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Antioxidant intake among maladapted highlanders: link to vascular function

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Exposure to high altitude leads to an increased formation of free radicals[(1)]. This, in Chronic Mountain Sickness sufferers (CMS+), may contribute to systemic vascular dysfunction in comparison to the well-adapted controls (CMS-)[(1)]. The protective role of dietary antioxidants in minimising oxidative stress has been well documented[(2)]. Furthermore, the nutritional shift from locally sourced foods to westernised, nutrients depleted diet in Latin American urban areas, is also reported[(3)]. The aim of the study was to investigate vascular function and intake of dietary antioxidants in healthy, well-adapted and diseased maladapted highlanders born and bred in La Paz, Bolivia. We hypothesised that CMS sufferers will show impaired vascular function and low intake of dietary antioxidants compared to well-adapted highlander residents.

To address the aims, 2 studies were completed. Study 1: twenty-five male highlanders participated in the study; 13 of which were CMS+ [mean age 57 (SD 7) years] and 12 were CMS- [mean age 52 (SD 9) years]. Vascular function was assessed using pulse wave analysis and flow-mediated dilation (FMD). Pulse wave analysis was used to derive a normalized augmentation index (AIx) from the radial artery using the SphygmoCor system (AtCor Medical Pty Ltd), while FMD was assessed according to international guidelines[(4)] using a high-resolution ultrasound machine (Acuson P50, Siemens) and expressed as a percentage change of the brachial artery from baseline (Studio; Computer Vision Group). Study 2: thirty-six male highlanders; 22 of which were CMS+ [mean age 52 (SD 9) years] and 14 were CMS- [mean age 52 (SD 12) years] were interviewed to collect a 24-hour structured dietary recall using a portion size photo atlas[(5)]. The stages followed in the UK Low Income Diet and Nutrition survey were used[(6)]. Dietary data were analysed using NetWISP dietary analysis software (*Version* 4.0, *Tinuviel Software*; *Anglesey*, *UK*). Distribution of normality was determined using Shapiro-*W*-Wilks tests. Vascular data were analysed using independent samples *t*-tests and dietary data were analysed using Kruskal-Wallis and Mann-Whitney tests. Significance level was established at $P < 0{\cdot}05$ and data are expressed as mean and standard deviation (SD).

Study 1: FMD was lower and AIx was higher in CMS+ compared to CMS- ($P < 0{\cdot}05$; table).

Study 2: Consumption of vitamin C and carotene were lower in the CMS+ in comparison to CMS- showing borderline significant

	FMD		AIx[3]			Vitamin C		Carotene		Vitamin E	
	%		%			mg		µg		mg	
Study 1	x[1]	SD[2]	x	SD	Study 2	x	SD	x	SD	x	SD
CMS - n = 12	7·6[a]	1·7	12	7	**CMS - n = 14**	66	33	4529	3384	5	4
CMS+ n = 13	4·2[a]	0·7	23[a]	8	**CMS+ n = 22**	47[b]	35	2886[b]	2643	4	2

[1]Mean, [2]Standard Deviation; [3]AIx-75 % = augmentation index normalised to heart rate of 75 beats/min.
[a]$P < 0{\cdot}05$; [b]$P < 0{\cdot}08$

difference ($P < 0{\cdot}08$, table). Consumption of vitamin E was also lower; though, no statistical significance was observed.

The drop in FMD and increase in AIx observed in the CMS+ may be the result of free radical formation and increased oxidative-nitrosative stress. A potential explanation for the decrease in FMD and increase AIx may be linked to the insufficient intake of dietary antioxidants. The findings support the hypothesis that diseased native highlanders have an inadequate intake of dietary antioxidants compared to the non-diseased controls. Poor dietary antioxidant intake may lead to excessive oxidative damage and has been associated with cardiovascular events.

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