Response from five experts,

Stuart Khan, Professor and Head of School Civil Engineering. Research interests include research related to drinking water supply and quality.

3 April

The solubility of oxygen in water obeys Henry's Law: it is directly proportional to O2 partial pressure at the air-liquid interface. The oxygen content of bottled water can be raised by increasing the O2 partial pressure, but when the pressure returns to normal atmospheric pressure, such as when the bottle is opened, any additional O2 is released just like the CO2 fizz in a carbonated drink. The dissolved O2 content rapidly falls to a normal saturated dissolved oxygen concentration. Therefore, it is not clear to me how ‘super-oxygenated spring water’ can be supplied in a way that will maintain significantly elevated oxygen concentrations for a sufficient period of time for it to be consumed. This report does not provide any information on how the supposed ‘super-oxygenated spring water’ was prepared, or even what the oxygen levels are supposed to be, or how they compare with the oxygen levels of the control samples (regular spring water).

A normal human tidal volume (breath volume is 500 mL. Therefore, a normal breath contains around 150 mg of O2. Thus one single breath contains more than 20x the additional oxygen that the participants in this trial may have been exposed to by drinking 850 mL of super-oxygenated water.

While this part is not my area of expertise, my reading of the literature this afternoon indicates that to date, no study has verified that the human gastro-intestinal tract has the potential to absorb O2 into the bloodstream. So even that very small additional exposure to oxygen will not necessarily translate into additional oxygen availability for aerobic metabolism.

What I did notice was that the differences between the “KURE” results and the control results are generally very small. When based on such a small sample number of subjects, these small differences are not highly significant and can easily be a consequence of chance.

Overall, I see no theoretical justification and no compelling experimental evidence for any impact from consuming ‘super-oxygenated spring water’.

To answer your specific questions:

1. Is this a reliably study? Not in my opinion. The lack of theoretical justification, the very small sample size, the apparently insignificant differences in the results and lack of peer-review mean that the conclusions should not be considered reliable at this time.

2. Kure points to the positive findings on Transcutaneous (Skin) oxygenation ($TcpO_2$), Blood lactate (BLa-) during sub-maximal exercise and Cardiovascular stress Blood Pressure (BP) and Assoc. Prof. Steve Hunter concludes in that video that “Kure certainly seems to facilitate oxygen getting into the body”. Is that a sound conclusion? Not in my opinion. For the reasons described in my previous response

3. Does this study prove Kure’s claims to have improved technology to deliver 10 times the oxygen of normal H20? No. But actually its also not established that “normal H_2O“ plays a significant role in oxygen delivery to human physiology. To fish, yes, but people are not fish. It is generally well known that humans acquire oxygen for physiological processes by breathing air through the lungs. It is via the lungs that oxygen is transferred to the bloodstream and distributed to other parts of the body. If humans cease to breath air through the lungs, physiological processes begin to shutdown quickly and we suffer from a condition known as suffocation.

While its not impossible that oxygen dissolved in water is available to the human body via the gastrointestinal system, this is not generally established, and simple mass-balance tells us that it will be a minor source compared to breathing air. So even if KURE did deliver 10x the oxygen of normal H_2O, that’s still unlikely to be a meaningful additional supply of oxygen.

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Paul Glasziou, Professor of Evidence-Based Practice at Bond University

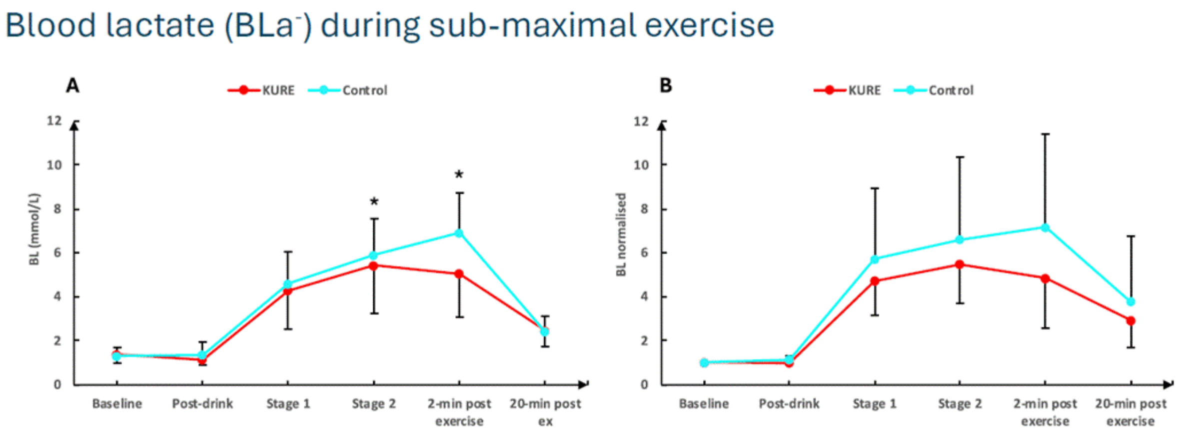
3 April

I agree this is a small study that would need replication.

But in addition their reporting is highly selective of the results.

So even if we accept them at face value, the full results need to be seen.

As one example the blood lactate graph in the study is below – it shows there may be a small difference 2 minutes post exercise but not at 20 minutes. So even if true, I am not sure its meaningful (but maybe ask an exercise scientist about that).



There website selectively picks only the 2-minute point to graph – then makes the claim that it

- "Improves Endurance
- Faster Recovery
- Enhances Performance
- Supports High-Intensity Training

Which are not things they measured, but claim this via the 2-minute difference in lactate.

Similar problems with many of the other claims but the most dubious is the claim that

"REVITALISE & ENERGISE

Can increase skin tissue O2 levels by as much as 40%."

So now look at the graph of transcutaneous oxygen below – do they look different to you?

Certainly not at Stage 1, 2 and 20 minutes post.

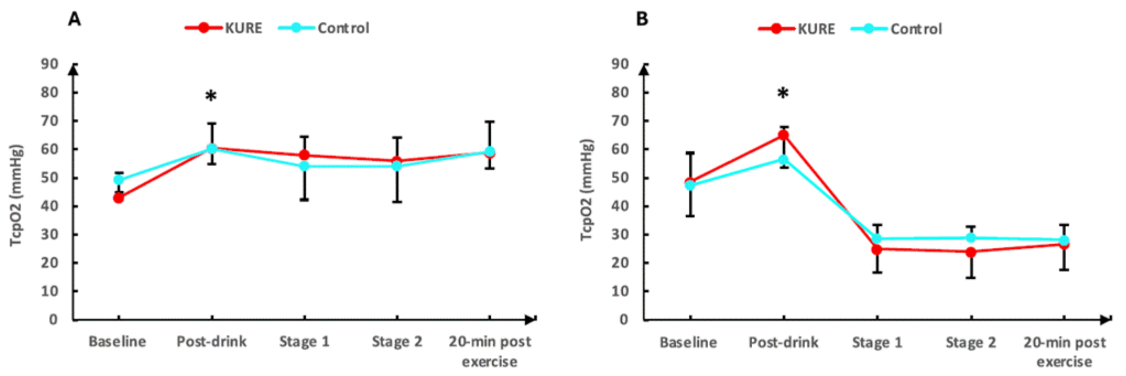
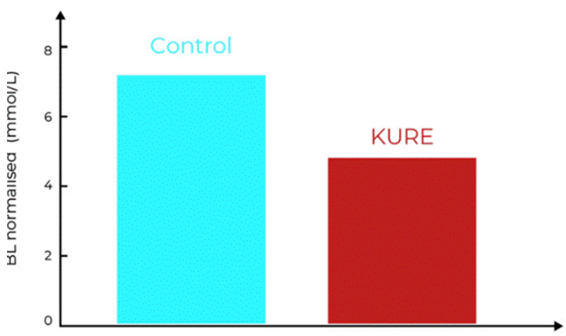


Figure 5. Transcutaneous oxygen pressure ($tcpO_2$) changes across the protocol in **A** Normoxia and **B** Hypoxia experiments. Changes are reported as means and standard deviation. **A** * = significantly higher $tcpO_2$ with KURE at post-drink compared to baseline (+ 17.333; $p = 0.006$).

B * = significantly higher $tcpO_2$ with KURE vs Control (+ 8.667; $p < 0.001$); * = significantly higher $tcpO_2$ with KURE at post-drink compared to baseline (+ 16.667; $p = 0.034$).



PERFORMANCE & RECOVERY

Can reduce lactate by as much as 20% helping to minimise muscle soreness and fatigue.

Why It Matters:

- Improves Endurance
- Faster Recovery
- Enhances Performance
- Supports High-Intensity Training

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Ian Stewart, PhD AEP Professor (Exercise Physiology), QLD Academy of Arts and Sciences School of Exercise and Nutrition Sciences | Faculty of Health | QUT

3 April

I would be highly sceptical of the claims being made.

The study is underpowered to detect any differences with only 12 participants.

As the media report indicates oxygenated water is not a new product, and none to date have ever been successful due mainly to some reasonably simply physiological principles.

1. Oxygen is primarily transported bound to hemaglobin (within the red blood cells of the body). At sea level this system is pretty much maxed out with normal values around 95-98%. This is reported as SpO2 (%) on page 14, where you can see no difference between the control and the KURE. Only a small amount of oxygen is transported dissolved in the blood and to increase this value you would need to breath hyperoxic gas (ie gas with greater than 21% oxygen), and this still only contributes a small amount to circulating oxygen levels.

The equation below gives how arterial oxygen content is measured

$$CaO2 = (1.34 \times Hb \times SaO2) + (0.003 \times PaO2)$$

Where:

CaO_2 = Arterial oxygen content (mL O_2 per 100 mL blood)

1.34 = Oxygen-carrying capacity of hemoglobin (mL O_2 per gram of Hb)

Hb = Hemoglobin concentration (g/dL)

SaO_2 = Arterial oxygen saturation (as a fraction, e.g., 0.98 for 98%)

0.003 = Solubility coefficient of oxygen in plasma (mL O_2 per mmHg per dL)

PaO_2 = Partial pressure of oxygen in arterial blood (mmHg)

2. Probably most importantly is how gases behave when dissolved in water under pressure, then are exposed to a normal environment ie when the lid is released. Similar

to opening a carbonated bottle, gas will move from an area of high pressure to one of low pressure (Dalton’s Law), so oxygen will come out of solution into the surrounding air even before the mixture is drank.

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Joe Schwarcz PhD Director, McGill University Office for Science and Society

3 April

I had a quick look at this rather lengthy publication. The study seems to have been well done, but the bottom line, a direct quote from the paper, is this:

"This pilot study found that drinking KURE super-oxygenated water did not affect the primary outcome measure of improved exercise performance as there were no significant differences observed in time to exhaustion during a ramp test to maximal exertion compared to the control water (observed in both normoxic and hypoxic conditions)"

This outright says that it does not help with performance. The rest is blah-blah. They do measure some differences attributable to oxygen absorption but that is only of academic interest because there were no changes in performance which was the primary objective. Any suggestion that this can reduce blood pressure generally is not borne out by this study and any claim that people worried about their blood pressure should rely on this product is unfounded.

As far as lactate goes, a 4% change has no practical significance, especially given that there was no overall change in performance.

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Timothy Schmidt, Head of the School of Chemistry, UNSW

Kure claim that they have 10x the O2 content of normal water. While surprising, there are ways to achieve this, and in the attached paper (https://bjsm.bmj.com/content/40/9/740) they measured 9x in a commercial product. I won't bother questioning this.

Now, how much is that? "Normal water" at 20C in air will dissolve about 9 mg of O2 per litre of water (https://www.sciencedirect.com/topics/earth-and-planetary-sciences/dissolved-oxygen). Under pure O2, this increases to 45 mg/L. This is equivalent to 34 mL of O2 gas per litre of water.

Let's now imagine that they manage 10x the amount of normal water. This is then 90 mg/L, or 68 mL of O2 gas.

How does this compare to a breath of air? Humans inhale 21% O2 and exhale 16% O2, and so consume that 5%, which enters the bloodstream. During exercise, the tidal volume of the lungs is 3L (Jamie? https://www.bbc.co.uk/bitesize/guides/z3xq6fr/revision/2). And so, 5% of this is 150 mL of O2.

So, an athlete who is exercising will take 150 mL of oxygen into their bloodstream PER BREATH. This is more than twice what is available in a whole litre of Kure (supposedly).

Let's put it another way, to get the same oxygen from Kure as breathing under exercise conditions, the athlete needs to drink 66L of Kure water a minute. Sounds like a good business.

My calculations are corroborated by this article in the BJSM (attached), though they state 80 mL/L for their highest measured product. That doesn't change the numbers too much. Jamie might like to comment on some of these numbers, and also on the study that was published. From a chemical perspective, Kure water having a significant effect is implausible.

The state of Kure's understanding of chemistry is nicely exemplified by this screenshot from their YouTube. Indeed, a mole of water is 18g, but a mole of O2 is 32g. This is nonsense.


the oxygen molecule, of course, weighs
less than the H2O molecule.