/j.jhep.2010.12.017>.

7. Saltiel AR, Olefsky JM. Inflammatory mechanisms linking obesity and metabolic disease. *J Clin Invest.* 2017;127:1–4, <http://dx.doi.org/10.1172/JCI92035>.

8. Choi J, Joseph L, Pilote L. Obesity and c-reactive protein in various populations: a systematic review and meta-analysis. *Obes Rev.* 2013;14:232–44, <http://dx.doi.org/10.1111/obr.12003>.

9. Alley S, Wellens P, Schoeppe S, de Vries H, Rebar AL, Short CE, et al. Impact of increasing social media use on sitting time and body mass index. *Health Promot J Austr.* 2017;28:91–5, <http://dx.doi.org/10.1071/HE16026>.

10. Bauman A, Bull F, Chey T, Craig CL, Ainsworth BE, Sallis JF, et al. The international prevalence study on physical activity: results from 20 countries. *Int J Behav Nutr Phys Act.* 2009;6:21, <http://dx.doi.org/10.1186/1479-5868-6-21>.

11. Rhodes RE, Mark RS, Temmel CP. Adult sedentary behavior: a systematic review. *Am J Prev Med.* 2012;42:e3–28, <http://dx.doi.org/10.1016/j.amepre.2011.10.020>.

12. Cheong SM, Kandiah M, Chinnna K, Chan YM, Abu Saad H. Prevalence of obesity and factors associated with it in a work-site setting in Malaysia. *J Commun Health.* 2010;35:698–705, <http://dx.doi.org/10.1007/s10900-010-9274-1>.

13. Chau JY, Grunseit AC, Chey T, Stamatakis E, Brown WJ, Matthews CE, et al. Daily sitting time and all-cause mortality: a meta-analysis. *PLOS ONE.* 2013;8:e80000, <http://dx.doi.org/10.1371/journal.pone.0080000>.

14. Martín AR, Nieto JMM, Ruiz JPN, Jiménez LE. Overweight and obesity: the role of education, employment and income in Spanish adults. *Appetite.* 2008;51:266–72, <http://dx.doi.org/10.1016/j.appet.2008.02.021>.

15. Al-Qalah SAAJ, Ghazi HF, Md Isa Z, Karim NA. Weight loss practice using physical activity among working women in Klang Valley, Malaysia. *Malays J Public Health Med.* 2014;14:81–7.

16. Daud A, Shahadan SZ, Ibrahim M, Md Isa ML, Derman S. Prevalence and association between triglyceride level and lifestyle factors among Malay obese class I and II adults. *Enferm Clin.* 2018;28 Suppl. 1:50–5, [http://dx.doi.org/10.1016/S1130-8621\(18\)30176-1](http://dx.doi.org/10.1016/S1130-8621(18)30176-1).

17. Petersen CB, Bauman A, Grønbaek M, Helge JW, Thygesen LC, Tolstrup JS. Total sitting time and risk of myocardial infarction, coronary heart disease and all-cause mortality in a prospective cohort of Danish adults. *Int J Behav Nutr Phys Act.* 2014;11:13, <http://dx.doi.org/10.1186/1479-5868-11-13>.