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Physical activity and cardiovascular risk factors in university students in the city of Leon, Mexico

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ABSTRACT

Objectives: Recent changes in life style have increased obesity, smoking and sedentary habits in the entire population. Obesity and overweight frequency have trebled in Mexico in the last few decades. The presence and frequency of cardiovascular risk factors were determined in students at the Universidad DeLa Salle Bajío, both newly admitted and in advanced years. Material and methods: Anthropometric variables, serum glucose, total cholesterol levels, blood hemoglobin and hematocrit were obtained and assessed in 4814 students, 1507 recently admitted and 1507 advanced students. Results: The prevalence of obesity was 15.3%, sedentariness 33.8%, hypercholesterolemia 8.16%, smoking habits 15.8%, and alcohol consumption 12.1%. Body mass index (BMI) (23.5 ± 4 vs. 22.7 ± 4), waist/abdomen index (0.84 ± 0.06 vs. 0.83 ± 0.06) and serum cholesterol (3.54 mmol/L ± 0.79 vs. 3.98 mmol/L ± 0.77) were greater in the advanced students ($p < 0.001$). BMI was associated only with the waist/abdomen index ($r = 0.99$, $p < 0.001$). Conclusions: There is a high prevalence of sedentarism, smoking and obesity in university students and these problems are more important in advanced students. Programs for integral health attention should be implemented in university students in order to avoid cardiovascular risk factors.

Keywords: Cardiovascular Risk Factors; University Students; Smoking; Physical Activity

1. INTRODUCTION

The Framingham heart study was used to identify the main cardiovascular risk factors. Many other risk factors and markers besides high blood pressure, smoking, hypercholesterolemia, diabetes, and a family history of myocardial infarction have now been identified, changing our approach in the prevention and control of individual risk factors. Cigarette smoking prevalence in adolescents has increased in the last years [1], and while light smoking has remained stable in Hispanic students, heavy smoking increased significantly from 3.1% in 1991 to 6.4% in 2009 [2]. Tobacco smoke is the most significant etiologic risk factor for lung cancer in current or previous smokers and has been strongly related to certain types of lung cancer, such as small cell lung carcinoma and squamous cell lung carcinoma [3,4], and bladder cancer [5].

Sedentary activities such as TV watching and low physical activity have been associated with cardio-metabolic risk factors in children and adolescents [6,7]. Inactivity during adolescence may interact with genetic factors to influence body mass changes between adolescence and young adulthood [8]. On the other hand, daily step counts and physical fitness levels were negatively associated with having one or more metabolic risk factors among adolescents [9].

Obesity prevalence is increasing in children and adolescents worldwide [10-12]. Obesity and overweight frequency in Mexico have trebled in the last few decades [13]. Obesity in children or adolescents predicts obesity in adult life [14], and is associated with lipid disorders, high blood pressure, type 2 diabetes mellitus, and liver diseases [15]. Obesity, high blood pressure, smoking, and alcohol ingestion are more frequent in Portuguese

men than in women when first admitted to university [16]. In Korea, stress about academic performance is an important factor affecting the increase in cigarette smoking among adolescent males in a rural area of Korea [17]. Byrd in 1996 showed that for every scholarship year, American boys are older than girls, and males are exposed more frequently to alcohol, tobacco and illegal drugs [18]. In Mexico, the frequency of cardiovascular risk factors in university students has been scantily studied.

2. MATERIAL AND METHODS

A cross-sectional, observational and comparative study was conducted in 4814 students in the University DeLa Salle Bajío during the first six months of 2010. All students attending the medical service at the university for their annual medical check-up were included after signing an informed consent form. The protocol had been previously approved by the ethical and scientific committees of the institution. Blood samples were obtained at the annual clinical check-up.

After 10 min resting in a quiet room, blood pressure was measured twice using a mercury sphygmomanometer (Welch Allyn Tycos, USA). We followed the Mexican guidelines for hypertension detection [19]. Weight and height were obtained by using a scale (Bame) with maximal capacity for 140 kg, and 2.20 m in height. The body mass index (BMI) was calculated according to the formula of Quetelet. Adolescent obesity was defined according to Saucedo [20]. Abdomen circumference was obtained at the umbilicus level, and the hip circumference at the most prominent gluteal point. Values of abdomen/hip index (A/HI) of 0.94 for males, and 0.82 for females were used as cutoff [21].

Smoking habit data (at least 1 cigarette/day), and alcohol consumption (yes or no) were recorded. Physical activity performed by the students was classified as sedentary when there was no physical activity at all, or as standard physical activity when there were one or more weekly sessions. After 12 hours fasting, a blood specimen was extracted and serum glucose and total cholesterol were measured.

Statistical analysis: Means and standard deviation of the data were obtained. The differences between the newly admitted students and the advanced students were determined with the Student's t test. Differences on life style were tested by X^2. Multiple regression tests were applied taking BMI as a dependent variable and serum glucose, cholesterol, alcoholic habit, smoking habit, abdomen/hip index, and sedentariness as independent variables. Significance was considered when $p < 0.05$. StatSoft Inc. (2000).

Statistica for Windows, Tulsa OK was utilized.

3. RESULTS

Of the 4921 students interviewed, only 4814 accepted to participate in the study. **Table 1** shows a significant difference in most of the clinical characteristics when comparing the advanced students with the recently-admitted students. Impaired fasting glucose was found only in 17 subjects (< 1%) out of the 4814 subjects. Hypercholesterolemia was found in 393 (8.1%) subjects. Advanced students showed the highest levels of total cholesterol, as well as the greater BMI, and AH/I. BMI was associated with abdomen circumference and the abdomen/hip index (adjusted $r = 0.98$, $p < 0.001$).

Most of the students (66.1%) performed standard physical activity, while 33.9% were sedentary (**Figure 1(a)**). The percentage of students who accepted their alcohol consumption on a daily or a weekend basis is shown in **Figure 1(b)**. The smoking habit was found in 15.9% (**Figure 1(c)**).

Alcohol drinking, smoking habits and sedentariness were present mainly in the advanced students (**Table 2**).

4. DISCUSSION

Recognizing cardiovascular risk factors in the young population may contribute to implementing preventive actions in order to decrease their morbi-mortality. An active lifestyle diminishes both obesity and cardiovascular risk factors in children [22]. On the other hand, regular exercise is associated with a decrease in the smoking

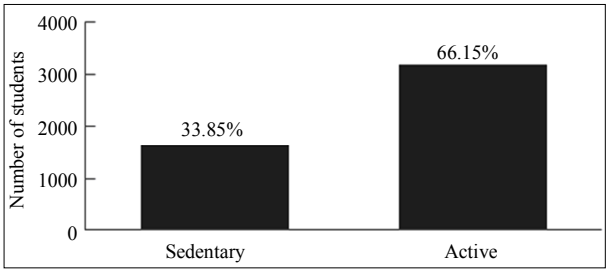
Table 1. Clinical characteristics of the two groups.

	Advanced Students (n = 3307)	Recently Admitted Students (n = 1507)	p
Age (years)	20.3 ± 2.1	17 ± 2.5	<0.001
Heart rate (bpm)	71 ± 5.5	71 ± 6.1	0.6
Weight (kg)	65.9 ± 14.6	63.1 ± 13.9	<0.001
Height (m)	1.67 ± 0.08	1.66 ± 0.08	<0.007
BMI ($kg \cdot m^2$)	23.4 ± 4	22.7 ± 4	<0.001
SBP (mm·Hg)	111 ± 9.1	110 ± 9.1	0.1
DBP (mm·Hg)	68 ± 7.4	68 ± 7.5	0.2
Abdomen circumference (cm)	80.5 ± 10.6	77.9 ± 10.6	<0.001
Hip circumference (cm)	95.6 ± 8.2	93.7 ± 8.4	<0.001
AH/I	0.84 ± 0.06	0.83 ± 0.06	<0.001
Glucose (mmol/L)	4.11 ± 0.11	4.05 ± 0.49	0.17
Cholesterol (mmol/L)	3.54 ± 0.79	3.98 ± 0.77	<0.001

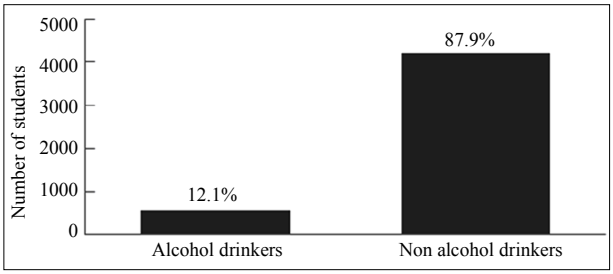
BPM = beats per minute, BMI = body mass index, SBP = systolic blood pressure, DBP = diastolic blood pressure, AH/I = abdomen/hip index. Student's t test. All data expressed as mean ± SD.

Table 2. Physical activity, alcohol drinking, and smoking habits of the two groups of students.

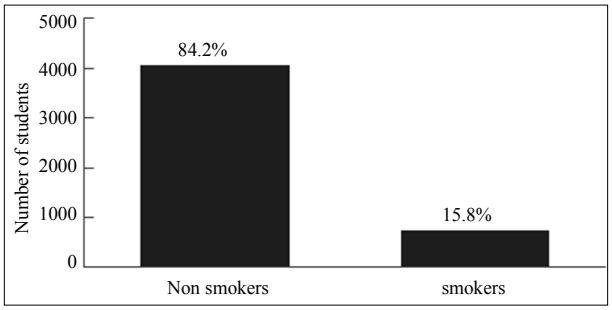
	Advanced students n = 3307	Recently admitted students n = 1507	X^2	P
Sedentary	1999	752	47.2	<0.001
Alcohol drinking	482	101	28.13	<0.001
Smoking	403	107	60.1	<0.001



(a)



(b)



(c)

Figure 1. Life style and habits in participants. Physical activity (a), alcohol drinking (b), and smoking habits (c) of the students. Data from n = 4814.

and alcohol habits [23]. Studies done in Brazil and Chile show that sedentary behavior in university students is associated with high serum cholesterol and triglycerides values [24-26].

Young smoking adults develop cardiologic incompetence, which is associated with an increased mortality [27]. Resting heart rates as well as body mass index (BMI) in high school students are predictive risk factors for high blood pressure in adult life [28].

The main risk factors found in our students were sedentariness (33.8%), elevated abdomen/hip circumference (30.2%), smoking (15.8%), obesity (15.3%), alcohol drinking (12.1%), and hypercholesterolemia (8.16%).

The percentage of hypercholesterolemia (8.16%) in our student population is similar to the hypercholesterolemia found in others studies [24,26]. Hypercholesterolemia decreases total antioxidant capacity and increases lypoperoxides [29].

Elevated serum cholesterol, high blood pressure, and cigarette smoking are the major risk factors for ischemic heart disease [30] in young adults; carotid intimal-medial thickness is associated with total cholesterol, BMI, and waist/hip ratio [31]. In this context, obesity is a public health problem that constitutes an important risk factor for cardiovascular diseases [15,32] and, as shown in several studies, adolescence obesity is a strong predictor of late obesity [14,33]. The frequency of obesity in our population is greater than the frequency found in other Latin American university populations [24,25], one possible explanation for this discrepancy could be that most of the students attending our university come from different cities, and may have to change their nutrition habits.

The aforementioned explanation should lead us to further investigate the importance of changing nutrition habits, and its consequences over the body composition. Our data regarding greater body mass index, total cholesterol, abdomen circumference, hip circumference, and abdomen/hip index in the group of advanced students, together with the positive association of body mass index with abdomen circumference, indicate a greater deposit of visceral fat, and therefore greater risk of cardiometabolic diseases [34].

The smoking habit found in 15.8% of our students is similar to the study of Rabelo in Brazilian university students [24], lower than the 46% found by Chiang-Salgado in Chilean students [25] and lower than the 20% found at Shahroud in Iran [35]. Smoking habit is the main cardiovascular risk factor [36], and the tendency to acquire and develop tobacco dependency is greater in adolescents [37,38], making it absolutely necessary to intervene on this population; however, the results of an interventionist program in adolescents to quit smoking reported by Moolchan show how much harder it is for adolescents to quit smoking, making it therefore crucial to innovate and reinforce programs aiming to stop smoking [39].

Student sedentariness in some South American universities [24,25] was more frequent than the sedentariness found by us. A possible explanation may be the greater importance given to compulsory sports at our university during the final years. It is important acknowledge that the physical activity data in the present study was ob-

tained using questionnaires; future research should measure the physical activity by means of field tests (Cooper Test) or physical fitness tests (Treadmill test).

However, despite our students being less sedentary, the obesity frequency is similar to the obesity in Brazilian students, which makes it necessary to search for other components of exercise, such as intensity and time of exercise. It is also important to search for alternative explanations concerning obesity and nutrition habits.

5. CONCLUSION

There is a high prevalence of sedentarism, smoking and obesity in university students and these problems are more acute in advanced students. Programs for integral health attention should be implemented in university students in order to avoid cardiovascular risk factors. Due to the great proportion of obese subjects, it is desirable to evaluate with more precision the components of metabolic syndrome. Programs aiming at diminishing the unhealthy habits such as sedentariness, television time, smoking, and alcohol drinking need to be analyzed, innovated and reinforced in our university students. Further research should be done on the nutrition habits of adolescents and their consequences over the body composition in order to modify the lifestyle improving the fitness of the youth.

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REFERENCES

[1] Hong, N.S., Kim, K.Y., Park, S.W., Kim, J.Y., Bae, J., Lee, W.K. and Kim, K.S. (2011) Trends in cigarette use behaviors among adolescents by region in Korea. *Journal of Preventive Medicine and Public Health*, **44**, 176-184. http://dx.doi.org/10.3961/jpmph.2011.44.4.176

[2] Jones, S.E., Kann, L. and Pechacek, T.F. (2011) Cigarettes smoked per day among high school students in the U.S., 1991-2009. *American Journal of Preventive Medicine*, **41**, 297-299. http://dx.doi.org/10.1016/j.amepre.2011.05.018

[3] Wen, J., Fu, J.H., Zhang, W. and Guo, M. (2011) Lung carcinoma signaling pathways activated by smoking. *Chinese Journal of Cancer*, **30**, 551-558. http://dx.doi.org/10.5732/cjc.011.10059

[4] Whang, Y.M., Jo, U., Sung, J.S., Ju, H.J., Kim, H.K., Park, K.H., Lee, J.W., Koh, I.S. and Kim, Y.H. (2013) Wnt5a is associated with cigarette smoke-related lung carcinogenesis via protein kinase C. *PloS One*, **8**, e53012. http://dx.doi.org/10.1371/journal.pone.0053012

[5] Mrizak, D., B'chir, F., Jaidane, M., Arnaud, M. and Saguem, S. (2011) Effects of change in smoking habits on bladder cancer incidence in Tunisia. *Health*, **3**, 613-619. http://dx.doi.org/10.4236/health.2011.310103

[6] Carson, V. and Janssen, I. (2011) Volume, patterns, and types of sedentary behavior and cardio-metabolic health in children and adolescents: A cross-sectional study. *BMC Public Health*, **11**, 274. http://dx.doi.org/10.1186/1471-2458-11-274

[7] Colley, R.C., Garriguet, D., Janssen, I., Wong, S.L., Saunders, T.J., Carson, V. and Tremblay, M.S. (2013) The association between accelerometer-measured patterns of sedentary time and health risk in children and youth: Results from the Canadian Health Measures Survey. *BMC Public Health*, **13**, 200. http://dx.doi.org/10.1186/1471-2458-13-200

[8] Graff, M., North, K.E., Monda, K.L., Lange, E.M., Lange, L.A., Guo, G. and Gordon-Larsen, P. (2011) The combined influence of genetic factors and sedentary activity on body mass changes from adolescence to young adulthood: The National Longitudinal Adolescent Health Study. *Diabetes/Metabolism Research and Reviews*, **27**, 63-69. http://dx.doi.org/10.1002/dmrr.1147

[9] Moreira, C., Santos, R., de Farias-Júnior, J.C., Vale, S., Santos, P.C., Soares-Miranda, L., Marques, A.I. and Mota, J. (2011) Metabolic risk factors, physical activity and physical fitness in Azorean adolescents: A cross-sectional study. *BMC Public Health*, **11**, 214. http://dx.doi.org/10.1186/1471-2458-11-214

[10] Antal, M., Péter, S., Biró, L., Nagy, K., Regöly-Mérei, A., Arató, G., Szabó, C. and Martos, E. (2009) Prevalence of underweight, overweight and obesity on the basis of body mass index and body fat percentage in Hungarian schoolchildren: Representative survey in metropolitan elementary schools. *Annals of Nutrition and Metabolism*, **54**, 171-176. http://dx.doi.org/10.1159/000217813

[11] Lazzeri, G., Rossi, S., Pammolli, A., Pilato, V., Pozzi, T. and Giacchi, M.V. (2008) Underweight and overweight among children and adolescents in Tuscany (Italy). Prevalence and short-term trends. *Journal of Preventive Medicine and Hygiene*, **49**, 13-21.

[12] Bac, A., Wozniacka, R., Matusik, S., Golec, J. and Golec, E. (2012) Prevalence of overweight and obesity in children aged 6-13 years-alarming increase in obesity in Cracow, Poland. *European Journal of Pediatrics*, **171**, 245-251. http://dx.doi.org/10.1007/s00431-011-1519-1

[13] Barquera, S., Campos-Nonato, I., Hernández-Barrera, L., Pedroza-Tobías, A. and Rivera-Dommarco, J.A. (2013) Prevalence of obesity in Mexican adults, ENSANUT 2012. *Salud Pública de México*, **55**, S151-S160.

[14] Fonseca, V.M., Sichieri, R. and da-Veiga G.-V. (1998) Factors associated with obesity among adolescents. *Revista de Saúde Pública*, **32**, 541-549.

[15] Eckel, R., Barouch W.W. and Ershow, A.G. (2002) Report of the National Heart, Lung, and Blood Institute-National Institute of Diabetes and Digestive and Kidney Diseases Working Group on the pathophysiology of obesity-associated cardiovascular disease. *Circulation*, **105**, 2923-2928. http://dx.doi.org/10.1161/01.CIR.0000017823.53114.4C

[16] Marques-Vidal, P., Llobet, S., Carvalho-Rodrigues, J.A.

and Halpern, M.J. (2001) Cardiovascular risk factor levels in Portuguese students. *Acta Cardiologica*, **56**, 97-101. http://dx.doi.org/10.2143/AC.56.2.2005624

[17] Hong, N.S., Kam, S. and Kim, K.Y. (2013) Factors related to increasing trends in cigarette smoking of adolescent males in rural areas of Korea. *Journal of Preventive Medicine and Public Health*, **46**, 139-146. http://dx.doi.org/10.3961/jpmph.2013.46.3.139

[18] Byrd, R.S., Weitzman, M. and Doniger, A.S. (1996) Increased drug use among old-for-grade adolescents. *Archives of Pediatrics and Adolescent Medicine*, **150**, 470-476. http://dx.doi.org/10.1001/archpedi.1996.02170300024006

[19] Oviedo-Mota, M.A., Espinosa-Larrañaga, F. and Olivares-Santos, R. (2003) Guía clínica para el diagnóstico y tratamiento de la hipertensión arterial. *Revista Medica IMSS*, **41**, S15-S26.

[20] Saucedo Molina, T.J. and Gómez Peresmitre, G. (1997) Validez diagnóstica del índice de masa corporal en una muestra de adolescentes mexicanos. *Acta Pediátrica de México*, **18**, 19-27.

[21] Franklin, B.A. (2000) ACSM's guidelines for exercise testing and prescription. Sixth Edition, American College of Sports Medicine Baltimore, Maryland.

[22] Owen, C.G., Nightingale, C.M., Rudnicka, A.R., Sattar, N., Cook, D.G., Ekelund, U. and Whincup, P.H. (2010) Physical activity, obesity and cardiometabolic risk factors in 9- to 10-year-old UK children of white European, South Asian and black African-Caribbean origin: The child heart and health study in England (CHASE). *Diabetologia*, **53**, 1620-1630. http://dx.doi.org/10.1007/s00125-010-1781-1

[23] Terry-McElrath, Y.M. and O'Malley, P.M. (2011) Substance use and exercise participation among young adults: Parallel trajectories in a national cohort-sequential study. *Addiction*, **106**, 1855-1865.

[24] Rabelo, L.M., Viana, R.M., Schimith, M.A., Patin, R.V., Valverde, M.A., Denadai, R.C., Cleary, A.P., Lemes, S., Auriemo, C., Fisberg, M. *et al.* (1999) Risk factors for atherosclerosis in students of a private university in São Paulo-Brazil. *Arquivos Brasileiros de Cardiologia*, **72**, 569-580. http://dx.doi.org/10.1590/S0066-782X1999000500004

[25] Chiang-Salgado, M., Casanueva-Escobar, V., Cid-Cea, X., González-Rubilar, U., Olate-Mellado, P., Nickel-Paredes, F. and Revello-Chiang, L. (1999) Cardiovascular risk factors in Chilean university students. *Salud Pública de México*, **41**, 4444-4451. http://dx.doi.org/10.1590/S0036-36341999000600003

[26] Coelho, V.G., Caetano, L.F., Liberatore Junior Rdel, R., Cordeiro, J.A. and Souza, D.R. (2005) [Lipid profile and risk factors for cardiovascular diseases in medicine students]. *Arquivos Brasileiros de Cardiologia*, **85**, 57-62. http://dx.doi.org/10.1590/S0066-782X2005001400011

[27] Srivastava, R., Blackstone, E.H. and Lauer, M.S. (2000) Association of smoking with abnormal exercise heart rate responses and long-term prognosis in a healthy, population-based cohort. *The American Journal of the Medical Sciences*, **109**, 20-26. http://dx.doi.org/10.1016/S0002-9343(00)00441-1

[28] Kawabe, H., Shibata, H., Hirose, H., Tsujioka, M., Saito, I. and Saruta, T. (2000) Determinants for the development of hypertension in adolescents. A 6-year follow-up. *Journal of Hypertension*, **18**, 1557-1561. http://dx.doi.org/10.1097/00004872-200018110-00005

[29] Ondrejovičová, I., Muchová, J., Mišľanová, C., Nagyová, Z. and Duračková, Z. (2010) Hypercholesterolemia, oxidative stress and gender dependence in children. *Prague Medical Report*, **111**, 300-312.

[30] Havas, S., Wozenski, S., Deprez, R., Miller, L., Charman, R., Hamrell, M., Green, L. and Benn, S. (1989) Report of the new England task force on reducing heart disease and stroke risk. *Public Health Reports*, **104**, 134-142.

[31] Dawson, J.D., Sonka, M., Blecha, M.B., Lin, W. and Davis, P.H. (2009) Risk factors associated with aortic and carotid intima-media thickness in adolescents and young adults: The Muscatine offspring study. *Journal of the American College of Cardiology*, **53**, 2273-2279. http://dx.doi.org/10.1016/j.jacc.2009.03.026

[32] Zabina, H., Schmid, T.L., Glasunov, I., Potemkina, R., Kamardina, T., Deev, A., Konstantinova, S. and Popovich, M. (2001) Monitoring behavioral risk factors for cardiovascular disease in Russia. *American Journal of Public Health*, **91**, 1613-1614. http://dx.doi.org/10.2105/AJPH.91.10.1613

[33] Brancati, F., Wang, N., Mead, L., Liang, K. and Klag, M. (1999) Body weight patterns from 20 to 49 years of age and subsequent risk for diabetes mellitus: The Johns Hopkins Precursors Study. *Archives of Internal Medicine*, **59**, 957-963. http://dx.doi.org/10.1001/archinte.159.9.957

[34] Van Itallie, T.B. (1988) In: Lohman, T.G. and Martorell, R. Eds., *Antropometric Standarization Reference Manual*, Human Kinetics, Champaign, 143-149.

[35] Nazemi, S. and Chaman, R. (2012) Prevalence of smoking among universities students of Shahroud in 2010. *Open Journal of Preventive Medicine*, **2**, 235-239.

[36] Grundy, S.M., Garber, A., Goldberg, R., Havas, S., Holman, R., Lamendola, C., Howard, W.J., Savage, P., Sowers, J. and Vega, G.L. (2002) Prevention conference VI: Diabetes and cardiovascular disease: Writing group IV: Lifestyle and medical management of risk factors. *Circulation*, **105**, e153-e158. http://dx.doi.org/10.1161/01.CIR.0000014022.85836.96

[37] Moolchan, E.T., Aung, A.T. and Henningfield, J.E. (2003) Treatment of adolescent tobacco smokers: Issues and opportunities for exposure reduction approaches. *Drug and Alcohol Dependence*, **70**, 223-232. http://dx.doi.org/10.1016/S0376-8716(03)00012-7

[38] Delnevo, C.D., Pevzner, E.S., Steinberg, M.B., Warren, C.W. and Slade, J. (2002) Cigar use in New Jersey among adolescents and adults. *American Journal of Public Health*, **92**, 943-945. http://dx.doi.org/10.2105/AJPH.92.6.943

[39] Moolchan, E.T., Ernst, M. and Henningfield, J.E. (2000) A review of tobacco smoking in adolescents: Treatment implications. *Journal of the American Academy of Child and Adolescent Psychiatry*, **39**, 682-693. http://dx.doi.org/10.1097/00004583-200006000-00006