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Correlations between Activity and Blood Pressure in African American Women and Girls

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CORRELATIONS BETWEEN ACTIVITY AND BLOOD PRESSURE IN AFRICAN AMERICAN WOMEN AND GIRLS.

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ABSTRACT

CORRELATIONS BETWEEN ACTIVITY AND BLOOD PRESSURE IN AFRICAN AMERICAN WOMEN AND GIRLS. **Brian A. Murray, C. Jayne Brahler, Janine Baer, John Marotta**. . *JEP*online. 2003;6(3):38-44. Is the level of physical activity recommended by the Surgeon General enough to elicit the beneficial effects of exercise on blood pressure in African American women and girls? This study investigated self-reported physical activity level and its relationship to blood pressure in a population of African American women (N=25) between the ages of 21 and 53 years and girls (N=52) between the ages of 5 and 17 years, in Dayton, Ohio, USA. Physical activity levels were estimated by an interviewer-administered questionnaire, which determined the average hours per week over the past year spent in occupational and leisure activities. Blood pressure was also measured. 56% of the women had average physical activity levels of 3.7 MET-hours per week, and 73% of the girls had average physical activity levels of 3.9 MET-hours per week compared to the Surgeon General's recommendation of 7.5-15 MET-hours per week. Inverse correlations between self-reported physical activity level and systolic and diastolic blood pressures were statistically significant in some but not all of the groups. These data suggest that increasing physical activity levels should be considered as part of an intervention program for African American women to control systolic and diastolic blood pressures.

Key Words: Occupational Activity, Leisure Activity, Met-Hours Per Week, Hypertension

INTRODUCTION

Hypertension is classified as having systolic blood pressure equal to or greater than 140 mmHg and/or diastolic blood pressure equal to or greater than 90 mmHg (3). Existing evidence indicates that aerobic exercise training reduces the magnitude of rise in blood pressure that can be expected over time in persons at increased risk for developing hypertension (3). Longitudinal studies have shown participation in chronic aerobic exercise may elicit an average reduction of about 10 mmHg in both systolic and diastolic blood pressure (3). This suggests physical activity is important in controlling and reducing blood pressure. Low levels of cardiorespiratory

fitness are also associated with increased risk of disease. About 14% of young Americans report no recent light, moderate or vigorous physical activity (11). This indicator of inactivity is higher among females than males, and African American females than Caucasian females. African American girls have been shown to have a significantly lower cardiorespiratory fitness when maximal oxygen consumption was expressed relative to body weight, shorter time to exhaustion, and less ability to utilize oxygen during maximal exercises at a given fat free mass compared to white girls (7). African American women engage in less leisure-time physical activity, and spend less time standing and walking stairs compared to their white counterparts (14).

The purpose of this study was to determine the correlation between physical activity and blood pressure in African American women between the ages of 21 and 53 years and girls between the ages of 5 and 17 years and to determine if the level of physical activity recommended by the Surgeon General is enough to elicit the beneficial effects of exercise on blood pressure in African American women and girls. The American College of Sports Medicine (ACSM) has correlated lower blood pressure, both systolic and diastolic, with increased physical activity. It has also reported increased blood pressure levels, and increased risk for cardiovascular and metabolic diseases with decreased levels of physical activity. ACSM has reported lower incidences of coronary artery disease, hypertension, obesity, stroke, cancer, Type 2 diabetes mellitus, and osteoporosis with increased physical activity and fitness. It is important to determine the physical activity levels in a sample of inner-city African American women and girls, and to correlate these activity levels with blood pressure. It is hypothesized that lower levels of physical activity will be reported by African American women and girls and that these low levels of physical activity will correlate inversely with both systolic and diastolic blood pressures because physical activity appears to be important in reducing blood pressure and controlling hypertension.

METHODS

Study population

The subjects in this study were African American women (ages 21-53 years) (N=25) and girls (ages 5-17 years) (N=52). Volunteers were recruited through an announcement, which was placed in two local Midwestern church bulletins and a local agency that provides assistance for low-income families. Interested persons were to contact the principle investigator for more information. To be eligible for the study the women had to be pre-menopausal and not on estrogen therapy. Children had to be between the ages of 5 and 17 years, female, apparently healthy and not pregnant. All participants were apparently healthy and medically stable, with no known acute heart disease complications, endocrine problems, complications from diabetes mellitus, HIV/AIDS, or other major diseases as determined by completing a health history questionnaire.

Procedures

The protocol and consent form were approved by the University of Dayton Institutional Review Board. There were 82 subjects in the study. Transportation to the University of Dayton provided was provided. The subjects were 12-14 hours fasted upon arrival at the university. All subjects signed a University of Dayton Institutional Review Board approved informed consent form before data collection began.

Measures

Physical activity levels were estimated by an interviewer-administered questionnaire. Each subject's physical activity level was assessed by self-report, using the Modifiable Physical Activity Questionnaire or the Modifiable Activity Questionnaire for Adolescents, developed by Kriska et al. (13,14). These questionnaires determined the average hours per week over the past year spent in occupational and leisure physical activity (13,14). Occupational physical activity was calculated according to whether light, moderate, or heavy work was involved while performing typical activities on the job. Time spent walking or biking to work was assessed as part of the occupational activity. Leisure physical activity was determined by providing a list of local leisure activities and estimating the frequency and duration of those activities performed over the past year. Each occupational activity or leisure activity was also weighted by an estimate of its relative intensity or MET value, which is the ratio of the working metabolic rate of an individual divided by the resting metabolic rate (7). One MET represents the energy expended at rest for an individual (estimated as 1 Kcal/kg body weight * height), whereas a 7-MET activity requires 7 times the resting energy expenditure. Validation and reliability testing of

the Modifiable Activity Questionnaires were previously published (14). Each subject's blood pressure was measured at least twice in the right arm with the subject seated and using an electronic blood pressure machine (Tango with ECG). Each subject sat quietly for five minutes before the first reading was taken. A second reading was taken after an additional five-minute rest. If there was more than 5 mmHg difference between the two readings, a third reading was completed after another five-minute rest. The average of readings one and two was taken, however if a third reading was needed, the average between readings two and three was taken.

Statistical analyses

Women data were blocked according to low, medium, and high levels (0-9.99, 10.00-34.99 and >35.00 MET-hours per week, respectively). Child data were blocked according to the Second Task Force on Blood Pressure Control in Children, Lung and Blood Institute's median normal blood pressure values for children at age (5,6-8, 9-11, 12-14, and 15-17 years). Child data were additionally blocked within each age group according to physical activity levels (0-9.99, 10.00 – 34.99, and > 35.00 MET-hours per week, respectively). Physical activities (expressed as MET- hours per week) were determined for past year occupational activity, past year leisure activity, and past year total activity (occupational + leisure). The physical activity level of each subject was compared to the Surgeon General's recommendation of 15-20 minutes of moderate intensity, approximately 3 to 6 metabolic equivalents, on most if not all days of the week (3). This recommendation was then converted to MET-hours per week using the following equations from the Modifiable Activity Questionnaires: (number of months) * (4.3 weeks/month) * (minutes/day) / (60 minutes per hour) / (52 weeks per year). This value of hours per week was then multiplied by the estimated metabolic cost of the activity. The estimated metabolic cost of each activity was based on Pollock, Wilmore and Fox's Energy cost of Various Activities (6). Blocking of children's blood pressure data according to both age and physical activity level reduced the number of children in each group. All analyses were conducted using Microsoft Excel 2000 for Windows.

RESULTS

The average physical activity level for 56% of the women was 3.7 MET-hours per week. This is significantly lower than the Surgeon General's recommended 7.5-15.0 MET-hours per week (3). The average physical activity level for 73% of the girls was 3.9 MET-hours/week. This is also significantly lower than the Surgeon General's recommendation of 7.5-15.0 MET-hours per week (Tables 1,2).

Table 1. Average correlations between physical activity level and systolic and diastolic blood pressure for women who are grouped according to low, medium, and high physical activity levels.

Age	*N*	*Range*	*Level*	*MET-hr/week*	*SBP R-value*	*DBP R-value*
Mothers	14	0.0 - 9.9	Low	3.7	0.088	0.132
Mothers	7	10.0 - 34.9	Medium	21.5	0.023	0.361

*Represents data that reached significance at P = 0.10
MET-hr/week, Average MET-hours per week; SBP, systolic blood pressure; DBP, diastolic blood pressure

The percentage of women in this study who had blood pressures higher than the median systolic and or diastolic blood pressures for adults was 40%. The majority of the girls in this study, 71%, also had blood pressure values that were higher than the median systolic and or diastolic blood pressures values for children of their respective ages.

Table 2. Average correlations between physical activity and systolic and diastolic blood pressure for daughters who are grouped according to age, and low medium and high physical activity level.

Age	N	Range	Level	MET-hr/wk	SBP R-value	DBP R-value
5	6	0.0 - 9.9	Low	1.7	-0.470	-0.734**
6 to 8	10	0.0 - 9.9	Low	3.2	-0.401	-0.491
6 to 8	5	> 35.0	High	36.4	0.149	-0.752*
9 to 11	11	0.0 - 9.9	Low	4.9	0.291	-0.449
12 to 14	4	10.0 - 35. 0	Medium	16.5	-0.403	-0.3111
15 to 17	4	0.0 - 9.9	Low	4.5	-0.108	-0.124
15 to 17	4	> 35.0	High	87.1	-0.568	-0.633

* Represents data that reached significance at the p<0.10
* Represents data that reached significance at the p<0.05
MET-hr/wk, Average MET-hours per week; SBP, systolic blood pressure; DBP, diastolic blood pressure

The trends observed in the data reached statistical significance for: women who had physical activity levels greater than 35.0 MET-hours per week had significantly lower systolic and diastolic blood pressure compared to the American College of Sports Medicine's normal median value for adults (2,3) (p=0.10), diastolic blood pressure in the five year old girls (p=0.05), and diastolic blood pressure in the six to eight year old girls who had activity levels greater than 35.0 MET-hours per week (p=0.10) were also significantly lower than the median normal blood pressure values for the respective age groups based on the Second Task Force on Blood Pressure Control in Children, Lung and Blood Institute's median normal blood pressure values for children at age (5, 6-8, 9-11, 12-14, and 15-17 years) (4) (Table 3 below).

However, it should be noted that blocking of the children's blood pressure data according to both age and physical activity level reduced the number of children in each group, making it more difficult to reach statistical significance (see Tables 1,2).

Table 3. Average systolic and diastolic blood pressures for women and girls compared to median systolic and diastolic blood pressures for their age category.

Age	Level	N	Avg SBP	Norm SBP	Avg DBP	Norm DBP
5	Low	6	101.9	92.0	65.7	55.0
6 to 8	High	5	104.1	96.0	64.1	57.0
9 to 11	Low	11	116.6	100.0	71.2	61.0
12 to 14	Low	8	113.6	107.0	64.8	64.0
12 to 14	Medium	4	108.8	107.0	62.8	64.0
15 to 17	High	4	107.88	114.0	66.8	65.0
Adult	Low	14	121.6	125.0	76.3	82.0
Adult	Medium	7	115.1	125.0	77.4	82.0
Adult	High	4	121.2	124.5	72.1	82.0

Level=Physical activity level; Avg SBP=average systolic blood pressure of the group; Norm SBP=normal median systolic blood pressure for someone of that age; Avg DBP=average diastolic blood pressure of the group; Norm DBP=average diastolic blood pressure for someone of that age.

There were two subjects considered to have inaccurate MET-hour per week levels based on self-reported physical activity exceeding 150.0 MET hours per week. There were three other subjects who had reported accurate physical activity level, that exceeding 39.0 MET hours per week but were at least three times higher than any other individual's MET hours per week in their age category. These five individuals were considered outliers and removed from the data analysis. There were three other subjects who had MET values that were less than 1.0 MET-hour per week above the lowest (7.5 MET-hours per week) recommendation for physical activity by the Surgeon General. These subjects were grouped in the low level with subjects in their age category. This was done to prevent any individual from being the sole member of a group.

DISCUSSION

Increases in physical activity have been reported to decrease both systolic and diastolic blood pressures (2,3). Therefore, the inverse correlation observed between high physical activity levels and lower blood pressure in the women would be expected. The same is true for these correlations in the girls. The strongest inverse correlations observed between systolic or diastolic blood pressure and physical activity were for women with physical activity levels greater than 35.0 MET-hours per week. Perhaps the most significant finding in this study was the fact that there was not a significant inverse association between systolic or diastolic blood pressure and physical activity for women who had physical activity levels that fell within the range of the Surgeon General's recommendation. This may suggest that the level of physical activity recommended by the Surgeon General's report is not enough to elicit the beneficial effects of exercise on blood pressure in this population.

All three physical activity levels, for the girls, were inversely correlated with systolic or diastolic blood pressure or both for all age groups except the 9-11 year olds. However, girls who had physical activity levels exceeding 35.0 MET-hours per week had the largest inverse correlations between physical activity and both systolic and diastolic blood pressure. This would be expected because physical activity has been reported to decrease blood pressure (2,3). This may suggest that the level of physical activity recommended by the Surgeon General's report is not enough to elicit the beneficial effects of exercise on blood pressure in this population.

This study was descriptive. Therefore, the only assessment of physical activity was self-reported. It is well known that self-reported physical activity does not yield as accurate data as a controlled intervention program would. A controlled intervention needs to be completed to assess the effects of physical activity on blood pressure. In conclusion, the results of this study indicate there is an inverse relationship between physical activity level and blood pressure. Results also suggest that, in the population studied, the Surgeon General's recommendation of 7.5-15.0 MET-hours per week may not be enough to elicit the beneficial changes in blood pressure that would be expected from chronic physical activity. These results suggest that 35.0 MET-hours or more may be needed to elicit the changes in blood pressure that would be expected from physical activity in this population.

CONCLUSIONS

Participation in greater than 35.0 MET-hours per week of physical activity may yield significantly lower systolic and diastolic blood pressures for adult African American females compared to the American College of Sports Medicine's normal median value for adults. Participation in greater than 35.0 MET-hours per week of physical activity for five to eight year old African American females may yield significantly lower diastolic blood pressures compared to the median normal blood pressure values for the respective age groups based on the Second Task Force on Blood Pressure Control in Children, Lung and Blood Institute's median normal blood pressure values for children at age (5, 6-8, 9-11, 12-14, and 15-17 years). Physical activity levels that meet the Surgeon General's recommendation of 7.5-15 MET-hours per week may not yield significant improvements in blood pressure values.

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REFERENCES

1. Aaron, Deborah J., Andrea M. Kriska, Steven R. Dearwater. et al. The epidemiology of leisure physical activity in an adolescent population. ***Med Sci Sports Exerc*** 1993;25(7):847-853.
2. American College of Sports Medicine: *Guidelines for Exercise Testing and Prescription*. ……, 6th ed. Philadelphia, PA, Lippincott, Williams, and Wilkins.
3. American College of Sports Medicine: *Exercise Management for Persons with Chronic Diseases and Disabilities*. 1997, Durstine.
4. Ball, Jane et al. *Pediatric Nursing: Caring for Children*. 1995, Applet and Lange.
5. Barlow, S.E. and Dietz, W.H. Obesity Evaluation and Treatment: Expert committee recommendations. ***Pediatrics*** 1998;102(3):29-46.
6. Brooks, George et al. **Exercise Physiology: Human Bioenergetics and Its Applications**. 2000, 3rd Edition. California: Mayfield Publishing Company.
7. Dill, D.B. The economy of muscular exercise. ***Physiol Rev*** 1936:16:263-291.
8. Fitzgerald, Shannon J., Andrea M. Kriska, Mark A. Pereira et al. Associations among physical activity, television watching, and obesity in adult Prima Indians. ***Med Sci Sports Exerc*** 1997;29(7):910-915.
9. Folsom, et al. Implications of Obesity and for cardiovascular disease in blacks: The CARDIA and ARIC studies. ***Am J Clin Nutr*** …;53:1640S-1611S.
10. Freedman, D.S., Dietz, W.H. et al. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. ***Pediatrics*** …;103(6):1175-1182.
11. Gordon-Larsen, P., McMurray, et al. Determinants of physical activity and inactivity patterns. ***Pediatrics*** 105(6):….
12. Kriska, A. Ethnic and Cultural issues in assessing physical activity. ***Res Quart Exerc Sport***. 2000;71(2) 47-53.
13. Kriska, A.M., and C.J. Caspersen. Introduction to the collection of physical activity questionnaires. In: *A collection of Physical Activity Questionnaires for Health-Related Research*, A. M. Kriska and C.J. Caspersen (Eds.). Centers for Disease Control and Prevention. ***Med Sci Sports Exerc*** 1997;29:S5-S9.
14. Kriska, A.M., W.C. Knowler, R.E. LaPorte. et al. Development of questionnaire to examine the relationship of physical activity and diabetes in Pima Indians. ***Diabetes Care*** 1990;13:401-411.
15. Lovejoy, Jennifer C., Catherine M. Champagne, Steven R. Smith. Ethnic differences in dietary intakes, physical activity, and energy expenditure in middle-aged, premenopausal women: the Healthy Transitions Study. ***Am J Clin Nutr***. 2001;74:90-5.
16. Must, A., Straus, R.S. Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity*. 1999;23:S2-S11.
17. National Center for Health Statistics. **NHANES III reference manuals and reports**. 1996, Centers for Disease Control and Prevention: Hyattsville, MD.
18. Pivarnik, James M. Molly S. Bray, Albert C. Hergenroeder. Ethnicity affects aerobic fitness in U.S. adolescent girls. ***Med Sci Sports Exerc*** 1995;27(12):1635-1638.

19. Vuillemin, Anne., Jean-Michel Oppert, Francis Guillemin. Self-Administered questionnaire compared with interview to asses past year physical activity. ***Med Sci Sports Exerc*** 2000;32(6):1119-1124.
20. Williamson, D.F., Kahn, H.S., and Beyers, T. The 10-year incidence of obesity and major weight gain in black and white US women aged 30-55 years. ***Am J Clin Nutr*** 1991;53, 1515S-1518S.
21. Wolf, Anne M., David J. Hunter, Graham A Colditz, et al. Reproducibility and Validity of a Self-Administered Physical Activity Questionnaire. *Int J Epidem*. 1994;23(5):991-998.