Relation of Sedentary Lifestyle with Cardiovascular Parameters in Primary Care Patients

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Abstract

Physical inactivity contributes to all-cause mortality and higher hospitalization risk. The present study aimed to estimate relation between sedentary lifestyle and cardiovascular parameters. A cross-sectional study was conducted on the retired defense personnel to relate socio-demographic variables, body mass index, dietary habits, alcohol, sleep, stress, dysglycaemia, hypertension and dyslipidemia with sedentary behaviour. Total prevalence of sedentary behaviour was 62.40%, which increases with age. Insomnia, stress, low education, unemployment, and upper social class were associated with sedentary behavior. A statistical inverse association of alcohol and sedentary behaviour was reported. Higher prevalence of metabolic syndrome, hypertension and obesity was observed in sedentary than active subjects. Rising sedentary lifestyles and its association with metabolic syndrome prompt to develop strategies of proper city designs with sidewalks, personal motivation, climbing stairs, doing household work, use of standing desks and break-prompting software at work place to discourage this behaviour.

Keywords — Age, metabolic syndrome, sedentary behavior, stress.

Cite this article as: Kaur J. and Kaur M. Relation of sedentary lifestyle with cardiovascular parameters in primary care patients. JCVd 2015;3(1):284-300.

I. INTRODUCTION

Sedentary behavior refers to activities involving energy expenditure equivalent to 1.0–1.5 metabolic equivalent units, and includes <150minutes of moderate physical activity or <60minutes of vigorous physical activity per week. Operationally, sedentary behavior can be referred to as ‘sitting time’ rather than simply low levels of physical activity which involves activities such as lying down, sitting, watching television, using computer and other screen based entertainment. Studies have shown individuals can spend more than half of their waking hours in sedentary activities.

Physical inactivity is considered as the fourth leading risk factor for global mortality, which accounts for 6% global deaths; and ranks before overweight and obesity (5%), and after hypertension (13%), tobacco use (9%), and high blood glucose (6%). Sedentary lifestyle attributes to ≥2million deaths and 19million disability adjusted life year globally each year.

Physical inactivity contributes to all-cause mortality; low quality of life; higher risk of obesity, diabetes, hypertension, cardiovascular disease (CVD), osteoporosis, fractures, colon cancer, breast cancer, prostate cancer, psychiatric disorders, and an overall higher hospitalization risk. Environment plays a major role in influencing the physical activity through significant changes in the form of rapid urbanization, automobile dominance for the personal travel, introduction of labor-saving devices in the home and the workplace, surplus availability of energy dense-calorie foods, satellite TV, increased reliance on computers and telecommunication technology as well as decreased occupational-work demands. These changes have had a remarkable lifestyle transformation by reducing the daily life physical requirements and encouraging sedentary lifestyles which consequently lead to an epidemic of non communicable diseases and contributes substantially to the global burden of disease, disability and death.

Public health recommendations have evolved to reduce sedentary behavior with an emphasize on a “lifestyle” approach towards increasing physical activity through common behaviors of brisk walking, climbing stairs, doing house and yard work, and engaging in active recreational pursuits. Physical activity is a therapeutic option due to its inverse relation with CVD risks and thus often prescribed to patients as a means of improving cardiometabolic profile. However, changes in individual risk factors with physical activity tend to be modest, on the order of 5% for blood lipids, 3.5mmHg for blood pressure (BP), and 1% for hemoglobin A1c in contrast to the large 30-50% reductions in CVD risk and increased longevity seen with physical activity independent of weight or body fat loss. Other CVD risk factors particularly related to inflammation and hemostasis are further favorably modified with physical activity. The strength of the
relationship between physical activity and health outcomes persists throughout individual lives; which highlights that avoiding a sedentary lifestyle during adulthood not only prevents CVD independent of other risk factors but also substantially expands the total life expectancy and the cardiovascular disease-free life expectancy in both sexes.\textsuperscript{16} Thus, the need of orientation of those tending towards being sedentary on how to adopt healthier lifestyles is of paramount interest in public health. However, assessing the prevalence of sedentary lifestyles in the current study population is an initial process towards achieving this orientation. Hence, the present comparative study of socio-demographic variables and cardiovascular parameters of sedentary and non-sedentary subjects was designed.

II. METHODS

Design overview: This nonexperimental and cross-sectional study was undertaken to determine the relationship between self-graded physical activity and the cardiometabolic parameters in a community-based Ex-Servicemen registered with Ex-Servicemen Contributory Health Scheme (ECHS) Polyclinic, Sultanpur Lodhi, Kapurthala, Punjab (India). The study population was representative of the primary care attendees in the primary care clinic of the Northern India which provides free at-the-point-of-access medical and follow up services for all kind of acute and chronic diseases solely to the registered retired defence personnel under health scheme. The selection criteria for the study subjects was the subjects who had retired from the defence services; their family members comprising spouse, children and parents; registered with ECHS Polyclinic, and had attended the polyclinic during the study period. Institutional ethical committee approval was obtained prior to the start of study and informed written consent was taken from all the subjects who attended the polyclinic from July, 2013 to Nov, 2013. Chi Square test was used for statistical analysis with a statistically significance of p value <0.05.

Physical activity assessment: The Johnson Space Centre (JSC) physical activity scale was used to assess the participant activity level over the preceding three months.\textsuperscript{17} This 8-point Likert scale consist of the following score choices:

0: Avoid physical activities whenever possible;
1: Light physical activities done occasionally;
2: Moderate physical activities done regularly for less than 1 hour per week;
3: Moderate physical activities done regularly for more than 1 hour per week;
4: Heavy physical activities done regularly for less than 30 minutes per week;
5: Heavy physical activities done regularly between 30 and 60 minutes per week;
6: Heavy physical activities done regularly between 1 and 3 hours per week; and
7: Heavy physical activities done regularly for more than 3 hours per week.

The patients were asked to select the appropriate score (0 to 7) which best described their general physical activity level. Patients who selected a score of either 0 or 1 were classified as sedentary because these activity values represent either no physical activity or an insufficient and inconsistent amount of physical activity that was far below the minimum recommendations. Those patients who selected a score of 2 or higher were classified as non-sedentary because these activity levels either approach or exceed the recommendations.\textsuperscript{18} The JSC physical activity scale has a strong independent relationship with maximal oxygen uptake in both sexes between 20-79 years of age group.\textsuperscript{17}

Survey Questionnaires: A structured in-person interview was conducted to record socio-demographic and cardiometabolic risk factors. Metabolic syndrome was defined on the basis of consensus statement for Asians Indians with three out of five variables abnormal for the diagnosis: Obesity (>25.00kg/m\textsuperscript{2}), fasting blood glucose >100mg/dl (>5.6mmol/l), hypertension ≥130/≥85mmHg, triglycerides (TGs) >150mg/dl (>1.7mmol/l) and/or High Density Lipoprotein Cholesterol(HDL-C) <40mg/dl (<1.03mmol/l) in men or <50mg/dl (<1.29mmol/l) in women. It includes those previously diagnosed with hypertension, high TGs, low HDL-C, impaired fasting glucose (IFG), impaired glucose tolerance (IGT) or diabetes mellitus and being on treatment for these disorders.\textsuperscript{19} Heavy alcohol consumption was defined by a self-reported >5 drinks on a single occasion, or a daily drinking of >1 drink per day.\textsuperscript{20} Job strain, social constraints, financial un-stability, and family distress were included subjectively under “stress” which significantly affects the daily life activities. Sleep adequacy was subjectively evaluated on the basis of sleep duration (7 to 8 hours), difficulty in initiating and maintaining sleep, and early awakenings.

Measurements: Height was determined using a wall mounted non extendable measuring tape with subjects standing in an erect barefoot position, arms by side, and feet together with 0.1cm precision. Weight measurements were taken with each subject standing at the centre of the weighing scale in light clothing with no shoes and socks with 0.5kg precision. Weight was divided on the basis of consensus statement: Normal weight (18.00-22.99kg/m\textsuperscript{2}), Overweight (23.00-24.99kg/m\textsuperscript{2}) and Obesity (>25.00kg/m\textsuperscript{2}).\textsuperscript{20} BP was measured in the right arm with the subject seated and rested for 5 minutes using a standard mercury sphygmomanometer and suitable calibrated cuff. A venous blood sample was obtained from all the pre-informed individuals after 8–10 hours of fasting to measure blood glucose using Erba glucose kit (GOD-POD method, end point), TGs with Erba triglyceride Des kit (GPO-Trinder method, end point) and HDL-C by cholesterol kit (Phosphotungstic acid method, end point).
III. RESULTS

All participants (N=351) were divided into two groups on the basis of physical activity level: sedentary (N=219; 62.40%) and non-sedentary (N=132; 37.61%). Table 1 shows sedentary and active lifestyle predominates in subjects who were younger and elder than 50years, respectively. Figure 1 further represents graphical presentation of age specific prevalence of active and sedentary lifestyle.

![Figure 1. Age-specific prevalence of active and sedentary lifestyle](image)

A statistically significant active and sedentary lifestyle was observed in men (72.72%; p<0.001) and women (64.38%; p<0.001), respectively. The study further observed subjects with low and high level of education leads a statistically significant sedentary (68.48%; p<0.001) and active lifestyle (49.23%; p<0.001), respectively. Subjects belonging to middle socioeconomic status reported physically active lifestyle (62.12%) as compared to their counterparts (39.72%). Similarly, statistically significant employed subjects were physically active (46.21%; p<0.001), and unemployed individuals leads sedentary lifestyle (81.27%; p<0.001).

Table 2 displays a statistically significant predisposition of sedentary lifestyle to obesity (56.63%; p<0.05), and active lifestyle to normal BMI range (34.10%; p<0.05). Figure 2 further shows the BMI specific prevalence of active and sedentary lifestyle.

Subjects who consume alcoholic beverages reported a statistically significant active (40.15%; p<0.001) than sedentary lifestyle (20.54%; p<0.001). Furthermore, sedentary subjects had a higher prevalence of sleep inadequacy (29.68%) than non-sedentary participants (23.48%). The prevalence of sedentary and active lifestyle was approximately the same among both vegetarians (sedentary: 60.73%; active: 59.84%) and omnivores subjects (sedentary: 39.26%; active: 40.15%), respectively. A statistically significant stress levels had predisposed the subjects to inactive (22.37%; p<0.05) than active lifestyle (12.12%; p<0.05).

Table 3 reveals sedentary lifestyle had predisposed subjects to higher prevalence of metabolic syndrome (29.68%), hypertension (47.94%), obesity (56.63%; p<0.05) than non-sedentary individuals (metabolic syndrome: 26.51%, hypertension: 43.93%, obesity: 43.8%; p<0.05). Conversely, dysglycemia (25.00%) and dyslipidemia (30.30%) was observed more frequently in non-sedentary than sedentary subjects (dysglycemia: 23.74%; dyslipidemia: 25.57%).

IV. DISCUSSION

This survey appears to be the first attempt to comprehensively analyze sedentary behavior in the study area of Northern India with the representative population sample >20 years; where sedentary lifestyle was found prevalent among 62.40% of the study population. Similarly, Varo et al. has found sedentary lifestyles ranged between 43.3% (Sweden) and 87.8% (Portugal) across European countries. However, World Health Organization has global projection for the prevalence of physical inactivity between 31% and 51% across the 14 sub-regions with a global average of 41.5%. The application of varying measures and protocols to estimate prevalence of physical activity/inactivity makes results difficult to compare and interpret, since large differences in estimates are obtained. Brownson et al. reported an ability to be physically active was influenced by personal factors (time and lack of motivation); social factors (family responsibilities, lack of role models and support from family and friends),
environmental factors (safety from crime and need to travel to exercise facilities), and policies (few workplace policies that encouraged physical activity).

Figure 2. Body mass index specific prevalence in active and sedentary lifestyle

The current study reported an increase in sedentary lifestyle as age advances (Figure 1). However, in comparison to active lifestyle (Table 1), it was more prevalent in subjects with the age range of 20-50 years than >50 years old. This can be contributed to less time available for physical exercise in subjects younger than 50 years due to involvement in jobs and/or raising and looking after their children and elderly family members. Subjects who were older than 50 years might consider physical activity as a non pharmacological approach to prevent, control and/or treat metabolic syndrome and its components. Conversely, Varo et al. 21 found active lifestyle among younger subjects and sedentary lifestyle in elder subjects. Furthermore, Milanovic et al. 24 found the age related reduction in physical activity level and functional fitness in both sexes due to the reduced muscle strength in both upper and lower limbs; and changes in body-fat percentage, flexibility, agility and endurance.

A significant sedentary lifestyle in women (64.38%; p<0.001) than men (35.61%; p<0.001) has been found consistence to Cabrera de León et al. 25 However, Vernon et al. 26 found that married women spent more time doing household activities such as food preparation, housework and primary childcare than leisure time physical activities. Moreover, Young and Voorhees 27 noticed that social and environmental factors did not significantly influence physical activity level among women. The study further found a statistically significant relation of employment with active (46.21%; p<0.001), and unemployment with sedentary lifestyle (81.27%; p<0.001) which is consistent with Ishii et al. 28 Furthermore, Van Domelen et al. 29 revealed that women with full-time sedentary jobs had less physical activity compared with unemployed women. This observation, however, is in contrast to unemployed men who are less physically active than their employed male counterparts even those employed in sedentary jobs. This shows women should increase their physical activity levels to regain their gender advantage in terms of cardiovascular risk. A statistically significant (p<0.001) positive relation between the level of education and physical activity in the present study is consistent with the data of Thornörnarísson et al. 30 Conversely, Norman et al. 31 reported that those with high education had lower total physical activity than those with elementary school. Furthermore, Shaw and Spokane 32 found that education-based disparities in physical activity widened over time during early old age and suggests the education influences health through promoting active lifestyle behaviors, which accumulate and grow over time. On the other hand, materialistic problems and a poor perceived health experienced by lower educated people additionally predicted educational differences in decreased leisure time physical activity among older individuals. 33 Sedentary lifestyle (39.72%) was more prevalent in upper social class than middle class subjects in the current study. Contrarily, Gidlow et al. 34 found higher levels of moderate-vigorous intensity physical activity in those at the top of the socio-economic strata compared with those at the bottom. Furthermore, the income gradient increases with age and more financially costly forms of physical activity are associated with larger socioeconomic positions contributing to the financial and cultural barriers which need to be overcome to reduce physical inactivity prevalence. 35

Table 2. Comparison of the lifestyle risk factors in sedentary and non sedentary subjects

<table>
<thead>
<tr>
<th>Category</th>
<th>Non sedentary</th>
<th>Sedentary</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(132)</td>
<td>(219)</td>
<td></td>
</tr>
<tr>
<td><strong>BODY MASS INDEX</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>34.10% (45)</td>
<td>22.38% (49)</td>
<td>6.21 (&lt;0.05)</td>
</tr>
<tr>
<td>Overweight</td>
<td>20.46% (27)</td>
<td>21.00% (46)</td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>45.45% (60)</td>
<td>56.63% (124)</td>
<td></td>
</tr>
<tr>
<td><strong>ALCOHOL CONSUMPTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>40.15% (53)</td>
<td>20.54% (45)</td>
<td>15.72 (&lt;0.001)</td>
</tr>
<tr>
<td>No</td>
<td>59.84% (79)</td>
<td>79.45% (174)</td>
<td></td>
</tr>
<tr>
<td><strong>SLEEP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate</td>
<td>76.51% (101)</td>
<td>70.31% (154)</td>
<td>1.58</td>
</tr>
<tr>
<td>In adequate</td>
<td>23.48% (31)</td>
<td>29.68% (65)</td>
<td></td>
</tr>
<tr>
<td><strong>DIETARY HABITS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetarian</td>
<td>59.84% (79)</td>
<td>60.73% (133)</td>
<td>0.04</td>
</tr>
<tr>
<td>Omnivores</td>
<td>40.15% (53)</td>
<td>39.26% (86)</td>
<td></td>
</tr>
<tr>
<td><strong>STRESS LEVELS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant</td>
<td>12.12% (16)</td>
<td>22.37% (49)</td>
<td>5.74</td>
</tr>
<tr>
<td>Insignificant</td>
<td>87.87% (116)</td>
<td>77.62% (170)</td>
<td>(&lt;0.05)</td>
</tr>
</tbody>
</table>

Parentheses represent absolute number of the subjects in a sample.

A significant relation (Table 2) of alcohol consumption and active lifestyle (40.15%; p<0.001) was found similar to French et al. 36 which could be contributed to people socialized drinking and further engaging themselves in frequent physical exercise to compensate for the extra calories gained through drinking or to counter-balance the negative health effects of drinking. However, studies have found no association, 37 a positive relationship, 38 or a negative correlation. 39
Table 3. Comparison of the metabolic syndrome and its components in all the study subjects

<table>
<thead>
<tr>
<th>Category</th>
<th>Non sedentary</th>
<th>Sedentary</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Health (132)</td>
<td>Disease (219)</td>
<td></td>
</tr>
<tr>
<td><strong>Metabolic syndrome</strong></td>
<td>6.49% (97)</td>
<td>26.51% (35)</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td>56.06% (74)</td>
<td>43.93% (58)</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Dysglycemia</strong></td>
<td>75.00% (99)</td>
<td>25.00% (33)</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Obesity</strong></td>
<td>54.53% (72)</td>
<td>45.45% (60)</td>
<td>4.14</td>
</tr>
<tr>
<td><strong>Dyslipidemia</strong></td>
<td>69.69% (92)</td>
<td>30.30% (40)</td>
<td>0.92</td>
</tr>
</tbody>
</table>

*Parentheses represent absolute number of the subjects in a sample.

Sedentary lifestyle had predisposed the present study subjects to sleep inadequacy (29.68%). Similarly, Reid et al.\(^{40}\) noticed that aerobic physical activity with sleep hygiene education is an effective therapeutic approach to improve mood, sleep and life quality in individuals with chronic insomnia. Conversely, Sutton et al.\(^{41}\) reported no relationship between a sedentary lifestyle and insomnia. The current study found no relation of dietary habits to sedentary behavior. Similarly, Agarwal et al.\(^{42}\) observed high sedentary lifestyle has weak association with the dietary covariates. Furthermore, Platat et al.\(^{43}\) found sedentary behaviors and physical activity were separately linked to distinct dietary habits, where physical activity appears to be associated more with healthy choices and sedentary activities with unhealthy choices. A statistically significant relation of stress and sedentary behavior was found in the present study (22.37%; p<0.05). Chronic stress have been reported with binge or comfort type eating with preferences for more palatable, higher fat and energy dense foods; reduced physical activity levels; increased sedentary behaviors and increased television viewing time.\(^{44}\)

A higher prevalence (Table 3) of metabolic syndrome (29.68%) among sedentary subjects was found similar to Edwardson et al.\(^{45}\). Similarly, a statistically significant higher prevalence of obesity (56.63%; p<0.05) among the present study sedentary subjects was found consistent to Cabrera de León et al.\(^{25}\). However, Ekelund et al.\(^{46}\) shows the physical inactivity or sedentary behavior may be a consequence rather than a cause of body-weight gain. Hypertension (47.94%) was diagnosed more frequently in sedentary than non-sedentary subjects. Similarly, Huai et al.\(^{47}\) meta-analysis suggested an inverse dose–response association between levels of recreational physical activity and hypertension risk, however noticed no significant association between occupational physical activity and hypertension. Furthermore, Santulli et al.\(^{48}\) recently highlighted that regular physical activity even among elderly subjects ameliorates β adrenergic activity which contributes to the clinical improvement of cardiovascular health.

Dyslipidemia was observed more frequently in non-sedentary (30.30%) than sedentary subjects (23.74%). Skoumas et al.\(^{49}\) depicted physically active subjects had significantly lower levels of total serum cholesterol, LDL-C, TGs, apolipoprotein B and higher levels of HDL-C and apolipoprotein A1. However, the Diabetes Prevention Program\(^{50}\) experienced improvements in all the metabolic syndrome components except plasma HDL-C concentrations, indicating that plasma HDL-C concentrations are somewhat resistant to modification through general diet and physical activity changes. Furthermore, dysglycemia (25.00%) was observed more frequently in non-sedentary than sedentary subjects (23.74%) in the present study. The Diabetes Prevention Program\(^{50}\) found that lifestyle interventions including ~150min/week of physical activity and diet-induced weight loss of 5–7% reduced the progression risk of IGT to diabetes mellitus by 58%. On the other hand, sedentary lifestyle is associated with prolonged sitting time and fewer skeletal muscle contractions which results in reduced lipoprotein lipase activity and TGs clearance, reduced oral glucose clearance load, and less glucose-stimulated insulin secretion, and further predisposes to high glucose and lipid levels.\(^{51}\)

However, a higher prevalence of dyslipidemia and dysglycemia in the present study non-sedentary subjects might have led them to live active lifestyle; however these results are not consistent with previous findings and must be further explored.

**Study Limitations:** Physical activity can be assessed subjectively using self-reported questionnaire or objectively (directly measured) using equipments such as pedometers or accelerometers. Self-reported questionnaires are commonly used in primary care centre because they are cheap and easy to use. However, both methods have drawbacks and are subjected to potential bias. Self-reported questionnaires may not be able to capture all types of physical activity, whereas certain devices may not be worn in activities such as swimming to measure physical activity.\(^{22}\) Troiano\(^{52}\) recommended using both objective and subjective measurements to validate the results for better measurements and physical activity recording. However, assessment of leisure-time physical activity has been controversial and there is still a lack of a universal measurement. The current study is based on self-reporting of the physical activity where the trend to over-report the actual level of physical activity is well known. Therefore, future longitudinal studies including multiple, repeated, precise measurements of the exposure and outcome from early age are more likely to be able to address the causality.

**V. Conclusions**

Rising distribution of sedentary lifestyles and its association with metabolic syndrome should be taken into account to identify at-risk groups and develop strategies to discourage this
behavior. Safety of the social environment and transportation; city designs with proper sidewalks; personal motivation; climbing stairs instead of using elevators; doing house and yard work; use of standing desks and break-promoting software at work place; further incorporating physical activity into the working day during transport to and from work, and during lunch and other breaks between productive work time; and elaborating weight loss associations with physical activities may make an important contribution to increase physical activity and reduce sedentary behavior.

VI. ACKNOWLEDGEMENTS
We acknowledge all the patients who gave their permission to be a part of this study and thankful to the entire staff of polyclinic for their consistent support and Ms. Manjit Kaur for her assistance in the statistical analysis.

References
[28] Ishii K, Shibata A and Oka K. Sociodemographic and anthropometric factors associated with screen-based sedentary behaviour among Japanese Adults: A