Nutrition for saturation divers: current guidelines and future developments

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Background: why do we need nutritional guidelines?

Challenges to the body

- Loss in body mass (particularly muscle mass)
- Disturbances to hydration status
- Excess sodium loss
- Enhanced oxidative stress on key cells
- Possible period of immunosuppression (increase chance of cold and flu)
- Reduced red blood cell concentrations
- No vitamin D availability due to lack of sunlight (UVB rays)

Practical challenges

- Chamber limiting daily physical activity
- The environmental conditions (eg. Hyperoxia, helium and pressure)
- Work shift patterns
- Underwater excursions

Nutrition has the potential to support these physiological disturbance and therefore, support the health and performance of divers at work

Nutrition guidelines for saturation divers

- Energy balance
- Macronutrients
  - Carbohydrates and fats
  - Protein
- Micronutrients/ supplements
  - Vitamin D
  - Antioxidants (Vit C and E)
  - Iron, Folate and Vit B12
- Hydration (Daily and lockout)
- Nutrition for lockout

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Nutritional considerations during prolonged exposure to a confined, hyperbaric, hyperoxic environment: recommendations for saturation divers

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Abstract

Saturation diving is an occupation that involves prolonged exposure to a confined, hyperoxic, hyperbaric environment. The unique and extreme environment is thought to result in disruption to physiological and metabolic homeostasis, which may impact human health and performance. Appropriate nutritional intake has the potential to alleviate and/or support many of these physiological and metabolic concerns, whilst enhancing health and performance in saturation divers. Therefore, the purpose of this review is to identify the physiological and practical challenges of saturation diving and consequently provide evidence-based nutritional recommendations for saturation divers to promote health and performance within this challenging environment. Saturation diving has a high-energy demand, with an energy intake of between 44 and 52 kcal/kg body mass per day recommended, dependent on intensity and duration of underwater activity. The macronutrient composition of dietary intake is in accordance with the current Institute of Medicine guidelines at 45–65 % and 20–35 % of total energy intake for carbohydrate and fat intake, respectively. A minimum daily protein intake of 1.3 g/kg body mass is recommended to facilitate body composition maintenance. Macronutrient intake between individuals should, however, be dictated by personal preference to support the attainment of an energy balance. A varied diet high in fruit and vegetables is highly recommended for the provision of sufficient micronutrients to support physiological processes, such as vitamin B12 and folate intake to facilitate red blood cell production. Antioxidants, such as vitamin C and E, are also recommended to reduce oxidised molecules, e.g. free radicals, whilst selenium and zinc intake may be beneficial to reinforce endogenous antioxidant reserves. In addition, tailored hydration and carbohydrate fueling strategies for underwater work are also advised.

Keywords: Saturation diving, Hyperbaria, Hyperoxia, Confinement, Nutrition

Overall Research aims

1. Develop a strong evidence base for effective nutritional guidelines for the health, performance and wellbeing of saturation divers while at work and home.

2. Translate research findings to saturation divers by developing a research informed guide to educate and encourage good practise amongst saturation divers

Ongoing research projects

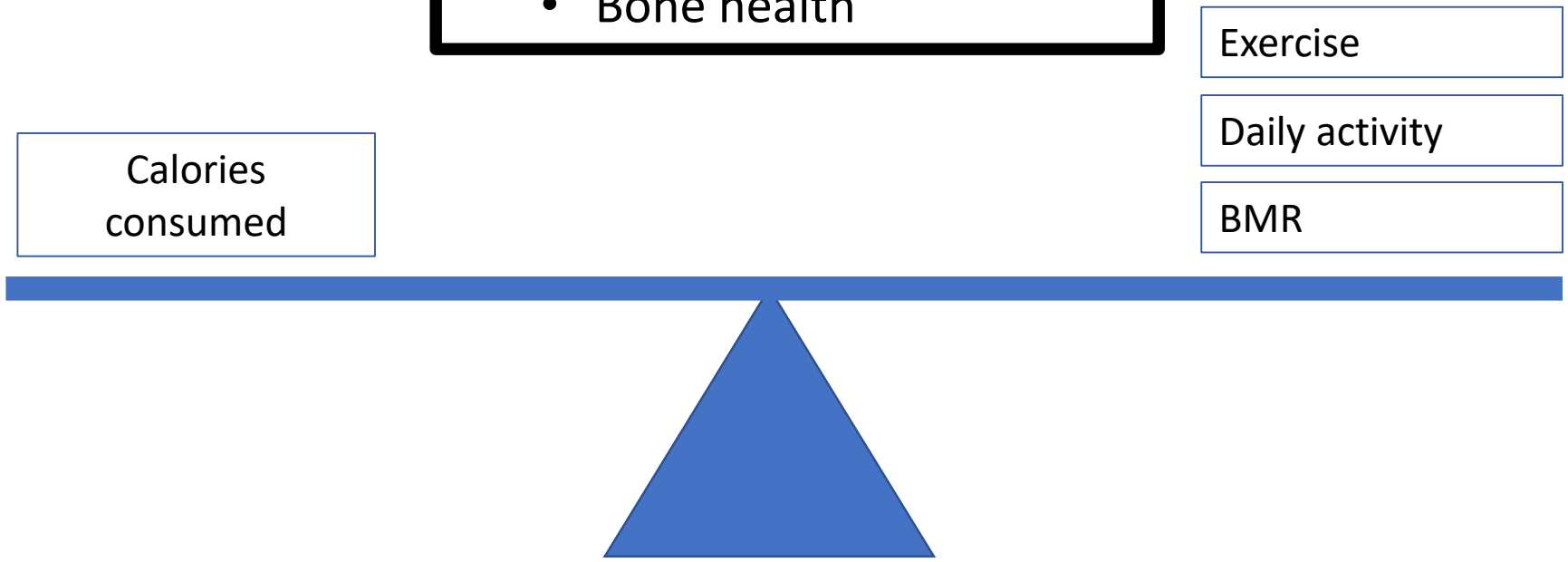
- To characterise the effect of saturation diving on vitamin D and calcium status; and subsequently identify the implications on bone health of divers.

- Assess the energy demands of operational saturation diving.

Why is it important to understand the energy demands?

Supports:

- Body weight maintenance
- Immune function
- Cognitive function
- Delay/ reduce fatigue
- Bone health



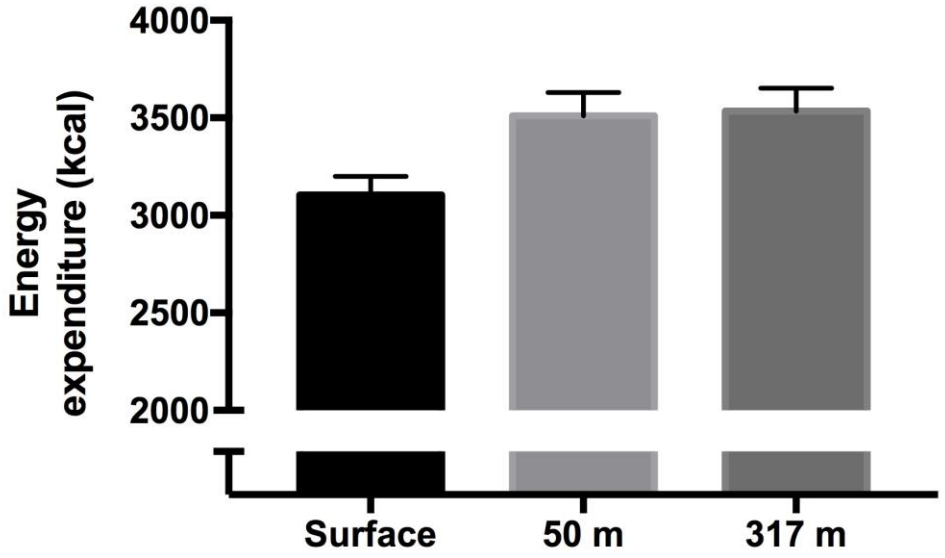
Saturation diving increases calories expenditure

Undersea & Hyperbaric Medicine, Vol. 21, No. 2, 1994

Energy expenditure and fluid production in hyperbaric He-O_2 environments using doubly labeled water

J. L. SEALE, J. W. THORP, J. M. CONWAY, W. V. RUMPLER, and K. J. HABERMAN

U. S. Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center, Energy and Protein Nutrition Laboratory, Beltsville, Maryland; and U.S. Navy Medical Research Institute, Diving Medicine Laboratory, Bethesda, Maryland 20889



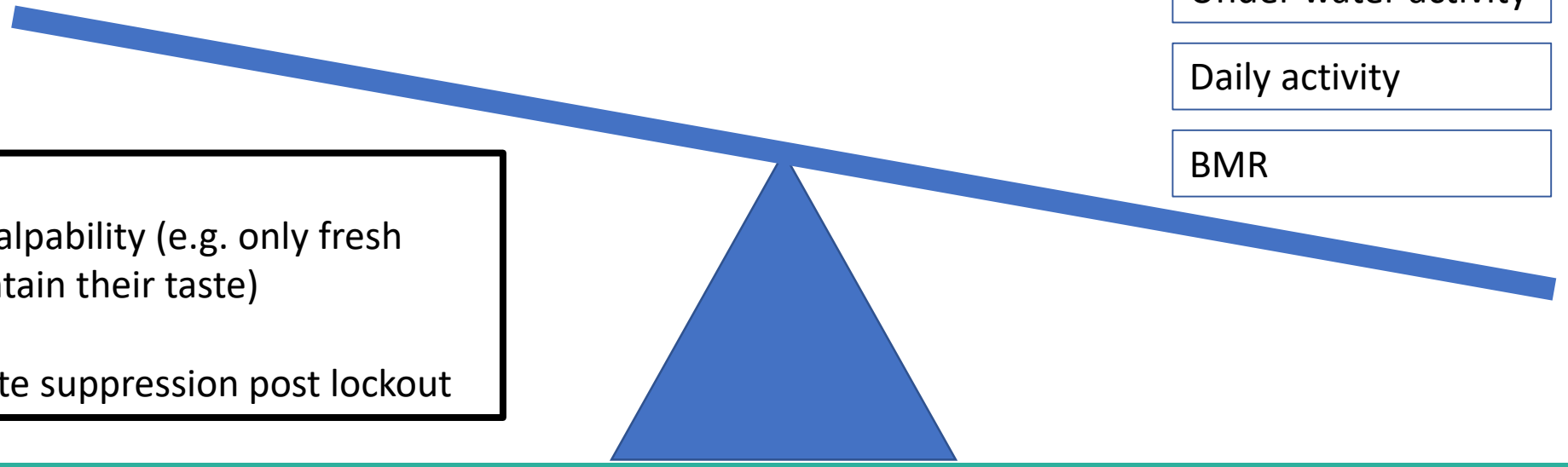
Significant increase in energy expenditure (average 430 kcal) was observed regardless of magnitude of hyperbaric pressure, therefore suggesting the hyperoxic and helium atmosphere are principle drivers.

Saturation Divers Are Susceptible To A Negative Energy Balance

Consequence:

- Body weight loss (Busch-Stockfish + Bohlen, 1994)
- Increase likelihood of colds and flu (Brenner et al. 1999)
- Impaired cognitive function and decision making
- Early fatigue development during underwater excursions

Calories consumed may also reduce



Environmental factors

Under water activity

Daily activity

BMR

Due to:
Reduced food palpability (e.g. only fresh vegetables maintain their taste)

Potential appetite suppression post lockout

More research is needed to identify how many calories saturation divers need

Supports:

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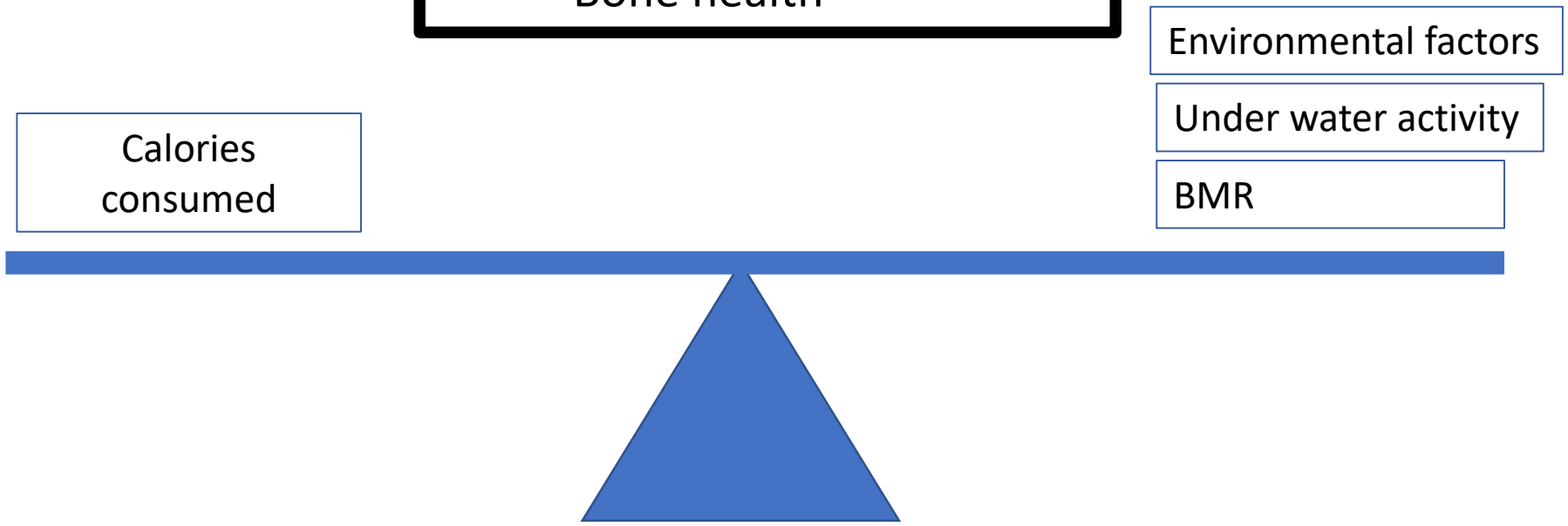

Visual outline of recent research testing protocol

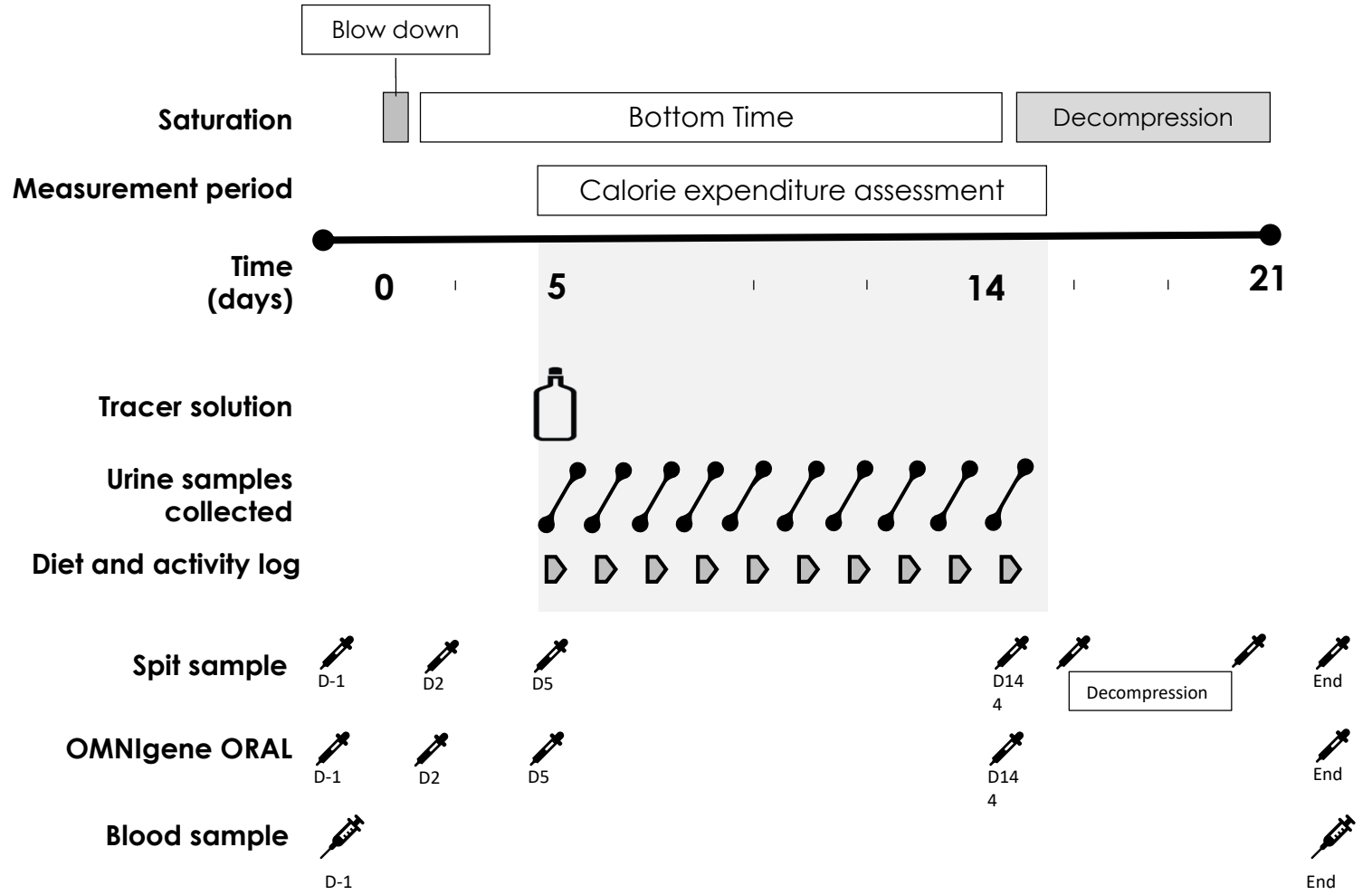

Figure showing the timeline of research, which includes a 10-day calorie expenditure assessment, 2 types of spit sample and blood collection.
'D' under symbol represent the day after blow down that the respective samples is taken. D-1 represent pre-saturation medicals. End represents post -saturation medical.

Future research projects

1. *Identify the optimal dose of vitamin D and calcium supplementation to support bone health and immune system in saturation*
2. *Investigate the role of anti-oxidant supplements in minimising the oxidative stress that may occur during saturation diving.*
3. *Identifying methods to monitor and advice on appropriate hydration strategies for saturation divers.*
4. *Design, implement and evaluate the effectiveness of a nutritional education platform designed for saturation divers and support personnel.*

Overall Research aims

1. Develop a strong evidence base for effective nutritional guidelines for the health, performance and wellbeing of saturation divers while at work and home.

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Thank you