EGAS MONIZ INTERNATIONAL SCIENTIFIC CONGRESS
JULY 2-4th 2025

ESSATLA Escola Superior de Saúde Atlântica

SURFING MEDICINE INTERNATIONAL

VENTILATORY PROFILE OF BIG WAVE SURFERS – AN EXPLORATORY STUDY

Autores: Pedro Seixas[1,2], PhD, PT; Ana Laura Ricci-Vitor[1], PhD, PT; Lara Costa e Silva[1], PhD, PT

[1] Escola Superior de Saúde Atlântica

[2] Surfing Medicine International

Introduction

Big wave surfing is a sport, performed by man and women who ride waves greater than 30 feet and that, in the event of falling (wipeout), their cardiorespiratory capacity is taken to the limit, as the surfers must hold their breath (apnea) for several seconds or a few minutes, until being able to return to the surface of the water to breathe again. Despite being a growing sport with its own world championship, no studies are known regarding these athletes' profile, namely the physiological effects of their specific training and activity. The main physiological effects experienced by these athletes are related to the prolonged periods of apnea to which they are exposed. The apnea training causes an increase in respiratory workload, since the hydrostatic forces to which the individual is subjected compress and deform the thorax, requiring the inspiratory muscles to counteract these forces. This leads to deeper inspirations and longer respiratory cycles. There are also a reduction in lung volume due to mechanisms previously described — thoracic compression and increased blood flow to the thoracic region — both influenced by hydrostatic pressure, which contributes to a reduction in vital capacity and total lung capacity. This study was designed to investigate if Big Wave Surfers (BWS) have specific ventilatory characteristics, resulting from possible functional changes related to the practice.

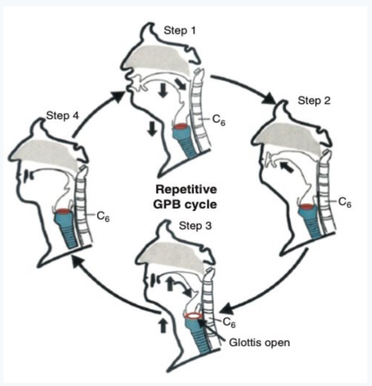

Figure 1 : Glossopharyngeal Breathing (GPB) (*in:* Fritz-Clarke, 2018)

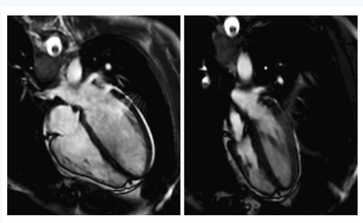

Fig. 4. Glossopharyngeal insufflation (GI). End-diastolic four-chamber view (steady-state free precession MRI). Left: supine control. Right: after GI and 2-min apnea. Reproduced with permission from Schipke et al. [48].

Figure 2 : Effects of a two-minute apnea period on the heart (*in:* Schipke *et al*., 2019)

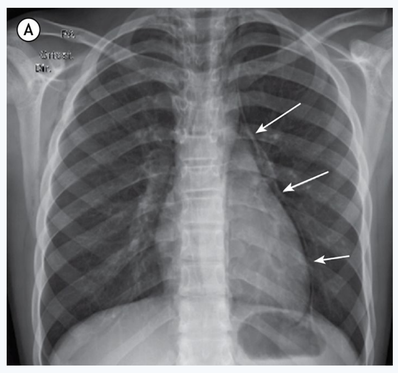

Figure 3 : Pneumomediastinum (*in:* Marchiori, Hochhegger & Zanetti, 2019)

Aim

Identify BWS respiratory profile and surf-related social-demographics, as well as possible respiratory compromises in the mid-long term.

Materials and Methods

For this epidemiological, cross-sectional, retrospective and exploratory study, 17 (14 male, 3 female) elite BWS aged 33±8.50 years, were assessed regarding their surf-related social-demographics (age, sex, surfing experience and competition profile), lung function variables (Forced Vital Capacity – FVC; Forced Expiratory Volume in one second - FEV1; FEV1/FVC; Peak Expiratory Flow – PEF; and Forced Expiratory Flow - FEF25-75%) and respiratory muscle strength (Maximum Inspiratory Pressure – MIP; and Maximum Expiratory Pressure – MEP). Study approved by the Ethics Committee of ESSATLA (PCE05_2022). The social-demographic profile was assessed by a questionnaire, the lung function by the spirometry with the MIR portable spirometer SPIROLAB II and respiratory muscle strength using a pressure gauge. Correlations were assessed by multiple linear regression. The respiratory profile was assessed at first using Kolmogorov-Smirnov normality test and with paired T-test. Statistical significance was set in 5%.

Figure 4 : MIP & MEP testing

Results and Conclusions

The number of years of surfing experience was 24.49±7.53. A total of 58.82% had been surfing big waves for ≥9 years, and 7 participants reported competing on a regular basis. Among the sample of the study, 15 had previously won a big wave surfing competition. The data of the respiratory parameters analyzed did not revealed any correlations with age or years of big wave surfing practice. However, BWS had higher FVC, FEV1, PEF ($p<0.001$), FEV1/FVC ($p<0.05$) and lower FEF25-75% ($p<0.05$) than the predicted values. Male BWS had higher MIP values than predicted ($p<0.001$), and when compared to healthy individuals.

n= 17	*BWS scores*	*Predicted scores*	*Predicted scores (%)*	*p*
FVC (l)	6.28±1,42	4.68±0.69	134.29±21.92	< 0,001**
FEV1 (l)	4.73±0.85	3.92±0.56	120,94±15.63	< 0,001**
FEV1/FVC (%)	76,19±6.17	81.51±1,43	93,47±7.34	< 0,001**
PEF (l/s)	10,54±2.26	9.10±1.17	115,71±18.53	0,002*
FEF 25-75% (l/s)	4.21±0.77	4.55±0.48	93.00±16.95	0,044*

Abbreviations: FVC: forced vital capacity; FEV1: forced expiratory volume in the 1st second; PEF: peak expiratory flow; FEF25 – 75%: average forced expiratory flow. * p < 0.05, ** p < 0.001

Table 1: Spirometry parameters of BWS

n= 17	*Score*	*Predicted Score*	*p*
MIP (cmH2O)	138,35±29,03	*n.a.*	*n.a.*
♂ (n=14)	143.36±25.72	106.85±3,77	<0,001*
♀ (n=3)	114±36,71	86,85±2,88	0,178
MEP (cmH2O)	143,88±27,89	*n.a.*	*n.a.*
♂ (n=14)	149.57±23.69	147,38±7,63	0,372
♀ (n=3)	117,33±35,92	101,18±4,06	0,276

*Abbreviations: MIP: Maximum Inspiratory Pressure; MEP: Maximum Expiratory Pressure; ♀: woman; ♂: man; ** p<0.001; n.a: not applicable*

Table 2: Maximum Respiratory Pressures (MRP) of BWS

This study findings suggest prolonged apnea and GPB practiced in big wave surfing since it led to enhanced respiratory capacity, mainly in FVC and respiratory muscle strength (MIP, MEP). Therefore, tailored training programs emphasizing respiratory muscle conditioning might improve performance and safety during wipeouts. Additionally, the observed tendency towards obstruction in small airways raises concerns about potential long-term pulmonary health risks, such as reduced airflow in the bronchioles. This highlights the need for regular pulmonary assessments for BWS, as well as the development of preventive strategies and physiotherapy interventions to mitigate respiratory compromise, optimize training and improve safety for BWS.

References

- Chung, S., Seccombe, L., Jenkins, C., Frater, C., Ridley, L., Peters, M. (2010). Glossopharyngeal insufflation causes lung injury in trained breath-hold divers. *Respirology*;15(5):813-7.
- Diniz, C., Farias, T., Pereira, M., Pires, C., Gonçalves, L., Coertjens, P., Coertjens, M. (2014). Chronic adaptations of lung function in breath-hold diving fishermen. *International Journal of Occupational Medicine and Environmental Health, 27(2), 216–223.*
- Durmic, T., Lazovic, B., Djelic, M., Lazic, J., Zikic, D., Zugic, V., Dekleva, M., Mazic, S. (2015). Sport-specific influences on respiratory patterns in elite athletes. *J Bras Pneumol*, *41*(6), 516-522.
- García, I., Drobnic, F., Arrillaga, B., Pons, V., Viscor, G. (2021). Lung capacity and alveolar gas diffusion in aquatic athletes: Implications for performance and health. *Apunts Sports Medicine,* 209(56), 1-7
- Patrician, A., Spajić, B., Gasho, C., Caldwell, H., Dawkins, T., Stembridge, M., Lovering, A., Coombs, G., Howe, C., Barak, O., Drviš, I., Dujić, Ž., Ainslie, P.. (2021) Temporal changes in pulmonary gas exchange efficiency when breath-hold diving below residual volume. *Exp Physiol*., 106(4):1120-1133.