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# Effects of physical exercise on butyrylcholinesterase in obese adolescents

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## Abstract

The aim of the present study was to evaluate the effect of a 12 week program of physical exercise (PE) on butyrylcholinesterase (BChE) in obese adolescents. This study compared obese adolescents (N = 54) before and after PE, regarding the relative intensity (RI) and activity of different molecular forms (G1, G2, G4 and G1-ALB) of BChE found in plasma. Waist circumference (WC) and lipid profile were also assessed before and after PE. It was shown that before PE, mean plasma BChE activity was significantly higher in obese than in non-obese adolescents and that it was significantly reduced after PE, becoming similar to that found in non-obese adolescents. Lipid profile and WC also changed in response to PE. These results are consistent with studies that found a correlation between BChE and lipid metabolism and suggest that PE may have led to a physiological regularization of plasma BChE activity. Although mean BChE activity of each isoform was significantly reduced by PE, their RI did not change. This is in accordance with a previous suggestion that this proportion is maintained under factors such as obesity, and may therefore be important for BChE functions.

*Key words:* BChE activity; physical exercise, obesity.

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Butyrylcholinesterase (BChE; EC 3.1.1.8) is coded by *BCHE* gene (3q26.1-q26.2), synthesized in the liver and distributed to several parts of the organism. Plasmatic BChE is found in four possible homomeric forms (G1 monomers, G2 dimmers, G3 trimers and G4 tetramers) or heteromeric forms formed in association with other proteins, such as albumin, G1-Alb (Masson, 1989).

Several studies verified that BChE has a role in lipid metabolism (Kutty *et al.*, 1977), and is correlated with weight (Chautard-Freire-Maia *et al.*, 1991; Li *et al.*, 2008) and body mass index (Alcântara *et al.*, 2001, 2003; Souza *et al.*, 2005; Furtado-Alle *et al.*, 2008). It is also known that plasma BChE activity is positively correlated with obesity (Kutty, 1980; Chautard-Freire-Maia *et al.*, 1991; Furtado-Alle *et al.*, 2008).

The aim of this study was to compare the relative intensity (RI) of BChE isoforms revealed as bands (G1, G1-Alb, G2 and G4) in obese adolescents before and after 12 weeks of physical exercise (PE), and to search for a correlation between RI of BChE isoform bands, plasma BChE activity and PE.

The sample comprised 54 obese adolescents (BMI above percentile 95 and mean age 12.6 ± 2.01), these being participants of a 12 week program of physical exercise. Aerobic exercise consisted of 50 to 100 min activity during the first four weeks. Intensity was set at 35%-55% of $VO_2$ peak, and was increased to 55%-75% during the next eight weeks. Plasma was sampled at baseline and after terminating the program. A sample of non-obese adolescents (N = 45; mean age 13.3 ± 2.15) was used to measure plasma BChE activity.

The detection and analysis of BChE bands in plasma was made according to Boberg *et al.* (2010). Samples without any detectable BChE band were excluded from the analysis. Plasma BChE activity was measured according to Dietz *et al.* (1972), as modified by Evans and Wroe (1978). This study was approved by the Ethics Committee of Biological Sciences Sector from Federal University of Parana (05/2009).

Mean plasma BChE activity was significantly reduced after the 12 weeks program (before: 7.66 ± 2.64 KU/L, after: 5.89 ± 2.34 KU/L; t = 2.96, p = 0.008). Accompanying BChE activity, waist circumference (WC; before: 97.41 ± 11.20 cm, after: 94.62 ± 10.51 cm, t = 3.6 and p = 0.03), LDL-cholesterol (LDL-C; before: 94.45 ± 20.83 mg/dL, after: 86.00 ± 16.37 mg/dL, t = 2.77 and p = 0.012) and triglycerides (TG; before: 114.30 ± 57.14 mg/dL, after: 82.75 ± 42.66 mg/dL, t = 3.1 and p = 0.006) also showed significant reduction with PE,

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**Table 1** - Means (M) ± Standard Deviations (SD) of relative intensity (RI) and activity of BChE bands in obese adolescents (n = 34) before and after a 12 week program of physical exercise.

| | Relative Intensity | | | Activity (KU/L) | | | |
|---|---|---|---|---|---|---|---|
| | M ± DP | | *t*-test (p) | M ± DP | | *t*-test (p) | Means ratio (B/A) |
| | Before | After | | Before | After | | |
| G4 | 0.68 ± 0.19 | 0.72 ± 0.19 | 1.23 (0.23) | 5.35 ± 3.00 | 4.29 ± 2.29 | 2.48 (0.02) | 1.25 |
| G2 | 0.13 ± 0.09 | 0.10 ± 0.08 | 1.51 (0.14) | 0.99 ± 0.65 | 0.59 ± 0.36 | 3.19 (0.003) | 1.68 |
| G1-alb | 0.10 ± 0.09 | 0.10 ± 0.09 | 0.49 (0.62) | 0.69 ± 0.44 | 0.42 ± 0.43 | 2.29 (0.03) | 1.64 |
| G1 | 0.09 ± 0.08 | 0.08 ± 0.07 | 0.23 (0.82) | 0.77 ± 0.64 | 0.49 ± 0.40 | 2.52 (0.02) | 1.57 |

B = Before physical exercise, A = after physical exercise.

while HDL cholesterol (HDL-C) showed a significant increase (before: 42.54 ± 8.33 mg/dL, after: 49.05 ± 8.61 mg/dL; t = -4.53 and p = 0.0002). These changes in BChE activity, WC and lipid profile (LDL-C, TG and HDL-C) are consistent with an already described association between BChE and lipid metabolism. Considering that mean BChE activity in obese adolescents after the program was similar to that seen in non-obese adolescents (5.0 ± 0.11 KU/L, t = 1.5 and p = 0.13), and that mean BChE activity of each band was significantly reduced by PE (Table 1), the 12 weeks of PE may have led to a physiological regularization of plasmatic BChE activity. This contrasts with the lack of significance between means of RI of BChE isoform bands before and after the program (Table 1).

Boberg *et al.* (2010) had reported that higher plasma BChE activity is found in obese persons, the RI of each isoform is nonetheless maintained, independent of obesity. Our present data are in accordance with the observation made by Boberg *et al.* (2010), showing that, although mean BChE activity (total and related to each band, Table 1) decreased in response to PE, the RI of each band was maintained. This indicates that this proportionality is regulated and may therefore be important for BChE functions.

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## References

Alcântara VM, Rodrigues LC, Oliveira LC and Chautard-Freire-Maia EA (2001) Association of the *CHE2* locus with body mass index and butyrylcholinesterase activity. Hum Biol 73:587-595.

Alcântara VM, Oliveira LC, Réa RR, Suplicy HL and Chautard-Freire-Maia EA (2003) Butyrylcholinesterase and obesity in individuals with the CHE2 C5+ and CHE2 C5- phenotypes. Int J Obes 27:1557-1564.

Boberg D, Furtado-Alle L, Souza RLR and Chautard-Freire-Maia EA (2010). Molecular forms of butyrylcholinesterase and obesity. Genet Mol Biol 33:452-454.

Chautard-Freire-Maia EA, Primo-Parmo SL, Picheth G, Lourenço MAC and Vieira MM (1991) The C5 isozyme of serum cholinesterase and adult weight. Hum Hered 41:330-339.

Dietz AA, Rubinstein HM, Lubrano TE and Hodges LK (1972) Improved method for the differentiation of cholinesterase variants. Am J Hum Genet 24:58-64.

Evans RT and Wroe J (1978) Is serum cholinesterase activity a predictor of succinyl choline sensitivity? An assessment of four methods. Clin Chem 24:1762-1766.

Furtado-Alle L, Andrade FA, Nunes K, Mikami LR, Souza RLR and Chautard-Freire-Maia EA (2008) Association of variants of the -116 site of the butyrylcholinesterase *BCHE* gene to enzyme activity and body mass index. Chem Biol Interact 175:115-118.

Kutty KM (1980) Biological function of cholinesterase. Clin Biochem 13:239-43.

Kutty KM, Redheendran R and Murphy D (1977) Serum cholinesterase: Function in lipoprotein metabolism. Experientia 33:420-421.

Li B, Duysen EG and Lockridge O (2008) The butyrylcholinesterase knockout mouse is obese on a high-fat diet. Chem Biol Interact 175:88-91.

Masson P (1989) A naturally occurring molecular form of human plasma cholinesterase is an albumin conjugate. Biochim Biophys Acta 988:258-266.

Souza RLR, Fadel-Picheth C, Allebrandt KV, Furtado L and Chautard-Freire-Maia EA (2005) Possible influence of *BCHE* locus of butyrylcholinesterase on stature and body mass index. Am J Phys Anthropol 126:329-334.

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