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ABSTRACT The aim of this paper is to assess the impact of living in Saudi Arabia on expatriate employees and their families' behavioural cardiovascular risk factors (BCVRFs), and to examine the association between changes in BCVRFs and metabolic syndrome (MetS). A cross-sectional study was conducted on 1437 individuals, aged ≥ 18 years, from King Saud University in Riyadh, Saudi Arabia. We used the World Health Organization STEPS questionnaire to ask every participant questions about BCVRFs twice: (1) to reflect their period of living in Saudi Arabia and (2) to shed light upon life in their country of origin. Their mean age was 40.9 (11.7) years. The prevalence of BCVRFs was as follows: tobacco use in 156 (11%), physical inactivity in 1049 (73%) low intake of fruit and vegetables in 1264 (88%) and MetS in

378 (26%). Residing in Saudi Arabia had reduced physical activity and intake of fruit and vegetables. There was also a significant increase in the fast food consumption. In conclusion, living in Saudi Arabia had a significant negative effect on BCVRFs. However, there was no statistically significant association between changes in fruit and vegetable intake and physical activity and MetS status, except that intake of fast food was lower among participants with MetS.

Changements concernant les habitudes alimentaires et l'activité physique, et situation du syndrome métabolique parmi les expatriés vivant en Arabie saoudite

La présente étude avait pour objectif d'évaluer l'impact de la vie en Arabie saoudite sur les employés expatriés, ainsi que les facteurs de risque cardio-vasculaire comportementaux de leurs familles, et d'examiner l'association entre les changements en termes de facteurs de risque de ce type et le syndrome métabolique. Une étude transversale a été menée auprès de 1437 individus âgés de 18 ans et plus à l'Université Roi Saoud de Riyad, en Arabie saoudite. Nous avons utilisé le questionnaire STEPS de l'Organisation mondiale de la Santé afin d'interroger chaque participant à deux reprises au sujet des facteurs de risque cardio-vasculaire comportementaux afin de refléter leurs comportements durant leur séjour en Arabie saoudite et d'apporter un éclairage sur leur habitudes de vie dans leur pays d'origine. L'âge moyen était 40,9 ans (ET 11,7). La prévalence des facteurs de risque cardio-vasculaire comportementaux était la suivante : tabagisme pour 156 individus (11 %), sédentarité pour 1049 (73 %), faible consommation de fruits et légumes pour 1264 d'entre eux (88 %) et présence de syndrome métabolique chez 378 des participants (26 %). Le fait de résider en Arabie saoudite avait réduit l'activité physique et la consommation de fruits et légumes. On observait également une augmentation significative de la consommation de fast food. Le fait de vivre en Arabie saoudite avait un impact négatif significatif sur les facteurs de risque cardio-vasculaire comportementaux. Néanmoins, il n'y avait pas d'association statistiquement significative entre les changements dans la consommation de fruits et légumes, l'activité physique et le syndrome métabolique, excepté que la consommation de fruits et légumes était plus faible chez les participants porteurs de syndrome métabolique.

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Introduction

The Gulf Cooperation Council (GCC) countries, which came into existence in 1981, include Bahrain, Saudi Arabia, Kuwait, Oman, Qatar and the United Arab Emirates (1). Following oil discovery in the Gulf region during the 1950s, these countries including Saudi Arabia lacked human resources, particularly in health professions. They have therefore attracted professionals from all over the world seeking opportunities for employment and a better standard of living (2). For this reason, the Saudi Arabian population profile has changed and, like other GCC countries, enjoys a wide variety of expatriates from diverse ethnic backgrounds.

The Annual Statistical Report from the Saudi Ministry of Health indicates that 33% of the total inhabitants (30 770 375) in 2014 were expatriates. In Riyadh, where the present study took place, the expatriates represented 38% of the total population (3). Also, an official statistical report form King Saud University (KSU) showed that expatriates constituted 23% of the total university employees.

The policies of most host countries, including the GCC, require all expatriates to undergo medical screening, and people who have health issues are usually denied entry (4). Overall, new expatriates have good health status, however, it is perceived that the health of expatriates progressively deteriorates with their duration of stay in a new host country. Such deterioration may be attributed to cultural differences, psychosocial and socioeconomic changes, as well as lifestyle changes (including dietary habits and physical activity) with migration, which may have negative impacts on health (5).

Worldwide, 6% (3.2 million) of deaths each year are attributed to physical inactivity, where physical inactivity is considered to be the fourth most frequent cause of adult death (6). In wealthy GCC countries, particularly in Saudi Arabia, rapid socioeconomic transition and vast urbanization have led to a predominantly sedentary lifestyle among the population. Consequently, physical inactivity has become a major public health concern in this region as well as in some other countries. Prevalence of physical inactivity varies among the countries of the Eastern Mediterranean, with the highest level in Saudi Arabia (96%) and the lowest in the Syrian Arab Republic (31%) (7).

Globally, 2.8% (1.7 million) of deaths are attributable to low consumption of fruit and vegetables (8). However, the worldwide consumption of fruit and vegetables is still below the recommended intake of ≥ 5 five servings per day (9). Likewise, in Saudi Arabia, a recent report shows that only 3% of the population consumed the recommended daily portions of fruit and vegetables (10).

Substantial evidence worldwide demonstrates the phenomenon of acculturation, which has been simply defined as the gradual adoption of the host country's cultural patterns, including attitudes, values, customs, beliefs and behaviours by the migrants (11, 12). Furthermore, one of the well-established migration effects is dietary acculturation, where the minority groups adopt the dietary practice of their host countries (12). In addition, acculturation influences the physical activity of migrants (13).

The present study estimated the prevalence of behavioural cardiovascular risk factors (BCVRFs), including unhealthy diet and physical inactivity, among expatriate employees and their families at KSU, to assess the possible impact of living in Saudi Arabia on expatriates' BCVRFs, and the association between the changes in BCVRFs and metabolic syndrome (MetS).

Methods

Study design

This was a cross-sectional study conducted on KSU employees and their families over 9 months from 8 July, 2013 to 30 April, 2014. The current investigation was a substudy of a larger study (n= 4500 subjects) and focused only on non-Saudi employees and their families (n=1437). The details of the larger study and participants' recruitment procedure are described elsewhere (14).

We used a modified version of the World Health Organization (WHO) STEPS questionnaire (15), version 2.1 (both Arabic and English forms). This questionnaire uses sequential steps, starting with a questionnaire (Step I), followed by physical measurements (Step II) and biochemical measurements (Step III).

All participants personally reported their sociodemographic information, such as age, sex, country of origin, marital status, educational level, job title, and length of residence in Saudi Arabia. Body weight and height and waist and hip circumferences were measured for all participants, as described previously (14). Questions about lifestyle behaviour, including diet, physical activity and tobacco use, were asked twice: (1) to describe their current behaviour and

(2) to report their behavioural habits before moving to Saudi Arabia. The biochemical measurements in this study included: glycosylated haemoglobin (HbA1C), high-density lipoprotein–cholesterol (HDL-C), low-density lipoprotein–cholesterol (LDL-C), total cholesterol (TC) and triglyceride (TG). Participants were instructed to fast for ≥ 12 hours before they were subjected to blood testing.

MetS

Using the National Cholesterol Education Programme classification (16,17), participants were identified as having MetS if they had ≥ 3 of the following 5 factors: (1) abdominal obesity measured by waist circumference; participants were considered to have abdominal obesity if waist circumference was ≥ 102 cm for men and ≥ 88 cm for women; (2) raised triglyceride ≥ 1.7 mmol/l ; (3) reduced HDL, ≤ 1.03 mmol/l for men and ≤ 1.29 mmol/l for women; (4) raised fasting plasma glucose (≥ 5.6 mmol/l) or under treatment for and/or previously diagnosed with diabetes; and (5) hypertension (systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg or under treatment for hypertension).

Statistical analysis

Categorical data were summarized as absolute numbers and percentages. Numerical data were summarized with means and standard deviations (SDs). Categorical variables were compared using the $\chi 2$ test or Fisher's exact test, and continuous variables were compared using independent sample t test or Mann–Whitney U test. To compare the dietary habits and physical activity patterns of participants before and after residing in Saudi Arabia, we used a paired sample t test. To study the association of duration of stay, gender and MetS with changes of dietary habits and physical activity patterns, a calculation was done using the mean difference, and a comparison between different groups was conducted using an independent sample t test or Mann–Whitney U test. For testing the marginal homogeneity between tobacco use before and after residing in Saudi Arabia, the McNemar test was used, and the results presented as text.

All analyses were performed using SAS/STAT version 9.2 (SAS Institute Inc., Cary, NC, USA). A 2-sided P value **Ethical standards**

This study was conducted according to the principles expressed in the Declaration of Helsinki. Furthermore, it was reviewed and approved by the Institutional Review Board of KSU, College of Medicine; approval letter number is 13-372. In addition, written informed consent was obtained from each participant prior to participation in the study.

Results

Sociodemographic characteristics of the studied population

There were 1437 expatriates in our study; 1091 (75.9%) were non-Saudi Arabs, 37 (2.57%) were from different nationalities, and 309 (21.5%) were South Asians. The mean age of participants was 40.9 (SD 11.7) years, and more details about sociodemographic characteristics are shown in Table 1 .

Prevalence of BCVRFs

One hundred and fifty-six (11%) of the participants were current tobacco users; 1049 (73%) were physically inactive; and women were more physically inactive than men were (Table 1). Moreover, 1264 (88%) of the participants were reported to have low intake of fruit and vegetables and women had a significantly higher rate of low fruit and vegetable consumption compared to men (P

Effect of living in Saudi Arabia on BCVRFs

Tobacco use

There was a low rate of current daily tobacco use (n = 156; 11%). The prevalence before and after residing in Saudi Arabia (using McNemar test) was 16% (n = 134) and 15.4% (n = 129) for men and 2.8% (n = 17) and 3.1% (n = 18) for women, respectively. Although this indicates that living in Saudi Arabia had a small effect on the pattern of tobacco use (higher in men and lower in women), the changes were not statistically significant.

Dietary intake

Table 2 presents the mean and SD of number of days of eating fruit and vegetables, as well as the number of servings per day before and after residing in Saudi Arabia. There were significant differences in both measures before and after coming to live in Saudi Arabia (P 5 years in Saudi Arabia compared to their counterparts (P Table 3). In contrast, the consumption of fast food increased significantly almost threefold during living in Saudi Arabia (P
Table 2
). This increased consumption was significantly higher among men than women (P
Table 3
).

Physical activity

Physical activity patterns in all domains, such as travel to work, traveling to/from places or recreational activities were affected negatively by living in Saudi Arabia. Thus, the number of

days and duration of physical activity were decreased noticeably during residence in Saudi Arabia (Table 2). This decrease was significantly higher in the first 5 years of living in Saudi Arabia than in later years for both domains of physical activity (work and sport), whereas not statistically significant changes were reported between the lengths of stay and type of traveling (Table 4). A significant reduction in physical activity in both work and recreational domains was higher in men than in women.

Association between food consumption and MetS

The intake of fruit and vegetables remained low in both groups, with or without MetS, and there was no association between MetS and low intake of fruit and vegetables. However, consumption of fast food was significantly lower among people with MetS (P = 0.001) (Table 3) . Furthermore, MetS was not associated with physical activity pattern changes in all domains.

Discussion

Our findings indicate that non-Saudi participants demonstrated significant negative effects on BCVRFs after their arrival in Saudi Arabia; namely, high rate of physical inactivity, high consumption of fast food and low consumption of fruit and vegetables.

The expatriates' low consumption of fruit and vegetables is comparable with the Saudi participants in the larger study (14), as well as country-wide population findings (18), and agrees with other studies worldwide (19).

Also noteworthy, in recent decades, GCC nations have been influenced by a global trend towards high consumption of fast food, which is thought to have the following attributes: fast food is often quick, delicious, appealing to all age groups and affordable to all socioeconomic classes (20). Moreover, within Saudi Arabia, fast food is generally available and easily accessible throughout the year through a wide variety of global fast food chains, especially in food courts of modern shopping malls (21). This could also explain our reported significant increase in fast food intake by expatriates during their residence in Saudi Arabia, which resembles that in the larger study (14) and the findings of prior Saudi and GCC studies (22, 23). Moreover, previous studies have indicated that men consume more fast food than women do (24,□25), which is in accordance with the findings of our study. One reason for this could be the greater number of social activities for men (26).

Substantial evidence worldwide supports the results of the present study concerning the

changes in dietary pattern among expatriates living in Saudi Arabia. This transition in nutritional habits and consumption is usually associated with dietary acculturation when the migrants adopt the dietary practices of the host country (11,□12,□27).

Saudi Arabia, like other GCC countries, has witnessed vast change in wealth and subsequent urbanization over the past few decades. This led to a sedentary lifestyle, in part due to increased use of motorized commuting, as well as changes to the nature of the work environment and facilities that require less physical activity (28). A significant decline was observed in the physical activity of expatriate employees and their families in this study during their residence in Saudi Arabia. Such changes were more marked during the first 5 years of residence. Moreover, these results are in line with findings from other Saudi and regional studies (18, 28, 29).

The significant changes in physical activity levels were reported by male participants, which indicates that expatriate men were more physically active than women in their homeland (30). Nevertheless, overall women from the larger study (14) as well as expatriate women in this study all reported higher rates of physical inactivity compared to men, and this finding is strongly consistent with previous reports from Saudi Arabia and the region (18, 28, 29). Reasons behind this phenomenon among women could be due to the prevailing conservative social norms and restrictions on outdoor exercise for women in Saudi Arabia. Another possible contributing factor to such high rates of physical inactivity among all participants after living in Saudi Arabia is the hot arid climate in the Gulf Region, which is present for a substantial part of the year and restricts outdoor activities (31). In addition, Saudi Arabia has a scarcity of sidewalks, parks and facilities, which is not conducive for walking and sporting activities (32).

We observed that there was no association between the negative changes in physical activity pattern or consumption of fruit and vegetables and MetS status. However, there was an inverse correlation between fast food intake and MetS status. The only explanation is that participants with MetS were more aware of the negative effects of fast food on their health, hence participants with MetS reported less consumption (33).

This study is one of the few to explore the possible effects of living in Saudi Arabia on BCVRFs of expatriate employees and their families. It represents a comprehensive survey of BCVRFs using a standardized WHO STEPwise approach; furthermore, data were collected by well-trained research assistants under close supervision.

Nevertheless, the limitations of this study include the following. First, the answers to questions about behavioural risk factors, such as dietary habits, physical inactivity and tobacco use were self-reported. In addition, relying on memories about past behaviour could have led to over- or under-reporting. Second, the results cannot be generalized to the entire expatriate population in Saudi Arabia as the sample was not randomly selected. Finally, due to its cross-sectional design, the study does not allow us to assess whether MetS was prevalent or not before entering Saudi Arabia.

Despite the above limitations, this was a comprehensive survey and the findings are expected to inform public health policy and practice, to take further steps towards best interventions for changing adverse behavioural patterns in KSU, including among the expatriate population.

Conclusions and recommendations

Our study indicated a high prevalence of BCVRFs among the study population. Non-Saudi participants showed a higher rate of physical inactivity, higher consumption of fast food and lower consumption of fruit and vegetables after their arrival in Saudi Arabia. Living in Saudi Arabia had a different impact on gender. Among women a significant reduction was reported in physical activity and intake of fruit and vegetables, while men reported greater fast food consumption. There was no association between the changes in physical activity or intake of fruit and vegetables and MetS, except that the intake of fast food was lower among participants with MetS.

Based on the findings of our study, we recommend building an effective public health strategy to prevent cardiovascular events, and to improve cardiovascular wellness among the university staff and their dependents. This should be done through the following. (1) A behavioural intervention programme focusing on promoting and sustaining a healthy diet and active lifestyle at the university level could prevent and reduce the burden of diet-related diseases. (2) Such a high rate of behavioural risk factors is enough to justify both population- and high-risk-based public health intervention programmes and health promotion activities to prevent further increases, and to manage future cardiovascular disease burden at both university and national levels.

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