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Original article

THE YOUNGER GENERATION IS NO LESS VULNERABLE TO CARDIO-METABOLIC RISKS THAN THEIR PARENTAL GENERATION: THE ROLE OF PHYSICAL ACTIVITY LEVELS

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ABSTRACT

Background:
Change in physical activity level –a shift from traditional non-sedentary activities towards modernized sedentary lifestyle has severely affected the cardio-metabolic health of people worldwide. The change in physical activity level is more pronounced among the recent generation than their parents.
Objective:
The present study aims to compare the prevalence of metabolic syndrome (MetS) between younger and parental generations and to evaluate the influence of physical activity levels on cardio-metabolic risk among adult members of the Toto community.
Materials and Methods:
A total of 676 adults Toto (aged ≥20 years) participated in the study. Anthropometric measurements, body composition, and blood pressure were measured using standard techniques. Lipid profiles were assessed from blood samples collected after an overnight fast (~12 hours).MetS was defined using NCEP ATP-III criteria.
Results:
The younger males showed a significantly higher prevalence of MetS ($p = 0.010$) than their parental generation, due to their sedentary lifestyle. It has been observed that the prevalence of sedentary activity was significantly higher ($p < 0.001$) in the younger generation than in the parental generation.
Conclusion:
Lifestyle transitions, especially reduced physical activity, are significantly impacting the cardio-metabolic health of the younger generation. The idea that they are "no less vulnerable than their parental generation" is no longer a prediction but a reality, as reflected in the current findings.

KEY WORDS: Toto, Lifestyle, Generation, Cardio-metabolic health

1. INTRODUCTION

Cardiovascular diseases (CVD) are often referred to as silent killers due to the high mortality rates worldwide (Goldsborough et al., 2022). CVD are commonly associated with a cluster of metabolic abnormalities such as abdominal obesity, hypertension, hyperglycaemia, and dyslipidaemia, which are collectively classified as metabolic syndrome (MetS). The prevalence of MetS is continuously increasing in many developing countries, including India, primarily due to lifestyle changes. MetS increases the risk of CVD and type 2 diabetes mellitus (T2DM) by two- and five-fold, respectively (Grundy, 2007; Alberti et al., 2009).In India, recent studies have reported a high prevalence of MetS across tribal, rural, and urban populations. This increase is largely attributed to a shift from non-sedentary to sedentary lifestyles. The pooled prevalence of MetS in various regions of India was reported as follows: 27.0% in Central, 30.0% in North, 30.0% in South, 30.0% in Western, 33.0% in Eastern, and 35.0% in

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Northeast India (Krishnamurthy et al., 2020).

Among the Toto population, a statistically significant increase in obesity ($p \leq 0.01$) was observed between 2007 and 2020, primarily attributed to gradual changes in their physical activity levels and dietary habits (Das, 2022).Toto is a numerically small and genetically homogenous tribal community, residing in Toto para for over 200 years. Therefore, their genetic and physical environmental factors are similar across generations; hence, whatever changes were observed between generations were due to their changes in lifestyle. For that reason, the current study aims to compare the prevalence of MetS between younger and parental generations and to evaluate the influence of physical activity levels on cardio-metabolic risk among adult members of the Toto community.

2. MATERIALS AND METHODS

2.1. Research Design and Participants

The present cross-sectional study was conducted among the entire Toto population residing in Totopara, Alipurduar (*erstwhile* Jalpaiguri) district, West Bengal. Due to their small population size, a total enumeration sampling method was followed. A total of 676 adult participants (aged ≥20 years) were included, comprising 328 males and 348 females. Among them, 317 participants belonged to the parental generation and 359 to the younger generation. The younger generation comprised the biological children of the parental generation.

2.2. Data Collection

Data were collected between January 2023 and June 2023.Anthropometric measurements were taken using standard techniques (Lohman et al., 1988). Body mass index (BMI) and fat mass (FM) were calculated using standard equations (Das & Bose 2006). Blood pressure was measured following the method used by Das et al. (2009). After an overnight fast of approximately 12 hours, blood samples were collected to assess fasting blood glucose (FBG) and lipid profile using the Standard SD Biosensor (Korea) portable analyzer. Very low-density lipoprotein cholesterol (VLDLc) was calculated as triglycerides/5.MetS was identified using the NCEP ATP-III (2005) criteria (Grundy et al., 2005).Physical activity levels (PAL) were classified into two categories: (i) Sedentary: participants who did not perform regular exercise and were not engaged in physically demanding occupations; and (ii) Non-sedentary: participants who performed regular exercise and/or were engaged in a physically demanding occupation. This classification followed the criteria described by Mohan et al. (2005), which has been used and validated in previous studies (Das, 2022; Das, 2017).

2.3. Statistical Analyses

Data were analyzed using SPSS version 25 (IBM). Differences and associations between groups were assessed using the t-test (independent samples) and chi-square (χ^2) test. $p < 0.05$ (two-tailed)was considered statistically significant.

3. RESULTS

Participants were classified into sedentary and non-sedentary groups based on physical activity levels. Table 1 compares cardio-metabolic risk variables between the parental and younger generations among participants in the sedentary group. Among males, percent body fat (PBF) ($p = 0.001$) and systolic blood pressure (SBP) ($p = 0.009$) were significantly higher in the parental generation compared to the younger generation. In contrast,

triglycerides (TG) and very low-density lipoprotein cholesterol (VLDLc) were significantly higher ($p = 0.015$) in the younger generation. No statistically significant differences were observed for the other variables between the two generations. Among females, the mean values of body mass index (BMI), waist circumference (WC), percent body fat (PBF), fat mass (FM), systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol (TC), and low-density lipoprotein cholesterol (LDLc) were significantly higher in the parental generation ($p < 0.05$). On the other hand, TG and VLDLc were significantly higher in the younger generation ($p <0.001$). The differences in FBG and high-density lipoprotein cholesterol (HDLc) were not statistically significant between the two generations.

Table 2 compares the frequency of MetS between the parental and younger generations, based on the NCEP ATP III (2005) criteria. Participants were categorized as either having MetS or not (Non-MetS).Among males, the frequency of MetS was significantly higher in the younger generation compared to the parental generation ($p = 0.010$). The younger male participants had 1.809 times higher odds (OR) of having MetS compared to their parental counterparts. Among females, no statistically significant difference in MetS frequency was observed between the two generations ($p = 0.073$).

Figure 1 compares the prevalence of sedentary activity between the parental and younger generations. It has been observed that the prevalence of sedentary activity was significantly higher ($p <0.001$) among the younger generation, both males and females, compared to the parental generation.

Figure 2a shows the prevalence of MetS components among male participants. In the parental generation, high blood pressure (BP) (65.1%) was the most common component, followed by high FBG, low HDLc, high TG, and high WC. In contrast, among the younger generation, high FBG (74.3%) was the most common component, followed by low HDLc, high BP, high TG, and high WC. The prevalence of high FBG ($p <0.05$) and high TG ($p <0.01$) was significantly higher in the younger generation than in the parental generation.

Figure 2b presents the prevalence of MetS components among female participants. In the parental generation, high FBG (75.0%) was the most frequent component, followed by high BP, low HDLc, high TG, and high WC. Similarly, in the younger generation, high FBG (78.3%) was the most common, followed by high TG, low HDLc, high BP, and high WC. The prevalence of high TG and low HDLc was significantly higher ($p <0.05$) among the younger generation compared to the parental generation.

4. DISCUSSION

The present study aimed to compare the prevalence of MetS between the two generations among the Toto and to explore the influence of physical activity level (PAL) on cardio-metabolic health. The findings indicated a significant generational shift in the prevalence and the pattern of metabolic risk, particularly among males.

Table 1: Comparison of cardio-metabolic risk variables between two generations among the participants who fall under the category of sedentary

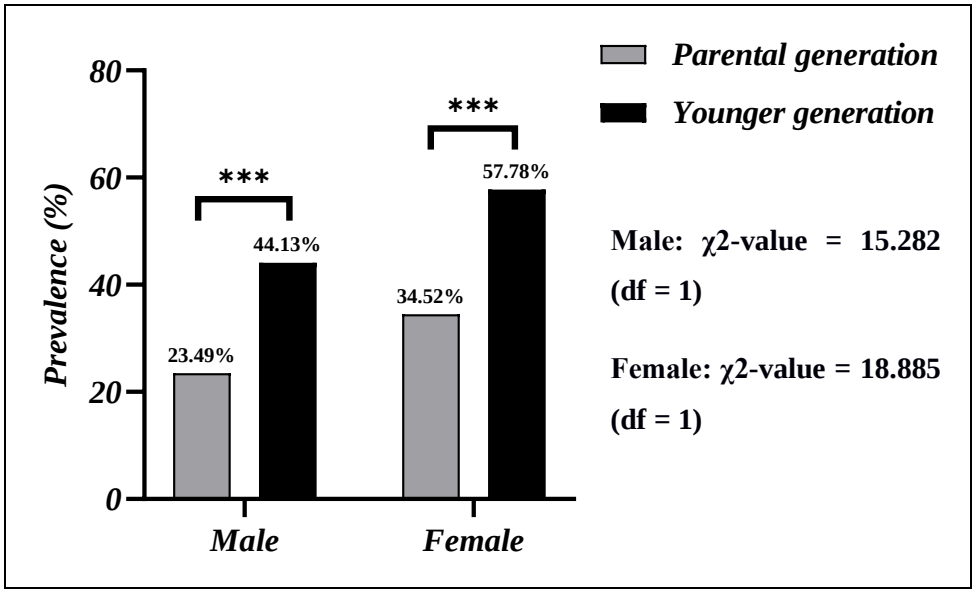
Cardio-metabolic risk variables	Male				Female			
	Parental generation Mean±SD (n = 35)	Younger generation Mean±SD (n = 79)	t value	p value	Parental generation Mean±SD (n = 58)	Younger generation Mean±SD (n = 104)	t value	p value
BMI (kg/m^2)	25.68±4.09	26.75±3.78	1.465	0.146	25.97±2.51	23.90±3.39	4.067	<0.001
WC (cm)	88.16±10.18	86.78±9.95	0.678	0.499	83.17±8.19	76.83±10.40	4.001	<0.001
PBF (%)	27.07±5.54	23.61±4.88	3.342	0.001	34.96±3.63	30.05±5.07	6.513	<0.001
FM (kg)	19.41±6.38	18.14±5.87	1.040	0.301	21.76±3.81	17.82±5.42	4.896	<0.001
SBP (mmHg)	145.11±21.08	136.14±14.20	2.664	0.009	137.81±25.18	126.35±17.63	3.389	0.001
DBP (mmHg)	90.03±13.77	85.57±12.38	1.713	0.089	86.02±12.39	81.15.12.14	2.426	0.016
FBG (mg/dL)	120.94±38.83	119.34±27.96	0.249	0.804	126.45±38.79	117.34±21.87	1.914	0.057
TC (mg/dL)	144.66±36.45	151.48±38.11	0.894	0.373	163.86±36.02	144.27±33.78	3.456	0.001
TG (mg/dL)	143.34±54.12	178.06±75.25	2.460	0.015	152.45±63.13	195.73±60.16	4.313	<0.001
HDLc (mg/dL)	38.94±17.56	38.11±14.64	0.262	0.794	43.47±17.64	47.92±13.80	1.780	0.077
LDLc (mg/dL)	70.73±29.91	76.57±29.43	0.973	0.333	76.62±23.40	67.77±21.53	2.433	0.016
VLDLc (mg/dL)	28.67±10.82	35.61±15.05	2.460	0.015	30.49±12.63	39.15±12.03	4.314	<0.001

Values are given Mean ± SD (Standard deviation), p = probability of significance

Table 2: Differences in metabolic syndrome (MetS) between two generations

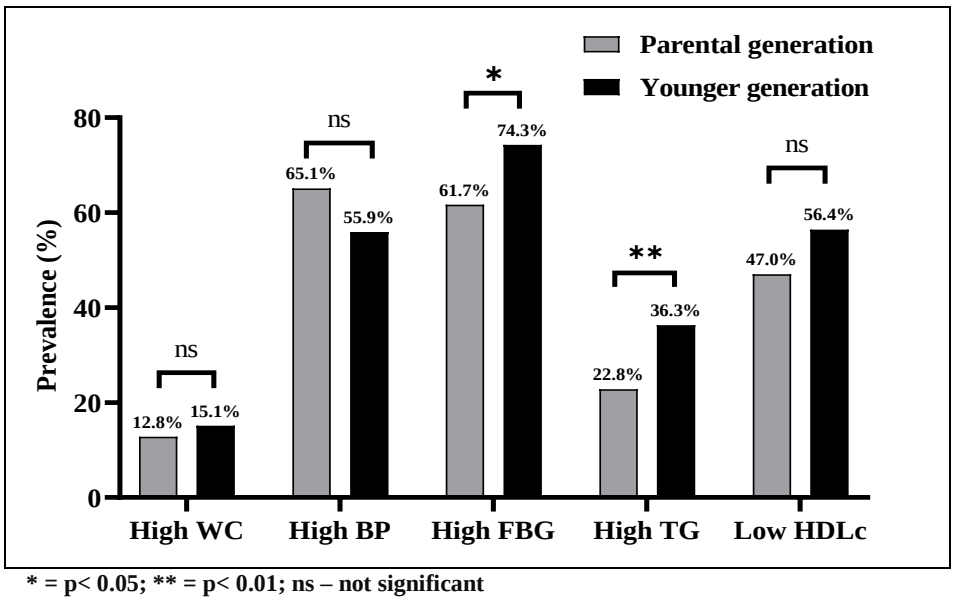
Sex	Generations	MetS n (%)	Non-MetSn (%)	Total n (%)	χ2-value	Odds Ratio (OR)
Male	**Parental**	46(30.9)	103(69.1)	149 (100.0)	6.565 (p = 0.010; df = 1)	OR: 1.809 95% CI: 1.147 to 2.854 z statistic: 2.551 p = 0.011
	Younger	80(44.7)	99(55.3)	179 (100.0)		
	Total	126	202	328		
Female	**Parental**	80(47.6)	88(52.4)	168 (100.0)	3.214 (p = 0.073; df = 1)	OR: 1.471 95% CI: 0.964 to 2.246 z statistic: 1.790 p = 0.074
	Younger	103(57.2)	77(42.8)	180 (100.0)		
	Total	183	165	348		

χ2 = chi-square, p = probability of significance, df = degree of freedom, CI = confidence interval



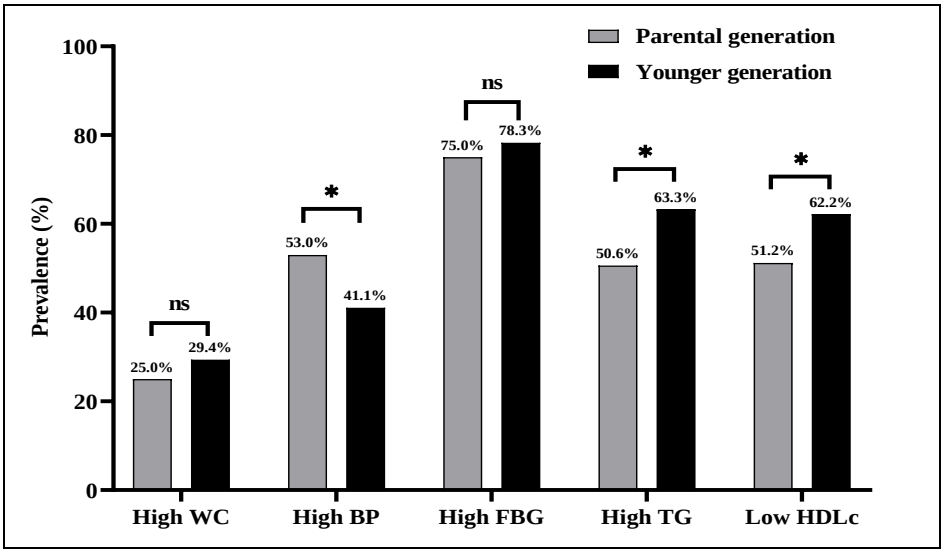
χ2 = chi-square, df = degree of freedom, *** = p < 0.001

Figure 1: Prevalence of sedentary activity between the parental and younger generations



*** = p< 0.05; ** = p< 0.01; ns – not significant**

Figure 2a: Prevalence of MetS components between two generations among male participants



*** p< 0.05; ns – not significant**

Figure 2b: Prevalence of MetS components between two generations among female participants

Despite being younger in age, a greater proportion of male participants from the younger generation showed a higher prevalence of MetS compared to their parental generation (Table 2). This finding aligns with the results of Selvaraj et al. (2019), who reported an increased metabolic risk among younger adults (aged 31–40 years) with lifestyle factors. In the present study, the prevalence of MetS was 13.8% and 9.6% higher in younger males and females, respectively, compared to their parental generation (Table 2), indicating that even the younger cohort is not spared from metabolic disturbances.

This generational shift in risk appears to be associated with a transition in lifestyle patterns, particularly a decline in physical activity level. Previous studies have also shown that physical inactivity contributes to the increased risk of MetS (Goldsborough et al., 2022; Krishnamoorthy et al., 2020; Das, 2022). In line with this, it was observed that the present generation engages less in strenuous occupations (which require higher levels of physical activity), which were more common among the parental generation (Das et al., 2006; Majumder, 1991).

Sedentary activity is a factor in the development of cardio-metabolic risk, as observed by Chakraborty et al. in 2015**.** The present analysis also reflected that sedentary activity was significantly higher among the younger generation (males: χ^2 = 15.282, $p < 0.001$; females: χ^2 = 18.885, $p < 0.001$) compared to their parental generation, reflecting a broader shift in occupational and lifestyle behaviours (Figure 1). These findings are consistent with the study conducted by Mahajan et al. in 2016, which noted a higher prevalence of MetS in rural India due to the growing adoption of urbanized behaviours.

Moreover, the odds ratio indicates that younger males are more vulnerable, with 1.809 times the odds of developing MetS compared to their parental generation. Among females, it was found that the MetS prevalence was higher among the younger generation than the parental

generation, although the difference between generations was not statistically significant (p = 0.073), which indicates that younger females are at equal risk as their parental generation (Table 2). These findings align with earlier research that showed males usually develop cardio-metabolic risk earlier than women do, while premenopausal females are relatively protected by estrogen (Saltiki et al., 2008).

In terms of specific components of MetS, the younger generation showed significantly higher levels of FBG and TG, particularly among males. These changes may reflect early signs of altered metabolic function potentially linked to increasing adiposity and central obesity. Parental males had relatively higher HDLc levels, which could confer some cardiovascular protection (Figure 2a).It has also been observed that among individuals with sedentary work, most of the cardio-metabolic risk variables of males were not statistically significant between generations, and the results indicate that due to physical inactivity, younger males are at equal risk as their parental generation (Table 1). Among females, most cardio-metabolic risk indicators were higher in the parental generation (Table 1), which is likely influenced by menopausal status and associated hormonal changes. In contrast, the significantly higher prevalence of High TG and low HDLc observed in younger females suggests emerging risks that warrant attention (Figure 2b).Overall, the findings highlight a clear inter-generational shift in metabolic health patterns, likely driven by lifestyle.

5. CONCLUSION

Lifestyle transitions, especially reduced physical activity, are significantly impacting the cardio-metabolic health of the younger generation. The idea that they are “no less vulnerable than their parental generation” is no longer a prediction but a reality, as reflected in the current findings. This trend demands urgent public health attention. Tailored interventions that promote physical activity from early life are crucial to mitigate future health risks. Without such efforts, the younger generation may experience earlier and more severe cardio-metabolic morbidity than their parents.

6. LIMITATIONS

It was a cross-sectional study, for that reason, it limits the ability to infer causality. A longitudinal approach would be essential to establish temporal relationships and to identify additional, potentially undiscovered risk factors contributing to cardio-metabolic health in this community.

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ETHICAL CLEARANCE

The Institutional Ethics Committee of Sidho-Kanho-Birsha University, Purulia, approved the study (Memo No: -R/IEC/1584/SKBU/24, Date: 03.10.2024).

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