The influence of body fat on post-dive bubble formation in recreational divers measured with precordial Doppler monitoring *

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*Schellart et al. Post-dive bubbles & body fat, *ASEM 2012;83(10): 951-7.*

A century of research of body fat and age in relation to pDCS and VGB

Age	Haldane's group **1908**; Sulaiman et al. 1997; Carturan et al, 2002; Conkin et al. 2003; Cameron et al., 2007; Boussuges at al, 2009; Schellart et al. 2012.
BF	Haldane's group **1908**; Dembert et al. 1984; Lam and Yau 1989; Carturan et al. 2002; Boussuges et al. 2009, Schellart et al. 2012.

And more recent with

VO_{2max}	Carturan et al, 2002; Schellart et al. 2012.

All 3 are thought to *influence* VGB/pDCS.

Is BF-VGB relation a co-association due to

- VO_{2max} – BF and
- age – BF correlation?

Age, VO_{2max}, BF are mutually interrelated;

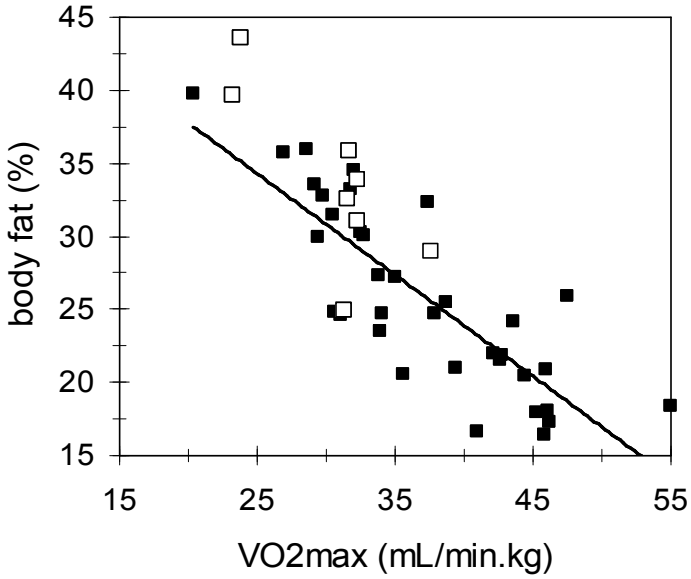
the problem of multicollinearity.

Statistical design

Regular Pearson correlation coefficients are biased; use partial correlations to remove multicollinearity.

and

Multivariate linear regressions needs Variance Inflation Factor (VIF) to evaluate reliability of MV-regression Eq's (VIF < 2 OK; 2 < VIF < 5 poor).



□ females

The maths of VIF

VGB = C_{0u}+ C_{1u}BF + error

UV-regression is biased since

VGB is also dependent on age, VO_{2max}.

VGB = C_0+ C_1 age + C_2VO_{2max} + C_3BF + error

This holds true when BF is **not** related to age, VO_{2max}

The 3 MV-regressions of the demographic variables are needed.

Each MV-regression yields

VIF= SS_{tot} /(SS_{tot} - SS_{err}) (multi-dimensional).

E.g. when VIF =4 then respective ci is doubled.

Experimental details

Open sea air dive:
20msw/40min, ascent 7 min, t_{water} 28 ºC.

Precordial Doppler (KM) at 40, and 100 min

Age 51 ± 9 y,
body fat 27 ± 7 (%)
VO_{2max} 36 ± 8 (mL/kg.min)

KM scores transformed to:

- #bubbles/cm² (Eftedal et al. 1998; Nishi et al. 2003 (B&E); Gutvik et al. 2010), then to logB{#bubbles/cm²) (Schellart et al. 2008,2012; Schellart & Sterk 2012)
- logKISS.

Results

Regular and Partial Pearson correlation coefficients

Inter-correlations demographic parameters

	age	body fat	VO_{2max}
age	1	NS	-0.42** (0.006)
body fat	***NS***	1	-0.84** (0.000)
VO_{2max}	***-0.44***** (0.004)	***-0.73***** (*0.000*)	1

P-values are indicated in parentheses.
* *P*<0.05, ** *P*<0.01

Correlations demographic parameters with logB

n = 72*	**logB partial, ρ**
age	*0.15* (NS)
body fat	***- 0.138*** (NS)
VO_{2max}	***- 0.296* (0.039)***

Data on linear regressions between demographic variables and logB

Model	Model description	Coefficient of model	SE of coefficient	*P*-value of coefficient	VIF	*P*-value of model
1	**logB(constant,A)**	0.036	0.012	**0.004***		0.004*
2	**logB(constant,Vm)**	-0.053	0.015	**0.001****		0.001**
3	**logB(constant,BF)**	0.033	0.018	**0.072**		0.072
4	**logB(constant,A,Vm,BF)**	0.018 [1)]	0.013	**0.19**	1.3	0.001**
		-0.078 [2)]	0.031	0.013*	4.2	
		-0.045 [3)]	0.032	**0.16**	3.7	
5	**logB(constant,A,Vm)**	0.023[1)]	0.013	**0.080**	1.2	0.001**
		-.041[2)]	0.017	**0.049***		
6	**logB(constant,A,Vm)** **Carturan et al. 2002**	0.043[1)]	0.019	**0.035***	1.3	0.001**
		-0.035[2)]	0.018	**0.050***		

[1)] Age (A), [2)] VO_{2max}, (Vm) [3)] body fat (BF), * $P < 0.05$, ** $P < 0.01$

Data on linear regressions between demographic variables and logB

Our data

$\log B(A,Vm) = -1.1 + 0.023Age - 0.041VO_{2max}$

Data Carturan et al. 2002:

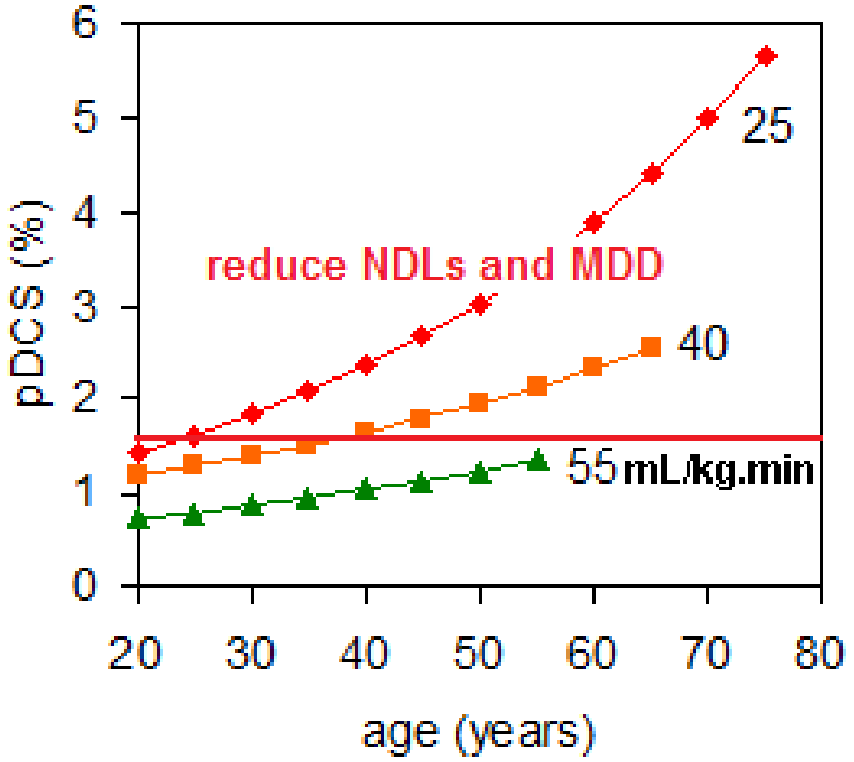
$\log B(A,Vm) = -2.1 + 0.043Age - 0.035VO_{2max}$

Combined (averaged):

$\log B(A,Vm) = -1.6 + 0.033Age - 0.038\ VO_{2max}$

$\#bubbles/cm^2 = 0.025x10^{0.033Age}/10^{0.038\ VO2max}$

With $pDCS = 6.0 \times 10^{0.33logB}$ the pDCS-age&VO2max relation can be estimated. (Schellart et al. UHM 2012:39;577-588)



Conclusion

BF (and BMI) appear not to influence VGB; but age and VO_{2max} do.

Recommendations

- Medical examinations of recreational divers should pay more attention to VO_{2max} and age,
- Minimum VO_{2max} value of 25 mL/min.kg (1800 m/h = 1 knot with a SCUBA) for recreational divers to have enough physical reserve and a restricted bubble stress.
- International institutions: consensus of VO_{2max} for recreational divers.

Schellart et al. Post-dive bubbles & body fat, *ASEM, 2012;83(10): 1-7.*