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Prevalence and associated factors of cardio-metabolic risk factors in Iranian seafarers

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ABSTRACT

Background: *Since Iran's economy is based on the sale of petroleum products, seafaring is considered a crucial job. Little research has been done on issues related to seafarers' health in Iranian maritime industry. The present study investigated the prevalence and associated factors of cardio-metabolic risk factors in seafarers of National Iranian Tanker Company (NITC).*

Materials and methods: *A cross-sectional study was performed on 234 Iranian male seafarers of NITC in 2015. Metabolic syndrome (MetS) was diagnosed according to the reports of National Committee of Obesity. Three main blood parameters (of elevated total cholesterol, elevated low-density lipoprotein cholesterol, and elevated very low-density lipoprotein cholesterol) and general obesity were included as additional cardio-metabolic risk factors.*

Results: *The mean age of the participants was 36.0 ± 10.3 years. The prevalence of MetS was 14.9%. The common cardio-metabolic risk factors were excess weight (51.1%), abdominal obesity (38.5%), and smoking (27.8%) among Iranian seafarers. In multivariate analysis, age (OR: 1.05, 95% CI: 1.01–1.09) and body mass index (OR: 1.14, 95% CI: 1.01–1.27) were associated with the increase in hypertension risk.*

Conclusions: *Our finding showed that the current prevalence of MetS among Iranian male seafarers working on tankers can affect negatively their health and career at sea.*

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Key words: metabolic syndrome, seafarer, cardiovascular, prevalence

INTRODUCTION

Metabolic syndrome (MetS) presents a group of metabolic disorders including insulin resistance, central obesity, dyslipidaemia, glucose intolerance, and hypertension [1]. MetS is diagnosed according to the recommendations of National Committee of Obesity [2]. Several studies have showed that MetS is associated with increased risk of diabetes type 2, cardiovascular diseases, and the mortality rate of cardiovascular diseases by 6, 5 and 2 times, respectively [1, 3]. Globally, the prevalence of MetS has increased in the past 20 years [1]. Based on published studies, the prevalence of MetS in developing countries ranges from 13% in China to 30% in Iran [4]. Also, the prevalence of MetS was 25.9% among male Danish seafarers [5]. Recent studies suggest that nutritional factors, shift work, sleep patterns [6], work stress [7], and fatigue [8] may play a critical role in the increase in MetS risk. Recently, few studies have assessed the prevalence of cardio-metabolic and associated

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risk factors among seafarers [5, 9, 10]. The study which was conducted among German seafarers showed that the prevalence of high blood pressure and high triglycerides were 49.7% and 41.6%, respectively [9]. Other studies have also suggested that the majority of seafarers' death is related to cardiovascular diseases, which was from 27 to 45 per 100,000 [11].

Since Iran's economy is based on the sale of petroleum products, seafaring is considered a crucial job. Little research has been done on issues related to seafarers' health in Iranian maritime industry. Hence, the present study was set to assess the prevalence of cardio-metabolic and associated factors in Iranian male seafarers working in National Iranian Tanker Company (NITC).

MATERIALS AND METHODS

A cross-sectional study was performed on 234 Iranian male seafarers of NITC who referred to Health Unit of the company for their annual health examination from the beginning of April 2015 until the end of September 2015. All seafarers with complete demographic data and with at least 6 months of sea service were included in the study. The health examination data encompassed seafarers' age, height, weight, waist circumference, lipid profile, fasting blood sugar, systolic, and diastolic blood pressure (BP). After complete description of the study to the seafarers, informed consents were filled out by all participants.

MEASUREMENT

Weight, height, and BP of the participants were measured by a trained physician of Health Unit of NITC. Participants removed their shoes and wore light clothing for anthropometric measurements. Weight was measured using an electronic scale (Seca, 707; range 0.1–150 kg), and height was measured using a tape meter stadio-meter according to standard protocols [12]. Waist circumference (WC) was measured at umbilicus level with 1 mm accuracy. Body mass index (BMI) was then calculated (BMI = W/H^2 in which 'W' is weight in kilograms and 'H' is height in meters). Systolic and diastolic BP were measured twice and averaged, while participants were in a seated position after 15 min rest using a standard mercury sphygmomanometer calibrated by the Iranian Institute of Standards and Industrial Research.

Fasting blood sugar, serum levels of triglyceride (TG), total cholesterol (TC), and high-density lipoprotein cholesterol (HDL-C) were tested using the relevant kits obtained from the Pars Azmoon Company, Iran, by an automatic analytical machine after 12–14 h fasting (BT3000, Italy). Serum levels of low-density lipoprotein cholesterol (LDL-C) were determined according to the Friedewald formula: LDL-C = TC – (HDL-C + VLDL-C), where VLDL-C is very low-density lipoprotein cholesterol [13]. Atherogenic index (AI) was calculated by the following formula: (TC – HDL-C) / HDL-C [14]; LDL-C / HDL-C ratio was calculated as the ratio of plasma LDL-C to HDL-C levels.

Metabolic syndrome was diagnosed according to the recommendations of National Committee of Obesity [2]. Seafarers who had at least three of the following criteria were classified as patients with MetS: WC > 95 cm, TG > 150 mg/dL, HDL-C < 40 mg/dL, systolic BP > 130 mm Hg and/ or diastolic BP > 85 mm Hg, and fasting blood glucose > 100 mg/dL.

Three main parameters of high TC, high LDL-C, and general obesity were included in this study as other cardio metabolic risk factors. High TC and LDL were defined as TC ≥ 200 mg/dL and LDL ≥ 130 mg/dL, respectively. General obesity was considered BMI ≥ 30 kg/m^2. Abdominal obesity was defined as waist circumference > 95 cm for men and excessive weight was defined as BMI > 25 kg/m^2.

STATISTICAL ANALYSIS

The data were analysed by the Statistical Package for the Social Sciences software, version 16 (SPSS Inc., Chicago, IL, USA). Categorical variables were reported in numbers (n) and per cent (%). Continuous variables were presented in mean and standard deviation (SD). The t-test was used to compare continuous variables and $\chi 2$ to compare categorical variables. Association of independent variables and MetS components was assessed using linear regression model. The significant level was set at $p < 0.05$.

RESULTS

The mean age of the participants was 36.0 ± 10.3 years, and 163 (69.7%) and 92 (39.3%) of the participants had academic degree, and their job history were more than 10 years. Respectively, 70.1%, and 27.8% of seafarers had shift work, and were smokers. Participants with MetS were older than those without MetS (44.1 ± 10.9 years vs. 34.6 ± 9.5 years). The mean weight (87.5 ± 10.6 kg) and BMI (27.9 ± 2.7 kg/m^2) were significantly higher among people with MetS compared with those without MetS (78.1 ± 11.2 kg and 24.8 ± 3.1 kg/m^2, respectively). A significant difference was observed in WC between seafarers with MetS and without MetS (< 0.001). Systolic and diastolic BP mean values in MetS group were 128.8 ± ± 16.8 mm Hg and 81.9 ± 8.0 mm Hg, respectively, and higher than in participants without MetS (< 0.05). In the seafarers with MetS, the TG mean, TC, and HDL-C were higher than in seafarers without MetS. Also, the LDL/HDL mean, TC/HDL, and VLDL in MetS group were higher than in seafarers without MetS (Table 1).

Totally, 8.6% and 38.5% of the participants were obese and had abdominal obesity. The rates of high systolic and

Table 1. Description of some quantitative characteristics of metabolic syndrome and non-metabolic syndrome groups

	Metabolic syndrome		Total (n = 234)	P
	Yes (n = 35)	No (n = 199)		
Age [years]	44.1 ± 10.9	34.6 ± 9.5	36.0 ± 10.3	< 0.001
Height [cm]	176.9 ± 8.3	177.2 ± 6.2	177.2 ± 6.6	NS
Weight [kg]	87.5 ± 10.6	78.1 ± 11.2	79.5 ± 11.6	< 0.001
Body mass index [kg/m^2]	27.9 ± 2.7	24.8 ± 3.1	25.3 ± 3.2	< 0.001
Waist circumference [cm]	97.6 ± 9.1	89.8 ± 10.3	90.9 ± 10.5	< 0.001
Systolic BP [mm Hg]	128.8 ± 16.8	121.6 ± 11.6	122.6 ± 12.7	< 0.05
Diastolic BP [mm Hg]	81.9 ± 8.0	77.4 ± 8.4	78.1 ± 8.5	< 0.05
Fasting blood glucose [mg/dL]	109.0 ± 25.5	92.9±16.2	95.3±18.7	NS
Triglyceride [mg/dL]	226.3 ± 72.5	108.8 ± 55.1	126.4 ± 71.5	< 0.001
Cholesterol [mg/dL]	198.8 ± 39.7	177.3 ± 41.2	180.5 ± 41.6	< 0.001
HDL-C [mg/dL]	41.8 ± 8.8	46.8 ± 10.1	46.0 ± 10.0	< 0.05
LDL-C [mg/dL]	110.7 ± 36.8	108.9 ± 32.1	109.2 ± 32.7	NS
LDL/HDL	2.6 ± 0.7	2.3 ± 0.6	2.4 ± 0.6	< 0.05
Total cholesterol/HDL	4.8 ± 0.9	3.8 ± 0.8	3.9 ± 0.8	< 0.001
VLDL	45.3 ± 15.6	21.7 ± 11.0	25.2 ± 14.4	< 0.001

*T-test; BP — blood pressure; HDL-C — high-density lipoprotein cholesterol; LDL-C — low-density lipoprotein cholesterol; VLDL-C — very low-density lipoprotein cholesterol

diastolic BP, and hypertension were 34.3%, 31.4%, and 60.0% in seafarers with MetS, respectively. The per cent of diabetes, high TG, TC, and low HDL were 23.1%, 25.2%, 28.2%, and 26.5%, respectively (Table 2). The prevalence of MetS was 14.9% among Iranian seafarers (Fig. 1).

About 10% of seafarers had three MetS components. Totally, 4.6% of the participants had 4 and 5 MetS components (Fig. 2).

Multivariate logistic regressions are presented in Table 3. In multivariate analysis, BMI is associated with increase in abdominal obesity (OR: 1.40, 95% CI: 1.25–1.57), high TC (OR: 1.19, 95% CI: 1.02–1.23), hypertension (OR: 1.14, 95% CI: 1.01–1.27), and MetS (OR: 1.32, 95% CI: 1.15–1.51). Older age was associated with increase in obesity, high TG, hypertension, and MetS, i.e. the odds ratio per year of age was 1.07 for obesity, 1.05 for high TG, 1.05 for hypertension, and 1.07 for MetS.

The prevalence of cardio-metabolic risk factors and MetS were shown in Figure 1. The per cent of subjects with excessive weight and abdominal obesity were 51.1, and 38.5%, respectively, which were higher than other risk factors.

DISCUSSION

The findings showed that the prevalence of MetS was about 15%, and a large proportion of seafarers had abdominal obesity. A study was performed among Danish seafarers, showing that the prevalence of MetS was 25.9% and this prevalence increased with age [5]; a similar status was seen in the present study, i.e. the risk of MetS increased by increase of 1 SD in age. High prevalence of the MetS has been reported from Sub-Saharan Africa and Middle East countries; South Africa, Morocco, Oman, Turkey, and Iran showed prevalence of 33.5, 16.3, 21, 33.4, and 33.7%, respectively [15]. The prevalence of the MetS is highly age-dependent. This pattern is clear in Iran where the prevalence is less than 10% for both men and women in the 20–29 year age group, rising to 38% and 67%, respectively, in the 60–69 year age-group [16]. The observed difference between prevalence of MetS between our study and general population of Iran can be attributed to difference in age range of studied subjects. On the other hand, perhaps using various criteria for MetS definition or higher sensitivity to health in this group due to annually health examination tests could cause differences in its prevalence in different studies.

Previous studies suggest that smoking [9, 17] and job duration [17, 18] are risk factors for chronic heart diseases (CHD) among seafarers. A study performed among seafarers of abroad German-flagged ships showed that seafarers having smoking habit were at a higher CHD risk [9]. The odds ratio of cardiovascular disease for seafarers who smoked cigarettes was 2.95 in INTERHEART study [19]. Other studies also confirmed that smoking cigarettes was prevalent among seafarers [17, 20] because of work related stress and lack of leisure time facilities [17]. Similar results were observed in our study, and cigarette consumption was com-

Table 2. The qualitative characteristics of the participants according to metabolic syndrome

	Metabolic syndrome		Total (n = 234)	P
	Yes (n = 35)	No (n = 199)		
Educational level:				< 0.05*
Diploma	17 (48.6%)	54 (27.1%)	71 (30.3%)	
Academic	18 (51.4%)	145 (72.9%)	163 (69.7%)	
Job history:				< 0.001
≤ 10 year	9 (25.7%)	133 (66.8%)	142 (60.7%)	
> 10 year	26 (74.3%)	66 (33.2%)	92 (39.3%)	
Shift work:				NS
No	15 (42.9%)	55 (27.6%)	70 (29.9%)	
Yes	20 (57.1%)	144 (72.4%)	164 (70.1%)	
BMI category:				< 0.001
Normal	7 (20.0%)	107 (54.0%)	114 (48.9%)	
Overweight	20 (57.1%)	79 (39.9%)	99 (42.5%)	
Obese	8 (22.9%)	12 (6.1%)	20 (8.6%)	
Smoking status:				NS
No	22 (62.9%)	147 (73.9%)	169 (72.2%)	
Yes	13 (37.1%)	52 (26.1%)	65 (27.8%)	
Abdominal obesity	26 (74.3%)	64 (32.2%)	90 (38.5%)	< 0.001**
High systolic BP	12 (34.3%)	16 (8.0%)	28 (12.0%)	< 0.001
High diastolic BP	11 (31.4%)	15 (7.5%)	26 (11.1%)	< 0.001
Hypertension	21 (60.0%)	24 (12.1%)	45 (19.2%)	< 0.001
Diabetes	22 (62.9%)	32 (16.1%)	54 (23.1%)	< 0.001
High TG	32 (91.4%)	27 (13.6%)	59 (25.2%)	< 0.001
High TC	15 (42.9%)	51 (25.6%)	66 (28.2%)	< 0.05
Low HDL	16 (45.7%)	46 (23.1%)	62 (26.5%)	< 0.01
High LDL	10 (28.6%)	52 (26.1%)	62 (26.5%)	NS

*χ^2, **T-test; BMI — body mass index; BP — blood pressure; HDL — high-density lipoprotein cholesterol; LDL-C — low-density lipoprotein cholesterol; TC — total cholesterol; TG — triglyceride

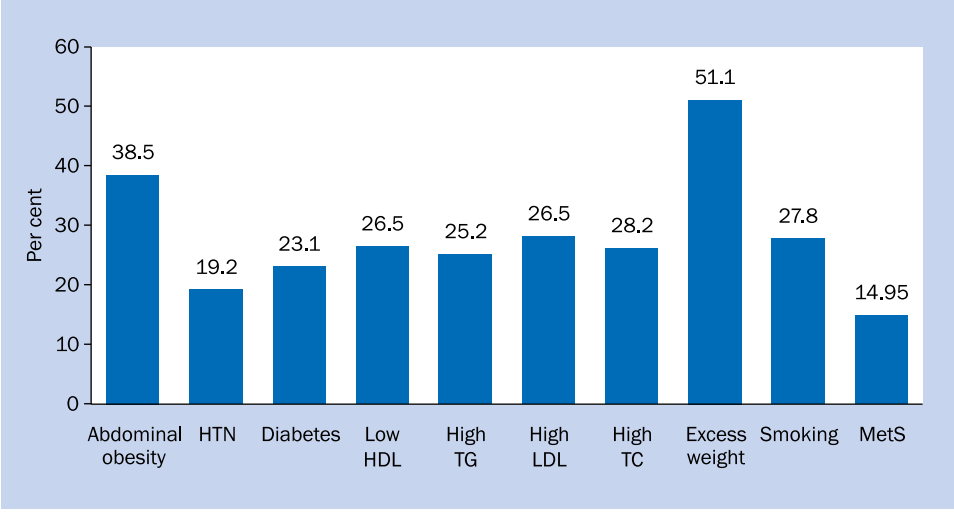

Figure 1. Prevalence of cardio-metabolic risk factors and metabolic syndrome (MetS); HDL — high-density lipoprotein cholesterol; HTN — hypertension; LDL — low-density lipoprotein cholesterol; TC — total cholesterol; TG — triglyceride

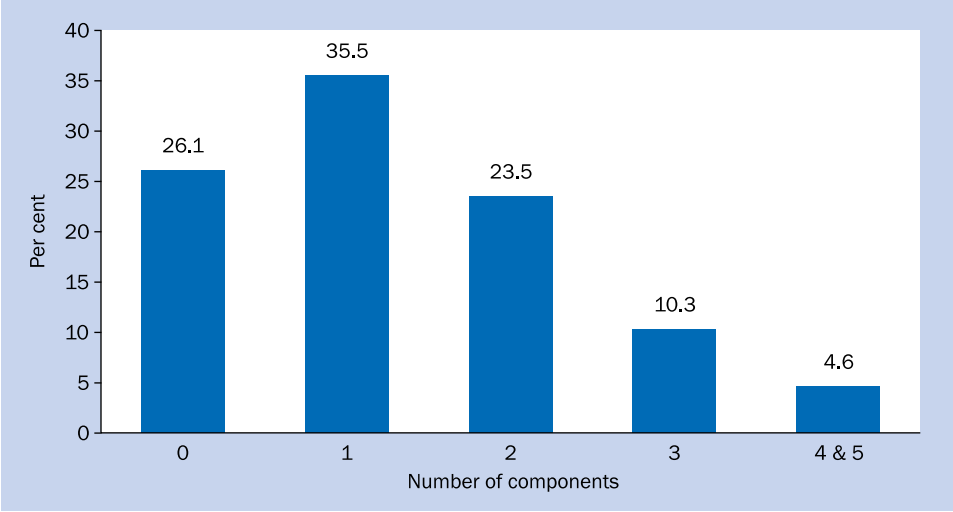

Figure 2. Prevalence of the number of metabolic syndrome components in seafarers

Table 3. Odds ratio (95% confidence interval) for association between independent variables with metabolic syndrome components in multivariable model

	Age (year)	Education (Academic/diploma)	Shift type (Yes)	Smoking (Yes/No)	BMI [kg/m^2]
Abdominal obesity	1.03 (0.995–1.06)	0.45 (0.125–1.644)	2.62 (0.733–9.37)	1.04 (0.521–2.08)	1.40 (1.25–1.57)*
Obesity	1.07 (1.02–1.13)†	2.87 (0.310–26.7)	1.015 (0.123–8.40)	0.76 (0.258–2.28)	–
High triglyceride	1.05 (1.02–1.09)‡	0.71 (0.196–2.59)	1.24 (0.352–4.41)	1.03 (0.508–2.08)	1.10 (0.999–1.22)
Low HDL	1.03 (0.996–1.06)	1.14 (0.321–4.05)	1.42 (0.412–4.88)	0.93 (0.483–1.83)	1.01 (0.920–1.11)
High LDL	0.992 (0.959–1.03)	0.86 (0.258–2.89)	0.70 (0.217–2.27)	0.77 (0.390–1.53)	1.05 (0.958–1.16)
High cholesterol	0.98 (0.957–1.02)	0.92 (0.280–3.03)	0.705 (0.221–2.24)	0.71 (0.359–1.41)	1.19 (1.02–1.23)‡
High systole	1.08 (1.03–1.12)‡	0.44 (0.08–2.36)	1.84 (0.357–9.48)	0.74 (0.282–1.95)	1.10 (0.962–1.26)
High diastole	1.01 (0.963–1.05)	0.39 (0.08–1.93)	0.84 (0.182–3.96)	1.09 (0.425–2.80)	1.16 (1.01–1.34)‡
Hypertension	1.05 (1.01–1.09)†	0.47 (0.118–1.90)	1.11 (0.283–4.33)	0.60 (0.262–1.39)	1.14 (1.01–1.27)‡
Diabetes	1.03 (0.991–1.06)	1.11 (0.307–3.98)	0.65 (0.190–2.23)	0.90 (0.448–1.84)	1.07 (0.965–1.18)
Metabolic syndrome	1.07 (1.02–1.11)†	0.62 (0.127–3.11)	1.62 (0.340–7.74)	1.51 (0.626–3.62)	1.32 (1.15–1.51)*

*p < 0.001, †p < 0.01, ‡p < 0.05; BMI — body mass index; HDL — high-density lipoprotein cholesterol; LDL — low-density lipoprotein cholesterol

mon among Iranian seafarers. Job duration at sea is one of CHD risk factors among seamen, and a previous investigation showed that seafarers who had longer job history at sea had about threefold increased risk of having coronary risk factors [17]. In our study, the prevalence of MetS was more common among seafarers with more than 10-year job history than seamen with less than 10-year job history. The results of a study among Polish seafarers presented that the mean experience of job duration at sea was 20.6 years, and because of the lack of a qualified officer, the retirement age increased and it was expected that the risk of CHD would rise during the coming years [21]. In other studies, the occurrence of MetS was associated with shift work [22, 23]. Violanti et al. (2009) [22] revealed that midnight shift work was significantly associated with MetS components, and likely the main contributors to the MetS. In the present research study, shift work was not associated with the risk of MetS among Iranian seafarers. Also, in the study of Canuto et al. [10], it was observed that shift work was not related to MetS. In the causal pathway that connects shift work to MetS, probably sleep duration is a confounder [24] which was not included in the current study and analyses. Previous studies have indicated that MetS and associated risk factors are more prevalent among seafarers compared with general population [25, 26]. Seafarers work in periods of months on Tanker followed by a few-month vacation which may contribute to different life-styles compared with other individuals [27].

In the current study, cardio-metabolic risk factors: diabetes, high TG, high TC, low HDL-C, high LDL-C, and abdominal

obesity preponderated with a frequency between 23% and 39%. High cardio-metabolic risk is confirmed in previous studies [9, 17]. Oldenburg et al. [17] showed that the rate of high triglyceridaemia (> 150 mg/dL) and high LDL-C among marines was about 41.6% and 18%, respectively. In a study in Germany on 35% of seafarers, there were at least 3 coronary heart disease risk factors, and the main risk factors were high triglycerides, hypertension, and ageing [9]. Other published data suggested that overweight was one of the main risk factors among seafarers [28], which is consistent with the current result that indicated abdominal obesity as a principal cardio-metabolic risk factor among Iranian seafarers (38.5%). Seafarers live and work differently from most of the other people and their conditions lead them to suffer from some special diseases [29]. Documentaries show that the majority of seafarers' death is related to cardiovascular disease [30]. During stays on Tanker over several months, seafarers have restricted leisure time facilities which can contribute to physical inactivity and consequently to obesity. Also, it is described that job duration, work-related stress, and reduced duration of sleep were associated with cardiovascular risk factors [30]. Moreover, as cooks employed in Tankers are not adequately trained, unhealthy eating pattern among seafarers can be accounted as a major risk factor for cardiovascular disease [29].

STUDY LIMITATIONS AND STRENGTHS

The limitation of the study is its cross-sectional design. The main strength of the study is the fact that this is, to the best of our knowledge, the first study that assessed the prevalence of cardio-metabolic and associated risk factors among Iranian seafarers working on tankers.

CONCLUSIONS

Our findings showed that the current prevalence of MetS among Iranian male seafarers working on tankers can affect negatively their health and career at sea. In this regard, more standardised identification of seafarers with elevated cardiac risk factors during the fitness test, with emphasis on obviously more prevalent ones, for controlling mentioned health problems should become a priority in Iranian maritime industry. Future preventive interventions for health promotion of seafarers, especially those working on tankers, are recommended.

AUTHORS' CONTRIBUTIONS

Dr. Olaf C Jensen and Dr. Farzad Shidfar conceived of the study and revised the manuscript. Fereshteh Baygi participated in study design and wrote a draft of the manuscript. Dr. Mostfa Qorbani conceived of the study and carried out the statistical analysis. Seyed Ali Salehi, Dr. Fatemeh Mohammadi, Dr. Aliasghar Farshad participated in its design and implementation. Hamid Asayesh edited the manuscript. All authors read and approved the final manuscript.

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ETHICAL CONSIDERATIONS

This study was proposed and approved by the Ethics-in-Research Commission of Iran University of Medical Sciences. Also, informed consent was obtained from all individual participants included in the study.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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