©Human Biology Review
www.humanbiologyjournal.com

Human Biology Review (ISSN 2277 4424) 4 (1) 2015
Original scientific paper (Agnihotri and Singh pp 47-58)
Revised and Accepted on December 18, 2014

The variations in Body Mass Index of different types of cigarette smokers

H. Agnihotri[1] and P. Singh[2]

Citation: Agnihotri H and Singh P. 2015. The variations in Body Mass Index of different types of cigarette smokers. Human Biology Review, 4 (1), 47-58.

[1]Hitanshu Agnihotri, Department of Sports Science, Punjabi University, Patiala, Punjab (India).

[2]Dr. Paramvir Singh, Associate Professor and Head, Department of Sports Science, Punjabi University, Patiala, Punjab (India). Email: tparamvir@yahoo.com

Corresponding author: Hitanshu Agnihotri, Department of Sports Science, Punjabi University, Patiala, Punjab (India). E-mail: hitanshuphysio@gmail.com. Phone: 91-9569601492.

ABSTRACT

The present study investigated the effect of both active and second hand smoking on Body Mass Index of adult smokers in rural areas of Chandigarh. The relationship of body mass index with smoking status was also assessed in current daily and intermittent smokers. The male subjects (N=240) of 20-30 years and 30-40 years age category were divided into four groups of 30 subjects each based on Global Adult Tobacco Survey Questionnaire, India as follows: Group 1 - Current daily cigarette smokers, Group 2 - current intermittent cigarette smokers, Group 3 - Second hand cigarette smokers and Group 4 - Non-smokers (Control group). One way ANOVA test showed non-significant differences between and within all the groups in body mass index ($F=1.11$, $p>0.05$) in 20-30 years age category. In 30-40 years age category, significant differences ($F=4.11$, $p<0.05$) were observed between and within all the groups. Post hoc Scheffe test in 30-40 years category also revealed significant mean differences between current daily smokers and non-smokers. Karl Pearson's correlation test showed a highly significant inverse linear relationship ($p<0.001$) between pack years and BMI in both current daily and intermittent smokers. Current smoking of moderate intensity has an effect to alter relative fatness (or BMI) of the body. There may be no substantial difference in BMI with moderate and light smoking as well as exposure to second-hand smoke (SHS) in younger adults. The greater the number of cigarettes smoked, the lower the adult smoker's BMI in both current moderate and intermittent light smokers.

Key-words: *Cigarette smoking, Second hand smoke, Intermittent smoking, Body Mass Index, Current daily smoking.*

INTRODUCTION

The smoking problem is very complex in India because of its associated health consequences (Gupta and Ray, 2004). The Global Adult Tobacco Survey (GATS) India, 2010 revealed that a daily cigarette smoker in India smokes 6.2 cigarette sticks per day, on an average. One-fourth of daily cigarette smokers smoke more than 10 cigarettes per day. Nearly two in five (38%) adults in rural areas and one in four (25%) adults in urban areas use tobacco in some form. Passive smoking or environmental tobacco smoke (ETS) exposure has been variously described as

'second-hand smoke' [SHS]. 52% of adults are exposed to SHS at home. In rural areas, 58% adults and in urban areas, 39% adults are exposed to SHS at home (The Global Adult Tobacco Survey, India, 2010).

Body mass Index corresponds to the relative fatness of the body. The patho-physiological factors involved in the association among smoking, body weight, and body fat distribution are little explored, and they remain to be elucidated. The relation between smoking and obesity is incompletely understood in India. There is a conspicuous loss of evidence on the effect of passive smoking on body fatness in India.

Numerous cross-sectional studies indicate that body mass index is lower in cigarette smokers than in nonsmokers (Williamson , 1991; Fukuba et al.,1993; Flegal , 1995; Potter , 2004). Given the metabolic effect of smoking, it is expected that the greater the number of cigarettes smoked, the lower the smoker's body weight. However, few cross-sectional studies indicate that heavy smoking could be associated with a greater risk of obesity (Shimokata , 1989; Chiolero , 2006; John , 2005).

Due to ambiguity in previous literature on the relationship between smoking and BMI, it is mandatory to assess the relationship between quantity of smoking and body fatness in adult smoking population. The present study aimed at evaluating the relationship of smoking pack years with BMI in current daily and intermittent smokers. The study also focused on comparing the effects of active as well as passive cigarette smoking on BMI.

MATERIALS AND METHODS

The present study had a prospective cross-sectional design. The study was approved by Research Development Committee, Department of Sports Science, Punjabi University, Patiala. The research was performed in accordance with principles of the Declaration of Helsinki. The data was collected by organizing health fitness check–up camps in rural areas of Chandigarh (U.T.) region from the year 2011 to 2013. The male subjects (N=240) were divided into two age categories: 20-30 years and 30-40 years. The subjects in each age category were further divided into four groups of 30 subjects each based on Global Adult Tobacco Survey Questionnaire, India, 2010 as follows: Group 1 - Current daily cigarette smokers, Group 2 - current intermittent cigarette smokers, Group 3 - Second hand cigarette smokers and Group 4 - Non-smokers (Control group).

All the subjects were asked to give an informed consent for participation in writing. Exclusion criteria was history or family history of cardio respiratory, Musculoskeletal, neuromuscular or systemic anomaly impairing participation in physical activity, any participation in active or recreational sport, physical activity since last 6 months. Bidi smokers/concomitant bidi and cigarette smokers, exposure to bidi smoke/concomitant bidi and cigarette smoke, current and former smokeless tobacco users, Former smokers and smokers trying to quit cigarette smoking with any kind of treatment were also excluded.

The smoking history of the smokers was taken to calculate the number of pack years with the following formula-

Number of Pack Years = (Number of cigarettes smoked per day X Number of years smoked)/20

The distance from the standing platform, to the highest position of the head (vertex) was measured with the help of stadiometer, which indicates the subject's height. The height was recorded to the nearest centimeter. The body weight of the subject was taken on a standard electronic weighing machine, having accuracy recorded to the nearest 50gm. The body weight was recorded to the nearest kilogram. The body mass index was computed as body weight in kilograms divided by square of height in meters. The measurement unit of BMI is kg/m^2.

$$\text{Body Mass Index} = \frac{\text{Body Weight (Kg)}}{(\text{Height in meters})^2}$$

RESULTS

The data was analyzed with a computerized software Statistical Package of Social Sciences version 16 (SPSS 16). One–way Analysis of Variance (ANOVA) test was done to compare between and within current daily smokers, current intermittent smokers, SHS exposed subjects and non-smokers. The post-hoc analysis, Multiple Scheffe test was done to check the significance of mean difference in the groups on comparison with each other, only if One-way ANOVA revealed significant F-value. The possible relationship between pack years and BMI in current daily and intermittent smokers was computed with Karl Pearson's correlation Test. The mean values and standard deviations of age, height and weight are presented in Table 1.

Table 1: Mean and Standard Deviation values of Age, Height and Weight in all the groups.

Variable	**Current Daily Smoker (n=30)**		**Current Intermittent Smoker (n=30)**		**Second Hand Smoker (n=30)**		**Non-Smoker (n=30)**	
Age Category	20-30 years	30-40 years	20-30 years	30-40 years	20-30 years	30-40 years	20-30 years	30-40 years
Age (Years)	25.23± 2.47	34.98± 2.80	24.45± 2.41	32.85± 1.83	25.23± 2.60	34.68± 2.74	24.80± 2.55	34.27± 2.89
Height (cm)	170.47 ± 6.16	169.47 ± 4.73	169.57 ± 5.75	169.37± 5.73	170.27± 0.77	169.63± 5.02	169.17 ± 5.93	166.77± 7.06
Weight (cm)	65.43± 8.54	65.70± 5.95	66.57± 6.88	66.20± 4.97	68.37± 4.70	68.6± 4.80	66.67± 1.13	67.47± 7.89
BMI (Kg/cm^2)	22.48 (±2.45)	22.87 (±1.74)	23.06 (±2.01)	23.08 (±1.39)	23.86 (±1.71)	23.55 (±1.39)	24.19 (±1.92)	23.19 (±3.07)

Current daily smokers, current intermittent smokers, second hand smokers and non-smokers were not significantly different in age ($F= 0.69$, $p> 0.05$), height ($F= 0.32$, $p> 0.05$) and weight ($F= 0.64$, $p> 0.05$) in 20-30 years age category, on comparison. In 30-40 years age-group category, there are non-significant differences between and within the four groups in height ($F= 1.72$, $p> 0.05$) and weight ($F= 1.41$, $p> 0.05$). However, there were non- significant differences in age between all other groups except between current daily smokers and current intermittent smokers ($F= 3.95$, $p< 0.05$) in 30-40 years age-group category. The mean value of BMI of current daily smokers has been observed as 22.48 (±2.45), current intermittent smokers as 23.06 (±2.01), second hand smokers as 23.55 (±1.39) and non-smokers as 23.19 (±3.07) in 20-30 age-group category. In 30-40 years age-group category, the mean value of BMI of current daily

smokers was observed as 22.87 (±1.74), current intermittent smokers as 23.08 (±1.39), second hand smokers as 23.86 (±1.71) and non-smokers as 24.19 (±1.92). The data pertaining to BMI of all the groups was statistically analyzed and the results are presented in Table 2 and 3.

Table 2: One way ANOVA between all the groups for BMI in both the age categories.

Variable		Sum of Squares	Df	Mean Square	F
BMI (20-30 years)	Between Groups	17.81	3	5.94	1.11
	Within Groups	620.17	116	5.35	
BMI (30-40 years)	Between Groups	35.584	3	11.86	4.11^{*}
	Within Groups	335.205	116	2.89	

* indicates $p<0.05$

One-way ANOVA revealed non-significant differences ($F= 0.35$, $p>0.05$) in BMI among current daily smokers, current intermittent smokers, second hand smokers and non-smokers in 20-30 years category. There were significant differences between all the groups ($F= 4.105$, $p<0.05$) in BMI in 30-40 years category.

Table 3: Post Hoc Multiple Scheffe Test between all the groups for BMI in 30-40 years age-group.

Dependent Variable	Variable (I)	Variable (J)	Mean Difference (I-J)
BMI	Current Daily Smokers	Current intermittent smokers	-0.22^{ns}
		Second hand smokers	-1.00^{ns}
		Non-smokers	-1.32^{*}
	Current intermittent smokers	Second hand smokers	-0.79^{ns}
		Non-smokers	-1.11^{ns}
	second hand smokers	Non-smokers	-0.32^{ns}

*indicates $p<0.05$, ^{ns} indicates $p>0.05$

Post Hoc Multiple Scheffe Test showed significant mean difference in BMI between current daily smoker and non-smoker groups ($p<0.05$). However, there were non-significant mean differences in BMI ($p>0.05$) between all other groups on comparison with each other in 30-40 years category.

The mean value of Pack years of current daily smokers has been observed as 4.77 ($\pm$2.89) and current intermittent smokers as 0.12 ($\pm$0.09) in 20-30 age-group category. In 30-40 years age-group category, the mean value of pack years of current daily smokers has been observed as 9.95 ($\pm$4.54), current intermittent smoker as 0.19 ($\pm$0.08). A highly significant negative linear correlation ($p<0.001$) of pack years with BMI was present in both current daily and current intermittent smokers in both age categories (Table 4).

Table 4: The relationship between BMI and pack years in Current Daily and Intermittent Smokers.

	Current Daily Smokers	**Current Intermittent Smokers**
20-30 years	-0.48*	-0.87*
30-40 years	-0.93*	-0.87*

*. Correlation is significant at the 0.01 level.

DISCUSSION

The present study has evaluated the BMI values in different types of cigarette smokers with a young body. BMI was significantly lower in current daily smokers than in persistent non-smokers in 30-40 years category. Moreover, a highly significant inverse relationship ($p<0.001$) between pack years and BMI was found in current daily smokers and current intermittent smokers in both age categories. The greater the number of cigarettes smoked, the lower the adult

smoker's BMI, irrespective of the frequency of smoking. The present findings correspond to the findings of Rasmussen , (2003), Macera , (2011) and Ricci , (2011).

Xu , (2007) also reported that cigarette smoking is negatively associated with body weight indicated by BMI but not with central obesity indexed by waist circumference in Chinese men. The metabolic effect of smoking could explain the lower body weight found in smokers. Smoking's effect on body weight could lead to weight loss by increasing the metabolic rate, decreasing metabolic efficiency, or decreasing caloric absorption and reduction in appetite, all of which are associated with tobacco use (Chiolero , 2008). On one hand, age related weight gain may be limited by smoking because of increased energy expenditure and reduced food intake. On other hand, because smoking is a strong risk factor for emaciating diseases such as cancer, lower BMI among smokers, which may result in weight loss due to a concomitant preclinical disease (Henley , 2002).

No significant difference ($p>0.05$) in BMI was observed between and within all the groups in 20-30 years category. However, current daily smokers had lower BMI than second hand smokers and current intermittent smokers in both age categories. However, these findings were statistically non-significant. Current smokers had a history of moderate smoking (pack years < 10). While, current intermittent smokers had a history of light smoking (pack years <1). 1 pack year corresponds to smoking 20 cigarettes a day for one year. The present findings may also be attributed to younger age, less number of pack years due to less number of cigarettes smoked, and shorter cigarette smoking duration since onset in 20-30 years age category. It may be inferred that there is no substantial difference in BMI with moderate and light smoking as well as exposure to SHS in younger adults.

Similar to the present findings, Akbartabartoori , (2005) observed that cigarette smoking is associated with a lower BMI in adults over 24 years particularly in men, but not in younger people. Rasmussen , 2003 reported that in middle-age subjects, longitudinal BMI increases are smaller among smokers than nonsmokers. During old age, the BMI of smokers decreases more than that of nonsmokers. Henceforth, this may justify the non-significant findings in 20-30 years category and significantly low BMI in current daily smokers in 30-40 years category.

Current intermittent smokers had non-significantly lower BMI compared to non-smokers. The history of light and intermittent smoking (pack years <1) may be the reason for such findings. However, trends highlighted on the decline in BMI of current intermittent smokers compared to non-smokers. Stable light smoking carries substantial health risks (Schane et al.,2010). Even a relatively short-term smoking habit i.e. less than one year duration from the onset of smoking, has a serious damage to the several parameters of physical fitness (Fukuba et al.,1993). Light and intermittent smokers often go undetected in a country like India due to socio-cultural and religious obligations. Majority of them hide their smoking habits, when asked. The previous studies had a negligible view on the recreational use of tobacco by young people. Hence, clinical screening for light and intermittent smoking should be improved.

The present findings could not replicate the findings of Shimokata , (1989) and Chiolero , (2006). The metabolic effects of nicotine that favor abdominal fat accumulation as well as the unhealthy lifestyle habits might outweigh the increase in metabolism induced by nicotine among heavy smokers in these studies. These factors could counterbalance and even overtake the slimming effect of smoking. Similar findings have also been reported by Clair , (2011). There is a need to assess the relationship between BMI and heavy cigarette smoking.

The health hazards of second hand smoke exposure were not different from active intermittent smoking as depicted by non-significant BMI mean difference between second hand smokers and current intermittent smokers. The trends showed lower BMI value in second hand smokers compared to non-smokers, though statistically non-significant. The significant difference in age in 30-40 years category at baseline may have confounding effect on the findings. The negative influence of passive smoking on anthropometric and spirometric variables has also been reported by Barisic et. al., (2006). Exposure to Second hand smoke either before or during an event also impairs athletic performance (The Non-Smokers' Movement of Australia, 2006).

Being unfit warrants consideration as a risk factor, distinctly from inactivity, and is worthy of screening and intervention (Williams, 2001). The smoking epidemic is so huge that every effort is needed to launch an effective campaign to protect our society and maintain a good quality health. In India, despite all public places being declared smoke free, compliance levels are variable (Singh and Lal, 2011). The present findings may be provide a framework for educating the adults in rural areas about the harmful hazards of both active and passive cigarette smoking

on health. The is a strong need to educate the cigarette smokers about the detrimental effects of cigarette smoking on BMI as well as the importance of physical fitness for maintaining a good health. The confounding variables like sedentary life style, diet, heredity etc. were not taken into consideration and may have affected the causal relationship between smoking and BMI. In a broader perspective, considering that inclination towards sedentary lifestyle and physical inactivity is high among adults and that smoking prevalence is high and increasing in India, it is clear that the co-occurrence of the two conditions may have devastating effects on the health of the adult smoking population in India.

CONCLUSION

Based on the findings of the present study, it can be concluded that current smoking of moderate intensity has an effect to alter relative fatness of the body as reflected by BMI in 30-40 years adults. There may be no substantial difference in BMI with moderate and light smoking as well as exposure to SHS in younger adults. The greater the number of cigarettes smoked, the lower the adult smoker's BMI in both current moderate and intermittent light smokers. Current daily smokers had the lowest BMI value compared to both current intermittent and second hand smokers, though statistically non-significant. BMI value of second hand smokers was not statistically different from current intermittent smokers.

REFERENCES

1. Akbartabartoori M, Lean MEJ and Hankey CR . 2005. Relationships between cigarette smoking, body size and body shape. *Int. J. Obes* **29**: 236–243.

2. Barisic IG, Bradaric A, Erceg M, Barisic I, Foretic N, Pavlov N, Tocilj J. 2006. Influence of passive smoking on basic anthropometric characteristics and respiratory function in young athletes. *Coll Antropol* **30** (3): 615–619.
3. Bernaards CM, Twisk JW, Van MW, Snel J, Kemper HC. 2003. A longitudinal study on smoking in relationship to fitness and heart rate response. *Med Sci Sports Exerc* **35**(5): 793-800.

4. Chiolero A, Faeh D, Paccaud F, and Cornuz J. 2008. Consequences of smoking for body weight, body fat distribution, and insulin resistance. *Am J Clin Nutr* **87** (4): 801-809.

5. Chiolero A, Jacot-Sadowski I, Faeh D, Paccaud F, Cornuz J. 2007. Association of cigarettes daily smoked with obesity in a general European adult population. *Obes Res* **15**(5): 1311–8.
6. Clair C, Chiolero A, Faeh D, Cornuz J, Marques-Vidal P, Paccaud F, Mooser V, Waeber G, Vollenweider P. 2011 Dose-dependent positive association between cigarette smoking, abdominal obesity and body fat: cross-sectional data from a population-based survey. *BMC Public Health*, **11**: 23-27.
7. Flegal KM, Troiano RP, Pamuk ER, Kuczmarski RJ, Campbell SM. 1995. The influence of smoking cessation on the prevalence of overweight in the United States. *N Engl J Med* **333**(18): 1165–70.
8. Fukuba Y, Takamoto N, Kushima K, Ohtaki M, Kihara H, Tanaka T, Une S, Munaka M. 1993. Cigarette smoking and physical fitness. *Ann Physiol Anthropol* **12**(4): 195-212.
9. Gupta PC, Ray CS. 2004. Epidemic in India. In: Boyle P, Gray, Henningfield J, Seffrin J, Zatonski W, editors. Tobacco: Science, policy and public health. Oxford University Press, Oxford. p 253-66.
10. Healton CG, Vallone D, McCausland KL, Xiao H, Green MP. 2006. Smoking, obesity, and their co-occurrence in the United States: cross sectional analysis. *BMJ* **333**: 25–26.
11. Henley SJ, Flanders WD, Manatunga A, Thun MJ. 2002. Leanness and lung cancer risk: fact or artifact? *Epidemiology* **13**(3): 268–276.
12. John U, Hanke M, Rumpf HJ, Thyrian JR. 2005. Smoking status, cigarettes per day, and their relationship to overweight and obesity among former and current smokers in a national adult general population sample. *Int J Obes Relat Metab disord* **29**: 1289–94.
13. Macera CA, Aralis HJ, MacGregor AJ, Rauh MJ, Han PP, Galarneau MR. 2011. Cigarette Smoking, Body Mass Index, and Physical Fitness Changes among Male Navy Personnel. *Nicotine Tob Res* **13**(10): 965-71.
14. Potter BK, Pederson LL, Chan SS, Aubut JA, Koval JJ. 2004. Does a relationship exist between body weight, concerns about weight, and smoking among adolescents? An integration of the literature with an emphasis on gender. *Nicotine Tob Res* **6**(3):397–425.
15. Rani M, Bonu S, Jha P, Nguyen S, Jamjoum L. 2003. Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional household survey. *Tob Control* **12**(4): e4.

16. Rasmussen F, Tynelius P, Kark M. 2003. Importance of smoking habits for longitudinal and age-matched changes in body mass index: a cohort study of Swedish men and women. *Prev Med* **37**(1):1-9.

17. Schane RE, Ling PM, Glantz SA. 2010. Health Effects of Light and Intermittent Smoking. *Circulation* **121**: 1518-1522.

18. Shimkhada R, Peabody JW. 2003. Tobacco control in India. *Bul World Health Organ* **81**(1): 48–52.

19. Shimokata H, Muller DC, Andres R. 1989. Studies in the distribution of body fat- III. Effects of cigarette smoking. *JAMA* **261**(8): 1169–73.

20. Singh RJ, Lal PG. 2011. Second-hand Smoke: A neglected public health challenge. *Indian J Public Health* **55**: 192-8.

21. The Global Adult Tobacco Survey report, 2010. New Delhi: Ministry of Health & Family Welfare, Nirman Bhawan, Maulana Azad Road, New Delhi 110011, India.

22. The Non Smokers' Movement of Australia. 2006. *Fact Sheet - Smoking and Fitness.* New South Wales. Available at: http://nsma.org.au/facts/fitness.htm (Accessed August 20, 2014)

23. The World Bank Group. 1999 *Economics of tobacco control*. Washington DC: World Bank. URL: http://documents.worldbank.org/curated/en/1999/05/437174/curbing-epidemic-governments-economics-tobacco-control (Accessed June 20, 2014)

24. U.S. Department of Health and Human Services. 2006. *The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General*. Atlanta GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

25. Williams PT. 2001. Physical fitness and activity as separate heart disease risk factors: a meta-analysis. *Med Sci Sports Exerc* **33**(5): 754–761.

26. Williamson DF, Madans J, Anda RF, Kleinman JC, Giovino GA, Byers T. 1991. Smoking cessation and severity of weight gain in a national cohort. *N Engl J Med* **324**: 739–45.

27. Xu F, Yin XM, Wang Y. 2007. The association between amount of cigarettes smoked and overweight, central obesity among Chinese adults in Nanjing, China. *Asia Pac J Cli Nut* **16**(2): 240-7.