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Correlation between glutathione peroxidase activity and anthropometrical parameters in adolescents with Down syndrome

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Abstract

Since we have recently found that regular exercise increased erythrocyte antioxidant enzyme activities such as glutathione peroxidase (GPX) in adolescents with Down syndrome, these programs may be recommended. This study was designed to assess the role of anthropometrical parameters as easy, economic and non-invasive biomarkers of GPX.

Thirty-one adolescents with Down syndrome performed a 12-week training program. Three days after its ending, GPX activity and anthropometrical parameters were assessed. Pearson's correlation coefficient showed negative but significant association ($r = 0.49$, $p = 0.022$) between GPX activity and waist circumference (WC). Body mass index (BMI) and waist-to-hip ratio (WHR) were not significant. We may conclude that anthropometrical parameters such as WC are easy to perform but not strongly associated to GPX activity. Further studies concerning other variables are needed.

Keywords: Exercise; Glutathione peroxidase; Waist circumference; Down syndrome

Individuals with Down syndrome have been described as having high levels of oxidative stress (Carratelli et al., 2001). This fact is of particular interest since oxidative damage has been proposed as a pathogenic mechanism of atherosclerosis, cell aging, neurodegeneration, carcinogenic events and immunological disorders in individuals with Down syndrome (Pastore et al., 2003). Fortunately, regular exercise may improve redox metabolism in general population

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(Elosua et al., 2003). However, far less information is available on handicapped populations such as Down syndrome individuals.

Since we have recently found that regular exercise improves erythrocyte antioxidant enzyme system in adolescents with Down syndrome, these programs may be valuable for this population (Ordonez, Rosety-Rodriguez, & Rosety, 2006). However, antioxidant enzyme assessment is a complex, expensive and invasive procedure. This study was designed to determine the potential correlations between antioxidant enzyme glutathione peroxidase (GPX) and anthropometrical parameters as a means of developing a less invasive, more economic assessment of this variable.

1. Method

1.1. Participants

Thirty-one male adolescents with Down syndrome (16.3 ± 1.1 years) performed a 12-week training program, 3 sessions/week, consisting of warm up (15 min) followed by a main part (20–35 min [increasing 5 min each 3 weeks]) at a work intensity of 60–75% of peak heart rate (HR_{max} = 194.5 − [0.56 age]) and by a cool-down period (10 min). Written informed consent was obtained from each participant's parents.

1.2. Procedures

Three days after treatment ended, erythrocyte GPX activity and anthropometrical parameters were assessed. Blood samples were obtained from antecubital vein puncture and collected in heparinized tubes. The whole blood was centrifuged at 3000 rpm for 20 min. The erythrocytes remaining after the removal of the plasma were washed three times with 310 mM isotonic Tris–HCl buffer (pH 7.4). Hemolysis was carried out by pipetting out the washed erythrocyte suspension into polypropylene centrifuge tubes which contained 20 mM hypotonic Tris–HCl buffer (pH 7.2). The activity of glutathione peroxidase (E.C. 1.11.1.9) was determined in the supernatant of erythrocyte hemolysates. The conversion of NADPH to NADP was evaluated using UV absorbance at 340 nm according to the method of Flohe and Gunzler (1984). Anthropometrical measurements such as body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) were performed by the same and long-experienced anthropometrist. Results were expressed as mean ± S.D. and 95% confidence intervals. Pearson's correlation coefficient was performed to assess potential associations. Significance was ascertained at $p < 0.05$.

2. Results

Post-exercise GPX activity in adolescents with Down syndrome was 29.3 ± 2.9 [28.1–30.5] U/g hemoglobin. Regarding anthropometrical parameters, BMI was 27.1 ± 1.1 [25.9–28.2] kg/m^2, WC 100.2 ± 3.9 [90.5–112.5] cm and WHR 0.93 ± 0.02 [0.89–0.95]. Pearson's correlation coefficients between GPX activity and BMI ($r = 0.39$, $p > 0.05$), WC ($r = 0.49$, $p = 0.022$) and WHR ($r = 0.37$, $p > 0.05$) were as already stated.

3. Discussion

Regular physical activity may increase antioxidant defense system in healthy young men and women (Elosua et al., 2003). In this respect, we have observed a 12-week training program

increased significantly total antioxidant status (TAS) (Ordonez, Rosety, & Rosety-Rodriguez, in press) and glutathione peroxidase activity (Ordonez, Rosety et al., 2006; Ordonez, Rosety-Rodriguez et al., in press) in adolescents with Down syndrome. Similarly, it was reported the levels of reduced glutathione (GSH) were increased after a 16-week training program in adults with Down syndrome (Monteiro et al., 1997). Consequently, these results suggested regular exercise may contribute to improve redox balance in this population. In any case it should be emphasized that our protocol lasted only 12 weeks.

Previous studies had successfully explored the relationship of anthropometrical parameters such as body mass index, and diet, exercise, disability status and degree of social integration in individuals with Down syndrome (Fujiura, Fitzsimons, Marks, & Chicoine, 1997). However, far less information is available on handicapped populations such as Down syndrome, regarding association between anthropometrical parameters and antioxidant system. In this respect we found a negative but significant association between GPX activity and WC. Regarding BMI and WHR, they were neither strongly nor significantly correlated to GPX. Similarly, BMI was not associated with antioxidant enzyme superoxide dismutase (SOD) in obese diabetics type II (Skrha et al., 2005). Further, Trevisan et al. (2001) did not find significant association between BMI and GPX activity. On the other hand, anthropometrical parameters have been widely associated with biomarkers of oxidative stress. Recently, Weinbrenner et al. (2006) reported that high WC was associated with high concentrations of ox-LDL in healthy males. Similarly, BMI and WHR were associated to lipid peroxidation expressed as malondialdehyde (MDA) content in obese prepubertal children (Mohn et al., 2005). These findings may be explained, at least in part, since obesity has been associated with accelerated oxidative stress (Mohn et al., 2005; Urakawa et al., 2003; Weinbrenner et al., 2006). We may conclude that anthropometrical parameters such as waist circumference are easy to perform but not strongly associated to GPX activity. Further studies concerning other antioxidants are highly required in order to facilitate the medical follow-up of exercise programs.

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