

## University of Dayton eCommons

---

Physical Therapy Faculty Publications

Department of Physical Therapy

---

2-2008

# The Mind-Body Connection: The Association between Adolescent Locus of Control and Indicators of Physical Health


C. Jayne Brahler

*University of Dayton*, [cbrahler1@udayton.edu](mailto:cbrahler1@udayton.edu)

James Cropper

*University of Dayton*, [jcropper1@udayton.edu](mailto:jcropper1@udayton.edu)

Follow this and additional works at: [https://ecommons.udayton.edu/dpt\\_fac\\_pub](https://ecommons.udayton.edu/dpt_fac_pub)

 Part of the [Cardiovascular Diseases Commons](#), [Cardiovascular System Commons](#), [Health Information Technology Commons](#), [Investigative Techniques Commons](#), [Medical Biochemistry Commons](#), [Other Analytical, Diagnostic and Therapeutic Techniques and Equipment Commons](#), [Other Medical Sciences Commons](#), [Other Medical Specialties Commons](#), and the [Women's Health Commons](#)

---

### eCommons Citation

Brahler, C. Jayne and Cropper, James, "The Mind-Body Connection: The Association between Adolescent Locus of Control and Indicators of Physical Health" (2008). *Physical Therapy Faculty Publications*. 39.

[https://ecommons.udayton.edu/dpt\\_fac\\_pub/39](https://ecommons.udayton.edu/dpt_fac_pub/39)

This Article is brought to you for free and open access by the Department of Physical Therapy at eCommons. It has been accepted for inclusion in Physical Therapy Faculty Publications by an authorized administrator of eCommons. For more information, please contact [frice1@udayton.edu](mailto:frice1@udayton.edu), [mschlangen1@udayton.edu](mailto:mschlangen1@udayton.edu).



# Journal of Exercise Physiology **online** (JEP **online**)

Volume 11 Number 1 February 2008

## Exercise and Health

### Managing Editor

Tommy Boone, Ph.D.

### Editor-in-Chief

Jon K. Linderman, Ph.D.

### Review Board

Todd Astorino, Ph.D.

Julien Baker, Ph.D.

Tommy Boone, Ph.D.

Lance Dalleck, Ph.D.

Dan Drury, DPE.

Hermann Engels, Ph.D.

Eric Goulet, Ph.D.

Robert Gotshall, Ph.D.

Melissa Knight-Maloney,  
Ph.D.

Len Kravitz, Ph.D.

James Laskin, Ph.D.

Derek Marks, Ph.D.

Cristine Mermier, Ph.D.

Daryl Parker, Ph.D.

Robert Robergs, Ph.D.

Brent Ruby, Ph.D.

Jason Siegler, Ph.D.

Greg Tardie, Ph.D.

Chantal Vella, Ph.D.

Lesley White, Ph.D.

Ben Zhou, Ph.D.

Official Research Journal  
of The American Society of  
Exercise Physiologists  
(ASEP)

ISSN 1097-9751

## THE MIND-BODY CONNECTION: THE ASSOCIATION BETWEEN ADOLESCENT LOCUS OF CONTROL AND INDICATORS OF PHYSICAL HEALTH

JAYNE BRAHLER<sup>1</sup>, JAMES CROPPER<sup>1</sup>

<sup>1</sup>Department of Health and Sport Science/ School of Education and Allied Professions/ University of Dayton, Dayton, OH, USA 45469-1220

### ABSTRACT

**Brahler CJ, Cropper JR.** The Mind-Body Connection: The Association Between Adolescent Locus of Control and Indicators of Physical Health? *JEPonline* 2008;11(1):1-8. Locus of control (LOC) is a construct that describes an individual's generalized beliefs or expectancies that their reinforcements are under internal versus external control (1). An individual exhibits either an internal or external LOC. This study examines the link between LOC and selected health risk factors in adolescents. A convenience sample of 167 high school physical education students completed a 13 item LOC questionnaire based on Rotter's 1966 instrument. Various anthropometric measurements, blood pressure, body mass index (BMI), and body fat were recorded on all subjects. A subsample of 61 female students were selected for blood chemistry analysis that included a lipid profile, hemoglobin A1c (HbA1c), Apo A-1, and Apo B. Mean body fat percents and LOC scores were significantly correlated ( $r=0.208$ ;  $p=0.006$ ) and mean body fat percent was significantly different between the internal and external LOC groups ( $p=0.039$ ). Regression equations were developed to predict HbA1c from hip circumference and LOC, and to predict Apo A-1 from LOC. Predictability was 99.8% and 97% respectively. We conclude that, with further research, LOC may prove to be a useful tool for screening large groups of adolescents for disease risk.

**Key Words:** Body Fatness, BMI, Cardiovascular Disease Risk, Psychometrics, Blood Chemistry

## INTRODUCTION

Locus of control is a construct that describes an individual's generalized beliefs or expectancies that their reinforcements are under internal versus external control (1). For example, an individual exhibiting an external locus of control believes that their actions will have little effect on their health status, whereas an individual exhibiting an internal locus of control believes that their actions will directly affect their health status. A link between locus of control and physical health status has been established (2-4). It has been shown that individuals with an external locus of control experience significantly more episodes of illness compared to individuals with an internal locus of control (5) and individuals with an internal locus of control tend to be healthier than externally oriented people (6). Adolescents with a high internal locus of control perform better in physical activities and are healthier overall than those with an external locus of control (7).

Relative risk for disease can be estimated by assessing the presence of disease risk factors (8,9,10,11,12). For example, prediction models that assess cardiovascular disease (CVD) risk may include metabolic, hemodynamic, and haemostatic measures (8,9,11,12) that have a known association with development of CVD. Metabolic risk factors include total cholesterol (TC), triglycerides (TG), high density lipoproteins (HDL), low density lipoproteins (LDL), very low density lipoproteins (VLDL), apolipoprotein A-1 (Apo A-1), apolipoprotein B (Apo B), TC:HDL ratio and Apo A-1:Apo B ratio. Hemodynamic risk factors include systolic blood pressure (SBP), diastolic blood pressure (DBP), augmentation index, aortic pulse wave velocity, carotid intima-media thickness, and femoral intima-media thickness. Hemostatic risk factors include tissue plasminogen activator (tPA), tPA inhibitor, tPA antigen, total plasminogen activator inhibitor type 1, and fibrinogen (8). Body fatness (8,10,11) and cardiovascular (CV) fitness are noninvasive measures that are independently predictive of CVD risk (9).

The link between physiological measures and health status is well established (10,11,12). For example, body fatness and cardiovascular fitness are two measures that are independently predictive of CVD risk. It is well established that excess body fat increases risk for CVD disease and that high levels of CV fitness are cardioprotective (8,9,11,13). Body fatness and CV fitness are also routinely used to predict presence of other disease risk factors such as TC, TG, HDL, LDL, VLDL, Apo A-1, Apo B, and TC:HDL ratio and Apo A-1:Apo B ratio, SBP, DBP, (8,13,14,15,16,17,18).

Given the facts that increased body fatness and poor CV fitness are independently predictive of increased risk for disease, it is difficult to understand why obesity rates are on the incline and time spent in physical activity is on the decline (19,20). In fact, many public schools facilitate low levels of physical activity as school children are often provided less than 30 minutes of physical activity per week in school-sponsored physical education programs (20). This fact is especially unsettling because the link between health status as a child and health status as an adult is quite clear. Twenty-six to forty-one percent of obese preschool, and 42-63% of obese school-age children become obese adults and the risk of adult obesity is at least twice as high for obese children than for non-obese children (21). Researchers are in universal agreement that obese children are more likely to become obese adults. Physical activity habits follow a similar pattern in that the greatest decline in physical activity is likely to occur between the ages of 15-18 and the trend persists into adulthood as physical activity levels continue to decline (19).

In its position statement in 1996, the American Heart Association stated that early detection and intervention are imperative to winning the fight against cardiovascular disease. Identifying children who are at risk for developing CVD in a school setting would support early detection and benefit a large number of children. However, measurement of the disease risk factors included in most

prediction models is costly, time-consuming, and invasive, making it unlikely for most schools to complete such assessments (22,23). The fact that most disease conditions are not manifest until later in life (21,24,25) further complicates early detection of relative risk for disease in children and adolescents.

The purpose of this causal comparative study was to determine if a psychometric variable such as locus of control (LOC) was associated with indicators of disease risk in a convenience sample of adolescents. The dependent variables were defined as indicators of cardiovascular disease risk (body fatness: body fat percent (BF%), and waist and hip circumferences; and hemodynamic and hemostatic measures: Plasma TC, TG, HbA1c, HDL, VLDL, Apo A-1, Apo B, LDL, TC:HDL ratio, and Apo A-1:Apo B ratio). The independent variable was locus of control as measured by the locus of control survey by J. B. Rotter, entitled "Generalized Expectancies for Internal versus External Control of Reinforcement" (1). We hypothesized that adolescents with an external LOC would have a more negative health profile compared to adolescents with an internal LOC. The study is important because it may provide an inexpensive, non-invasive way to screen school children for disease risk. Furthermore, it may provide insight into understanding why some adolescents have a negative health profile compared to other adolescents.

## **METHODS**

### **Subjects**

Participants were a convenience sample (n = 167) of students enrolled in physical education or health classes at a Midwestern high school. This causal comparative study was approved by the institutional review board (IRB) at the University of Dayton. Before participation, each adolescent returned an informed consent form that had been signed by a parent or legal guardian permitting their participation in the study.

### **Procedures**

Participants completed an online locus of control questionnaire based on J. B. Rotter's 1966 monograph entitled "Generalized Expectancies for Internal versus External Control of Reinforcement" (1) during their regular class session. LOC scores were divided into three groups: 1-6 Internal LOC; 7 Neutral LOC; 8-13 External LOC. A low score indicated an internal locus of control. A high score indicated an external locus of control. It should be noted that most subjects who were classified as external scored in the range from 8 to 10. Only one subject scored 11 and none scored 12 or 13. Therefore, only scores for externals scoring between 8 and 10 were included in the data analysis.

Height and weight were measured using a balance-beam scale with a rigid vertical height rod (stadiometer). Waist circumference was measured to the nearest 0.1 cm at the level of the umbilicus. Hip circumference was measured at the greatest girth of the gluteus. Upper-body bioelectrical resistance was measured with a hand-held bioelectrical impedance analyzer (BIA) (Model HBF-300, Omron Healthcare, Vernon Hills, IL) at a fixed signal frequency of 50 kHz. Subjects' height, weight, age in years, and sex were entered into the Omron BIA device. Height was entered to the nearest 0.25 in., and weight entered to the nearest 0.5 lb. The subject stood erect with feet placed shoulder-width apart, arms parallel to the ground, and elbows extended. The subject's hands and fingers maintained contact with source and sensor electrodes by firmly gripping the handles of the device. Relative body fat, estimated by the manufacturer's equation, was digitally displayed and recorded. Body mass index (BMI), calculated as weight/height squared, was also digitally displayed and recorded.

Additional measurements were taken on a subsample of 61 female students who were enrolled in a specific physical education class called the "walking class." The walking class meets five days per

week during the regular school day and successful completion requires that students engage in approximately 40 minutes of aerobic exercise each class period. For these 61 students, a trained phlebotomist drew a sample of blood from the inside of the elbow or the back of the hand. Samples were agitated and refrigerated until delivered to a local accredited laboratory for analysis. Plasma TC, TG, HbA1c, HDL, VLDL, Apo A-1, and Apo B concentrations were determined, and LDL, TC:HDL ratio, and Apo A-1:Apo B ratio were calculated. Subjects were seated in an upright position for a minimum of 5 minutes and resting systolic and diastolic blood pressures were measured indirectly using a mercury sphygmomanometer. A single measure of blood pressures was then taken by the clinician.

Data were not collected for students who did not return signed consent forms, were absent from class during testing days, expressed a desire not to participate in data collection, or who were not fasted for the blood draws. Survey data were collected in a Microsoft Access data base and other measurements were recorded in a Microsoft Excel spreadsheet. All data were combined in a single spreadsheet and exported to SPSS (Statistical Package for the Social Sciences version 14.0) for statistical analysis.

### Statistical Analyses

Means and standard deviations were calculated for all variables. Correlation matrices were completed for all variables and significant associations were noted. Prediction equations were developed using step-wise linear regression analysis to determine the best variables for predicting HbA1c, Apo A-1 and Apo B. Alpha was set at the  $p \leq 0.05$  level for all analyses.

Body fat percentages were divided into groups in 5% increments of increasing fatness as follows: GROUP 1: < 19.9% (N = 56); GROUP 2: 20 to  $\leq 24.9\%$  (N = 48); GROUP 3: 25 to  $\leq 29.9\%$  (N = 20); GROUP 4: 30 to  $\leq 34.9\%$  (N = 28); GROUP 5: 35 to  $\leq 39.9\%$  (N = 8); and GROUP 6: 40% and up (N = 7).

## RESULTS

Subject characteristics for the full sample of 167 adolescents and the sub sample of 61 students enrolled in the walking class only are presented in Table 1.

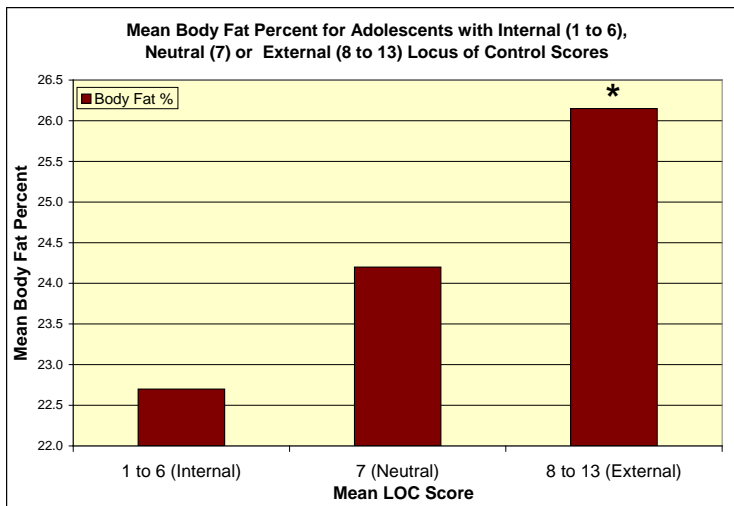
In the sample of 167 students, locus of control scores were, on average, higher for females (6.16; N = 111) compared to males (4.30; N = 56). In the sample of 167 students, mean body fat percents and LOC scores were significantly correlated ( $r = 0.208$ ;  $p = 0.006$ ) and the mean body fat percent was significantly different between internal and external locus of control groups ( $p = 0.039$ ; Figure 1). As locus of control score shifted from internal to neutral to external, mean body fat percentage increased significantly.

**Table 1: Subject Characteristics**

Subject	Age (years)	LOC score	Body Fat (%)	BMI
<b>Full Sample (N = 167)</b>	15.91 $\pm$ 1.18	15.91 $\pm$ 2.2	23.6 $\pm$ 8.62	23.78 $\pm$ 5.25
<b>Walking Class Only (N= 61)</b>	15.94 $\pm$ 1.15	6.63 $\pm$ 2.38	28.43 $\pm$ 17.56	24.78 $\pm$ 6.03

Blood chemistry data was available for the sub sample of 61 students enrolled in the walking class only. In this group, Apo A-1 and LOC were significantly and negatively correlated ( $r = -.467$ ;  $p = .021$ ) and HbA1c and LOC were significantly and positively correlated ( $r=.415$ ;  $p=.039$ ).

Stepwise regression tests were run to determine the predictive value of LOC for the dependent variables: SBP, DBP, TC, HDL, LDL, VLDL, TG, ApoA1, Apo B, and HbA1c using LOC scores, BF%, and BMI as independent variables.



The regression analysis to determine the ability of LOC score to predict HbA1c level returned an  $r^2$  value of 0.48 and a  $p$  value of 0.002 when combined with a measurement of hip circumference. As such, HbA1c and the combination of LOC and hip circumference have a shared variance of 48%. The  $p$  value of the regression equation ( $p = 0.002$ ) indicated a very reliable relationship in that it would be expected to persist 99.8% of the time. The regression equation is as follows:

**Figure 1.** Mean body fat percent is significantly different than the internal group ( $p=0.039$ ). Neither the internal nor the external group is significantly different than the neutral group.

$$\text{HbA1c} = 4.202 + [.004(\text{hip circumference})] + [.064(\text{Locus of Control})]$$

The regression analysis to determine the ability of LOC score to predict Apo A-1 levels returned an  $r^2$  value of 0.22 and a  $p$  value of 0.03. As such, Apo A-1 and LOC have a shared variance of 22%. The  $p$  value of the regression equation ( $p = 0.03$ ) indicated a very reliable relationship in that it would be expected to persist 97% of the time. The regression equation is as follows:

$$\text{Apo A-1} = 185.270 - [5.26(\text{locus of control})]$$

LOC scores were not significantly predictive of the other dependent variables.

## DISCUSSION

We sought to determine if a measure of locus of control could predict more invasive and costly indices of physical health in a sample of adolescent high school students. Locus of control and body fatness were found to be significant predictors of two of the most costly and revealing health measures (HbA1c and Apo A-1).

The current research findings are important for several reasons. One, if a measure such as LOC, which is cost effective, non-invasive and easy to obtain is predictive of costly and revealing health measures such as HbA1c and Apo A-1, then it may be possible to screen large groups of adolescents for disease risk. Individuals who are identified as possibly being at risk in the LOC screening process could be referred for further, more conclusive, testing and targeted for accelerated intervention if needed. Two, the current findings support the growing body of evidence that suggests there is an association between physical health status and locus of control (1-3). In particular, the current findings support earlier research by Deforche et al (2004) who found that adolescents with a high internal locus of control performed better in physical activities and are healthier overall than those with an external locus of control (7). Plasma HbA1c reflects glucose control over the life of a red blood cell (~120 days) and is proportional to average blood glucose concentration over the previous four weeks to three months (22,23). Apo A-1 is the major protein associated with HDL cholesterol.

Increased levels of Apo A-1 are associated with reduced risk for CVD, and decreased levels of Apo A-1 are associated with decreased HDL, and therefore decreased clearance of excess cholesterol from the body. Both of these measures may be reflective of physical fitness status and overall health status. It appears that locus of control may be a good predictor of certain indices of physical health, as indicated by Apo A-1 and HbA1c.

Another important finding that may be inferred from the current study is that a psychometric variable, such as LOC, could provide insight as to why some students are less apt to engage in behaviors that are associated with improved physical health. Mean body fat percents and LOC scores were significantly correlated ( $r = 0.208$ ;  $p = 0.006$ ), and as locus of control score shifted from internal to neutral to external, mean body fat percentage increased significantly. This suggests that adolescents with an external locus of control are significantly more likely to have higher body fatness compared to adolescents with an internal or neutral locus of control. Perhaps an effective approach to decreasing adolescent body fatness might be to work toward developing a more internal locus of control. Even though we showed that there is a strong association between locus of control and physical indices of health, more research needs to be completed to feel certain that a psychometric measure can reliably predict a physiological value.

The current research should be of value to future investigators seeking associations between noninvasive measures of body fatness and psychometric variables with indices of physical health that represent risk for developing disease and to educators and clinicians who are charged with the tasks of assessing and improving health status of adolescent youth.

## CONCLUSIONS

In conclusion, scores from Rotter's Internal and External Locus of Control Scale were significantly predictive of two important indices of physical health, namely Apo A-1 and HbA1c. With more research, it is possible that less invasive measurements, such as locus of control, may be proven useful in screening large groups of adolescents for disease risk. Further research should investigate the association between adolescent locus of control and physical health.

This research was supported by the United States Department of Education Carol M. White PEP Grant Award number Q215F040081 and the University of Dayton.

---

## ACKNOWLEDGEMENTS

We would like to thank Colleen Maxwell, Tecla Sweeney, Brian Wolfe, and Kimber Porter, University of Dayton students who assisted with data collection and the literature review.

---

**Address for correspondence:** Brahler CJ, PhD, Department of Health and Sport Science, University of Dayton, 300 College Park, Dayton, Ohio, USA, 45469-1210. (937)229-3975; FAX: (937)229-4244.; Email: [brahler@udayton.edu](mailto:brahler@udayton.edu).

---

## REFERENCES

1. Rotter JB. Generalized expectations for internal versus external control of reinforcement. *Psychological Monographs* 1966;80(609):1-28.
2. Goldstein LH, Atkins L, Leigh PN. Health-related locus of control: does it change in motor neuron disease (MND)? *Amyotroph Lateral Scler Other Motor Neuron Disord* 2003;4(1):27-30.
3. Graffeo LC, Silvestri L. Relationship between locus of control and health-related variables. *Education* 2006;126(3):593-596.
4. Weinstein SE, Quigley KS. Locus of control predicts appraisals and cardiovascular reactivity to a novel active coping task. *J Personality* 2006;74(3):911-932.
5. Seeman M, Evans J. Alienation and learning in a hospital setting. *Am Sociol Rev* 1962;27(6):772-782.
6. Raja SN, Williams S, McGee R. Multidimensional health locus of control beliefs and psychological health for a sample of mothers. *Soc Sci Med* 1994;39(2):213-220.
7. Deforche B, De Bourdeaudhuij I, Tanghe A, Hills AP, De Bode P. Changes in physical activity and psychosocial determinants of physical activity in children and adolescents treated for obesity. *Patient Educ Couns* 2004;55(3):407-415.
8. Christou DD, Gentile CL, DeSouza CA, Seals DR, Gates PE. Fatness is a better predictor of cardiovascular disease risk factor than aerobic fitness in healthy men. *Circ* 2005;111:1904-1914.
9. Carnethon MR, Gulati M, Greenland P. Prevalence and cardiovascular disease correlates of low cardiorespiratory fitness in adolescents and adults. *JAMA* 2005;294(23):2981-2988.
10. Williams DP, Going SB, Lohman TG, et al. Body fatness and risk for elevated blood pressure, total cholesterol, and serum lipoprotein ratios in children and adolescents. *Am J Public Health* 1992;82(3):358-363.
11. Nielsen GA, Andersen LB. The association between high blood pressure, physical fitness, and body mass index in adolescents. *Prev Med* 2003;36:229-234.
12. Sharp TA, Grunwald GK, Giltinan KE, King DL, Jatkauskas CJ, Hill JO. Association of anthropometric measures with risk of diabetes and cardiovascular disease in Hispanic and Caucasian adolescents. *Prev Med* 2003;37:611-616.
13. Eisenmann JC, Wickel EE, Welk GJ, Blair SN. Relationship between adolescent fitness and fatness and cardiovascular disease risk factors in adulthood: the aerobics center longitudinal study (ACLS). *Am Heart J* 2005;149:46-53.
14. Kelishadi R, Gheiratmand R, Ardalan G, et al. Association of anthropometric indices with cardiovascular disease risk factors among children and adolescents: CASPIAN study. *Int J Cardiology* 2007;117:340-348.
15. Maffei C, Corciulo N, Livieri C, et al. Waist circumference as a predictor of cardiovascular and metabolic risk factors in obese girls. *Euro J Clin Nutr* 2003;57:566-572.
16. Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, Berenson GS. Body mass index, waist circumference, and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents. *Pediatrics* 2004;114(2):198-205.
17. Thomas NE, Baker JS, Davies B. Established and recently identified coronary heart disease risk factors in young people: the influences of physical activity and physical fitness. *Sports Med* 2003;33(9):633-650.
18. Tarberner P, Barbeito S, Marino P, et al. Serum apolipoproteins as risk factors of childhood obesity. *Int J Obes Relat Metab Disord* 1998;22(S4):S15.
19. Caspersen CJ, Pereira MA, Curran KM. Changes in physical activity patterns in the United States by sex and cross-sectional age. *Med Sci Sports Exerc* 2000;32:1601-1609.
20. Watts K, Jones TW, Davis EA, Green D. Exercise training in obese children and adolescents: current concepts. *Sports Med* 2005;35(5):375-392.



21. Serdula MK, Ivory D, Coates RJ, Freedman DS, Williamson DF, Byers T. Do obese children become obese adults: a review of literature. *Prev Med* 1993;22:166-167.
22. Glow KM, Sperhac AM. A community collaborative partnership for the Chicago public schools. *J Sch Health* 2003;73(10):395-398.
23. Fardy PS, Azzollini A, Herman A. Health-based physical education in urban high schools: the PATH program. *J Teaching PE* 2004;23:359-371.
24. Barnekow-Bergkvist M, Hedberg G, Janlert U, Jansson E. Adolescent determinants of cardiovascular risk factors in adult men and women. *Scand J Public Health* 2000;29:208-217.
25. Lipp EJ, Deane D, Trimble N. Cardiovascular disease risks in adolescent males. *Appl Nurs Res* 1996;9(3):102-107.

---

**Disclaimer**

The opinions expressed in **JEPonline** are those of the authors and are not attributable to **JEPonline**, the editorial staff or ASEP.