Why Drink Water After Massage?

No reason! Massage therapy does not flush toxins into the bloodstream, and water wouldn't help if it did

Paul Ingraham • Sep 1, 2018 • 25m read

Many massage therapists believe [1] that massage releases toxins into the bloodstream, which can then be washed away by drinking water after you get off the table. Exactly which toxins and how they are "flushed" by massage or washed away by water is completely unclear to anyone. Many therapists know it's all rather vague but apply the precautionary principle: drinking water certainly won't *hurt*, right? No, probably not (although unnecessary worries about dehydration and over-hydrating are bigger problems than most people realize [2]).

It's polite and pleasant to offer post-massage water, but there's no biological, detoxifying need for it. It's about on par with a recommendation to "think positively" or "go for a short walk to get your blood moving" — fine things, but tepid medical advice.

This article is *detailed*. For a much faster tour of the topic, just watch this fun video from Laura Allen, a massage therapist in Rutherfordton, North Carolina. I get a big kick out of her folksy 3-minute

debunking of this classic massage myth. Her no-nonsense Southern twang and well-chosen words are perfect for this job!

Laura Allen, Massage Therapist, on Toxins & Massage 3:14

> How many massage therapists are still out there telling their clients that massage gets rid of toxins in the body? On any given day on Facebook, I see about half a dozen people making that claim … Would you *maaahnd* sharing with us exactly how that happens?
>
> ~ Laura Allen, Massage Therapist

Does massage release toxins? Which toxins are these, exactly?

There are real toxins and some legitimate "detoxification" treatments, but casual and careless use of these terms is almost always a red flag, [3] and a *strong* theme in all the bizarre and medically illiterate "shit massage therapists say." [4] It is accompanied by a more or less perfect ignorance of *which toxins.* Are we talking about lead poisoning here? Pesticides? What chemicals? Dihydrogen monoxide? [5] Magnesium sulfate? [6] *What?*

The toxin-talkers do not know. Or, worse, they *think* they know — but give examples that are mythical, [7] and/or absurdly extreme. [8]

The body deals with undesirable molecules in many ways. It excretes some and recycles others; some are trapped in relatively safe places (sequestering); and quite a few can't be safely handled at all (metals like lead). Most alleged "detox" treatments are focused on supposedly stimulating an excretion pathway, like sweating in a sauna — but sweating is mainly secretory, not excretory (sweating is about cooling, not taking out the trash). [9] There are very few truly "detoxifying" treatments that help the body eliminate or disarm molecules the body cannot process on its own. For instance, a stomach pump for someone with alcohol poisoning is *literally* "detoxifying." So is an antivenom, or chelation therapy for heavy metals. [10]

When massage therapists talk (or think) about detoxifying, they need to be much more specific: *what molecule*, how it normally works, and how massage or water intake supposedly improves the speed or effectiveness of normal biological waste processing (recycling, sequestering, or elimination). So what are some of the specific possibilities?

The real toxins

A *poison* is literally *any harmful substance*, and even something safe in typical doses becomes a poison in overdose (so you can be poisoned by either lots of water or a minuscule amount of lead). Toxins are technically *poisons produced by living things*, like venom or metabolic wastes, but informally the word is synonymous with poison.

Of course there's a staggering variety of poisons/toxins, but *pollutants* are probably what most people hope to purge. The best specific candidates would be the *persistent organic pollutants* like pesticides, flame retardants, and polychlorinated biphenyls (PCBs, now banned, but formerly ubiquitous in many plastics). Lead is also an alarmingly common environmental poison (and much in the news lately). All of these are indeed found in our environment and our bodies, where they mostly get trapped in fat and otherwise sequestered.

The idea that massage liberates any of these substances is extremely implausible, and is probably not what is meant by the average massage therapist. Any massage therapist who thinks they are squishing environmental pollutants out of your cells and into an excretory pathway (like urination) is really far out in left field. There is a more reasonable idea …

Metabolically speaking

When pressed to be specific about what toxins massage is flushing, some therapists will guess "metabolic wastes," the chemical products of cellular activity. The rest of the article will stick to the idea that the only "toxins" relevant to massage are waste metabolites.

But it's a large category that isn't much of an answer. Cellular chemistry produces *a lot* of molecules, with many fates. Technically they are toxins because they are biologically produced, and would be harmful *in abnormal concentrations*. But these are the *normal* products of biology, and so most of them are either safely excreted, or actually re-used and re-cycled, not "waste products" at all …

As in the rest of nature, not much in cellular chemistry is wasted. Most metabolic "wastes" actually have *utility* throughout a cascade of functional interactions. You literally don't *want* to "flush" these. You want them to go through their normal chemical lifecycle, processed and re-processed. Trying to flush them out would be sort of like trying to improve a car engine by getting rid of the exhaust before it hits the turbocharger. [11] Such metabolic by-products are *not* just nasty chemicals pooped out by cells that just hang around, stuck in tissue, waiting for your friendly neighbourhood massage therapist to come along and flush them away.

Lactic acid is the ultimate example.

Lactic acid

It's clear that we *still* don't have a fix on exactly which toxins therapists might think they are flushing. Let's work with an example of a rock-star-popular waste metabolite: *lactic acid*, or lactate.

Lactic acid is the poster boy for the "waste" metabolites, probably the only one that's a household name, and most massage therapists still assume that lactic acid can be flushed by massage. This is not a difficult thing to test, and it has been tested, and some results were a bit shocking: not only does massage definitely not "reduce" lactic acid, [12] perhaps massage even "*impairs* lactic acid and hydrogen ion removal from muscle." [13]

Oops.

This is not really surprising. If people needed massage to help them "clear" lactic acid, sprinters would drop like flies without emergency massage after every race. The effect must be minor or non-existent.

In any case, it's worth emphasizing that lactic acid is *not* the cause of muscle pain at any time. Recent (2008-2010) research has shown that muscle fatigue and the "burn" that you feel as you exercise intensely is probably caused by *calcium* physiology, not an accumulation of lactic acid. [14] In particular, lactic acid does *not* cause soreness the day after exercise — it's long gone by then.

And there's more: lactic acid is actually a *useful* molecule with a productive metabolic fate, *not* a dead-end waste product. Lactate as a "bad" molecule is one of the most persistent silly myths in all of exercise science. [15]

So presenting lactic acid as some kind of metabolic bogeyman that massage can get rid of is wrong, wrong, wrong on many levels. And any other metabolic waste is even less likely to fit the bill. So this is another nail in the coffin of the biologically illiterate notion that massage somehow "detoxifies."

But it gets worse. Now it's time for a plot twist.

Lactic acid is actually a useful molecule with a productive metabolic fate, not a dead-end waste product.

Oh, irony: poisoned by massage!

Not only is massage *not* a detoxification treatment in any sense, it is actually the opposite: a *toxifying* treatment. A little bit. Sometimes.

Post-massage soreness and malaise (PMSM) is a common phenomenon after any strong massage. It is probably caused by mild rhabdomyolysis ("rhabdo"), a form of poisoning. True rhabdo is a medical emergency in which the kidneys are poisoned by myoglobin from muscle crush injuries. Myglobin is a true toxin, a biologically produced poison, which we can handle in small doses but start to struggle with in larger doses.

Many physical and metabolic stresses cause milder rhabdo-like states — even just intense exercise, and probably massage as well. This is substantiated by a case study of acute rhabdomyolysis caused by intense massage, [16] by many well-documented cases of exertional or "white collar" rhabdo, and by the strong similarity between PMSM and ordinary exercise soreness (delayed-onset muscle soreness).

A rhabdo cocktail of waste metabolites and by-products of tissue damage is probably why we feel a bit cruddy after biological stresses and traumas — even massage, sometimes. It's not that big a deal. Massage is still worthwhile. But it is, technically, a little bit toxifying — not *de*-toxifying.

Nor can massage get rid of any rhabdo it causes. You can't "flush" the rhabdo cocktail away with massage, or drinking a little extra water — or any amount of water. PMSM is just an unavoidable mild side effect of strong massage, just like soreness after intense exercise. I have a detailed article just about rhabdo, which explains exactly why it can't be "flushed." The rest of this article explains the futility of flushing in more general terms.

Poisoned by Massage — Rather than being DE-toxifying, deep tissue massage may actually cause a toxic situation

~ 9,500 words

And how is *water* supposed to help anyway?

Even if there are some problematic waste metabolites in your tissues, and even if they can be mostly liberated into the bloodstream … why would drinking a couple extra glasses of water help get rid of them?

There's a prevalent and vague belief that drinking water somehow "rinses" your blood vessels or cells … or something. But your circulatory system is not a simple system of tubes that you can flush out by imbibing extra water. This makes about as much sense as adding fuel to a car to make it go faster.

In fact, fluid balance is quite stable and somewhat independent of modest changes in water intake. Drink some extra, drink some less — your blood volume will stay almost exactly the same. Your body is an "ugly bag of mostly water," but the total amount of water in circulation — in your blood and between your cells — remains nice and steady. You only need so much of the stuff. Just like your respiratory system excels at maintaining constant levels of oxygen and blood acidity, your guts cleverly keep your insides just the right amount of wet. Drinking more water than you need doesn't add it to your bloodstream — you just piss away the extra!

Your body is an "ugly bag of mostly water," but the total amount of water in circulation remains nice & steady. You only need so much of the stuff.

The liver and the kidneys are the primary detoxifying organs: this is where most junky molecules are transformed, disarmed, and/or excreted. And they don't require extra water to work any more than they need extra food to work. Their elaborate chemistry marches on unperturbed, whether you drink 4 glasses of water per day or 12. If you are *significantly* dehydrated, of course you would certainly start to have problems — but liver and kidney failure are not among the early consequences!

The many fates of metabolites

Carbon dioxide is a prevalent waste metabolite, and an easy one to understand: your cells produce it via combustion of fuels with oxygen, like a trillion [17] teensy car engines. It may be found at high levels in myofascial trigger points (muscle knots), indicating that they are metabolically "revving." [18] To hammer home that this stuff really is a "toxin," CO2 is also chemically equivalent to acidity: to be CO2-polluted is to be acidic!

But CO2 disposal just has nothing to do with water, nothing at all. Its fate is completely separate from fluid balance.

Carbon dioxide is processed at extreme speeds — quite "aggressively," because we cannot tolerate much variation in acidity — primarily by a chemical pathway through the bloodstream and lungs: a pathway that does not much involve the kidneys, fluid balance, or fluid excretion. And the amount of CO2 involved in trigger point toxicity is a drop in an ocean of chemistry anyway. Even if massage squished a trigger point's full cargo of CO2 into the bloodstream, that's an infinitesimally small amount of CO2 compared to the total CO2 produced in a single second by all of the body's cells. We produce and process *vast quantities* of CO2 constantly, and we do it effortlessly.

So much for *that* prominent toxin being flushed away by water!

And so it is with all the other "toxins" in a trigger point — problematic when concentrated in a patch, they are otherwise trivial and unaffected by water intake in any case. Even supposing that squishing a trigger point magically forces every molecule of every pain-causing metabolite into the bloodstream (not just into adjacent intercellular fluids, which is actually more likely), they still wouldn't require further "flushing" by any means. Once in the bloodstream, they would be lost like motes in a sandstorm, joining billions of their metabolic siblings that are routinely produced — and processed — by all the cells of the body, and drinking water has no relevance to those processes.

A hydration detour: do you need to hydrate in general?

Last year I stumbled across some evidence that surprisingly mild dehydration can make you a bit pissy and foggy [19] … which turned out to be funded in part by a giant corporation that sells bottled water! Pretty fishy, right? Conflicts of interest aren't always deal-breakers, but that one is highly suspicious.

And that's just the tip of an iceberg. There's *much* more to read about water and dubious industry-funded science. From "Everything You Know About Cramps Is Wrong, And Gatorade Is Full Of Shit":

> … much of the science surrounding exercise and hydration has been underwritten by Gatorade, which obviously has an interest in pushing the notion of dehydration as a performance killer and hydration as the silver bullet. (In their book *The Runner's Body*, Tucker and co-author Jonathan Douglas mention one fear-mongering study that suggests that "dehydration of 2 percent causes performance to decline by up to 20 percent.")

The whole thing is terribly damning and makes you wonder if any good science about hydration has *ever* actually been done. Read it all: it's quite good, albeit depressing. Or just read the *title* of this letter to a journal, which pretty much sums it up:

> "Time for the American College of Sports Medicine to acknowledge that humans, like all other earthly creatures, do not need to be told how much to drink during exercise"

What about "lymphatic drainage"? Isn't that a clear example of detoxifying massage?

No. This comes up in most Facebook debates between massage therapists on this topic. It's a red herring. Manual lymphatic drainage (MLD) is a fairly exotic and specialized manual technique for reducing swelling. Although it is performed with the hands and a natural fit for massage therapists to learn, it is not "massage" *per se*, and the effect is mostly absent from all other kinds of massage. It has a reputation for impressive, visible effects on swelling — which have been totally absent from some well-controlled tests, [20] or (at best) quite a bit less impressive than its reputation would suggest. [21]

In principle, MLD supposedly stimulates/exaggerates the normal action of *the lymphatic system*, the primary function of which is not waste disposal but the removal of excess tissue fluids, and then the filtration of lymph through nodules of immune cells (lymph nodes). Lymph nodes are really not at all like the liver, which actually *is* a "waste processing plant." The liver is the organ that processes junk in your blood. Lymph nodes are about catching *invaders*, foreign microbes, which makes them more like "security check points." You can see from this difference that it's not really correct to say that lymphatic drainage is about "waste removal," even if there are some cellular waste products in lymph (and there probably are).

If lymph were critical for waste removal, then the major impact of failure of lymphatic drainage would be tissue pollution. But failures of lymphatic drainage — for instance, drainage can fail because of surgical damage to lymph vessels and nodes, and indeed that is *why* MLD exists as a therapy — do not result in tissue "toxicity" at all, but severe swelling (elephantiasis, in the most extreme cases). It's super unpleasant, but it's not an issue of *toxicity*.

So MLD isn't really "massage" as we normally know it, and doesn't "release toxins/wastes" in any case: that's a gross misrepresentation of the physiology as I understand it, and cannot be used as an example of detoxifying massage … even if it weren't for the evidence that it doesn't work as advertised!

A classic case of oversimplification

The idea that drinking water after massage matters is a hopeless oversimplification, easily undermined by a cursory understanding of biochemistry. Metabolic wastes are already ubiquitous in tissue fluids, and they are constantly being produced and recycled. While massage has never been shown to have any significant effect on these processes — except to actually impair lactic acid removal! — it doesn't even make logical sense that water would have anything to do with it. Anything the body *can* get rid of *it is going to get rid of*, with or without massage, and with or without any *extra* water.

The body is good at handling metabolic wastes, and even many exogenous poisons, without any special help. If it weren't, we'd really be up the creek.

It's certainly nice to offer patients some water after massage, to quench whatever thirst they may have. But it is not medically important for any specific biological reason, and it perpetuates several minor myths we would be better off without. Massage doesn't really "detoxify." Water doesn't detoxify. And lactic acid is a useful metabolite, not a waste product. Adequate hydration is easy and mild dehydration is not a health risk.

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About Paul Ingraham


Headshot of Paul Ingraham

I am a science writer in Vancouver, Canada. I was a Registered Massage Therapist for a decade and the assistant editor of ScienceBasedMedicine.org for several years. I've had many injuries as a runner and ultimate player, and I've been a chronic pain patient myself since 2015. Full bio. See you on Facebook or Twitter, or subscribe:

Related Reading

- This topic has been around for a while. Very similar points were made by Keith Eric Grant in Massage Today in 2002: see Flushing Out Myths.
- **Does Epsom Salt Work?** — The science and mythology of Epsom salt bathing for recovery from muscle pain, soreness, or injury
- **Water Fever and the Fear of Chronic Dehydration** — Do we really need eight glasses of water per day?
- **Ugly Bags of Mostly Water** — The chemical composition of human biology
- ""Detoxification" Schemes and Scams," Stephen Barrett, QuackWatch.org.
- YouTube Laura Allen, Massage Therapist, on Toxins & Massage on YouTube.com.

The major myths about massage therapy are:

- Massage increases circulation. Probably not… and *definitely* not as much as a little exercise.
- "Tightness" matters. The three most common words in massage therapy — "you're really tight" — are pointless.
- Massage detoxifies. It's actually the opposite, if anything.
- Massage patients need to drink extra water to "flush" the toxins liberated by massage.
- Massage treats soreness after exercise. Studies have shown only slight effects.
- Massage reduces inflammation. An extremely popular belief based mainly on a single seriously flawed study.
- Fascia matters. The biggest fad in the history of the industry.
- The psoas muscle is a big deal. The most overhyped single muscle.
- Massage stimulates endorphins (natural opioid) and reduces cortisol (stress hormone). They do not.
- "Trigger points" are evidence-based. Actually, the science is seriously half-baked.
- Massage therapists have spooky palpation skills. No, it's just ordinary expertise… and misleading.

The complete list of dubious ideas in massage therapy is *much* larger. See my general massage science article. Or you can listen to me talk about it for an hour (interview).

And massage is still awesome! It's important to understand the myths, but there's more to massage. Are you an ethical, progressive, science-loving massage therapist? Is all this debunking causing a crisis of faith in your profession? This one's for you: Reassurance for Massage Therapists: How ethical, progressive, science-respecting massage therapists can thrive in a profession badly polluted with nonsense.

Appendix: What do massage therapists really believe about detoxification?

A common criticism of this article is that few massage therapists *actually* believe or say anything about detoxification at all — that it's a myth that massage therapists believe that massage detoxifies. A myth? It's reasonable counter-skepticism, but just speculation and contrary to my extensive experience.

I have an unusually good sense of what "many massage therapists believe" because they *tell me*, constantly, for many years now, responding to my widely read website. My email inbox is more or less constantly filled with examples. Here's one that just happens to be in there as I write this, from a discontented massage therapist writing about her clinic:

> My boss has an infrared sauna and she wants us all (her staff) to try to get our clients to have regular saunas because they are good for 'detoxing the body'. She always uses the mercury example of how we must rid our bodies of this insidious substance, citing that most of us have amalgam fillings in our teeth.

I have also witnessed countless Facebook arguments on this topic — often triggered by this article — and there is often a militant "detox contingent" that truly, madly, deeply *believes* detox dogma. For example, here is the first comment on a Facebook share of this article:

> massage stimulates circulation, mechanically and metabolically, which is an enormous factor in "toxin" processing.

But massage does not "stimulate circulation" to any significant degree (certainly much less than exercise). [22] If not a militant "detox contingent," even more inevitable is the innocent question (thoroughly answered above):

> Doesn't it help to flush lactic acid?

Sometimes I have heard massage therapists argue that it's *only* a minority of bad apples and poorly-trained therapists who make detox claims. However, I was trained in British Columbia when 3000-hour training was standard — by far the most rigorous massage therapy training program in the world at that time, closer to physical therapy programs than most other training for MTs. And *that* is where I first encountered widespread detox claims and beliefs! So it's clearly not a belief that is limited to poorly trained therapists.

Another clue that detoxification claims are not so rare or mild is that it tends to come up, with depressing frequency *as an excuse for adverse effects*. Unpleasant symptoms in the aftermath of massage, even serious ones, are often attributed to a "healing crisis" brought on by the detoxifying effects of massage. I have heard such anecdotes (complaints) countless times over the years from massage therapy consumers; my own clients told me about them many times, and many more readers. For a particularly chilling example, see What Happened To My Barber?

What's new in this article?

2018 — Added an explanation of toxins versus poisons, better examples of toxins, clarifications about the various fates of metabolic products, and more detail about why sweating isn't excretory/detoxifying.

2010 — Publication.

Notes

1. Do they really? I substantiate this in an appendix to the article, What do massage therapists really believe about detoxification?

2. Technically, it *can* hurt … and even kill. Excessive concern about dehydration leads to excessive hydration. And there is such a thing as "water toxicity," and there have even been some deaths from drinking too much water, prescribed by alternative health care professionals who believe that chronic dehydration is the cause of many ills. That is not true. See Water Fever and the Fear of Chronic Dehydration.

3. The idea of "toxins" is usually used as a tactic to scare people into buying *de*-toxifying snake oil of one sort or another. It's not that there's no such thing as a toxin — obviously there are toxic substances in the environment. The problem is with the kind of people who toss the idea around, the reasons they do it (profit), and their consistent and total failures to ever be biologically specific about what they mean. It is so vague that it's literally meaningless, except as a marketing message. Indeed, "detoxification" may be *the* single most common marketing buzzword in alternative health care.

4. Ingraham. 💩 Massage Therapists Say: A compilation of more than 50 examples of the bizarre nonsense spoken by massage therapists with delusions of medical knowledge. PainScience.com. 11683 words.

5. You get a gold star if you spot the joke there. If you don't get it, please return to grade 11 chemistry, do not pass go, and do not collect $200. But do read this explanation.

6. Another joke! Magnesium sulfate is Epsom salt — often touted as a detoxifying agent, but this is chemically illiterate and biologically absurd. The irony and the joke is that Epsom salt is actually mildly toxic if you eat it or inject it. But bathing in it? Epsom salt in your bath makes bath water feel "silkier," but that's probably all: it's unlikely to be biologically relevant to aches and pains, and it may not even make it through the skin (osmosis is not even relevant, and it cannot "detox" anything). See Does Epsom Salt Work? The science and mythology of Epsom salt bathing for recovery from muscle pain, soreness, or injury.

7. Mercury from fillings is a classic example. Mercury is certainly dangerous, but dental amalgam fear-mongering is a scam that has been denbunked ad infinitum. See The "Mercury Toxicity" Scam: How Anti-Amalgamists Swindle People.

8. Environmental lead poisoning is real and can be crippling and deadly, but it is only treatable by chelation, and only partially.

9. Imbeault P, Ravanelli N, Chevrier J. Can POPs be substantially popped out through sweat? Environ Int. 2018 Feb;111:131–132. PubMed 29197670 ❐ Good quality reporting on this study from National Geographic: "Fact or Fiction: Can You Really Sweat Out Toxins?"

10. Chelation is one of the few legitimate medical procedures that really does *detoxify*. However, it is also fairly limited and specific. Chelation is often used as a quack therapy for alleged toxins that it cannot actually treat. See Why Chelation Therapy Should Be Avoided.

11. A turbocharger reclaims some of the engine's energy by using the exhaust to power a fan that forces more oxygen into the engine — positive feedback. It uses "waste" to make the engine work better. It's a simple principle. If it can be found in car engines, you can rest assured that you'll find it in cellular chemistry as well.

12. Crane JD, Ogborn DI, Cupido C, *et al*. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. Sci Transl Med. 2012 Feb;4(119):119ra13. PubMed 22301554 ❐ This instantly famous gene profiling study was mostly reported because it supposedly proved that massage "reduces inflammation" (it doesn't, and I explain that thoroughly in another article). Although the study was not *about* lactic acid, they did check that … and found that "there were no effects on muscle lactate levels" with massage.

13. Wiltshire EV, Poitras V, Pak M, *et al*. Massage impairs post exercise muscle blood flow and lactic acid removal. Med Sci Sports Exerc. 2010 Jun;42(6):1062–71. PubMed 19997015 ❐

    One of the classic claims of massage therapy is that it "aids muscle recovery from exercise … by increasing muscle blood flow to improve 'lactic acid' removal." But this 2009 evidence showed that just the opposite may be the case, and probably is in at least some circumstances.

    It was a straightforward experiment: the researchers subjected twelve people to intense hand-gripping exercises and then measured their blood acidity with and without basic sports massage. Their measurements showed that massage significantly "*impairs* lactic acid and hydrogen ion removal from muscle following strenuous exercise by mechanically impeding blood flow." Yes, you read that right: massage *impairs*.

    That's quite a surprising result that applies a firm push to the side of a classic sacred cow of massage lore. (Note that good corroborating evidence was published again in 2012: see Crane 2012. Or see Franklin 2014 for some contrary evidence.)

14. See Bellinger, Fredsted, Wiltshire.

15. NYTimes.com [Internet]. Kolata G. Lactic Acid Is Not Muscles' Foe, It's Fuel; 2006 May 16 [cited 21 Oct 23]. PainSci Bibliography 54387 ❐

16. Lai MY, Yang SP, Chao Y, Lee PC, Lee SD. Fever with acute renal failure due to body massage-induced rhabdomyolysis. Journal of Nephrology, Dialysis and Transplantation. 2006 Jan;21(1):233–4. PubMed 16204282 ❐ PainSci Bibliography 54301 ❐

    Interesting, short, and readable story of an elderly man who collapsed after an unusually strong massage.

    This is one of three case studies of massage-induced rhabdo in my bibliography: see also Chen and Tanriover.

17. Or more. See Ten Trillion Cells Walked Into a Bar.

18. Shah JP, Danoff JV, Desai MJ, *et al*. Biochemicals associated with pain and inflammation are elevated in sites near to and remote from active myofascial trigger points. Arch Phys Med Rehabil. 2008;89(1):16–23. PubMed 18164325 ❐

    This significant paper demonstrates that the biochemical milieu of trigger points is acidic and contains a lot of pain-causing metabolites: this is among the best evidence supporting the energy crisis theory of trigger point formation and/or perpetuation. It's an improvement on an earlier paper from 2005 (Shah), with better methods. It is cogently summarized by Simons, and in my own short article: Toxic Muscle Knots.

    The validity of these findings have been questioned by Quintner *et al*. I think their concerns are justified, but they aren't deal-breakers either.

19. Armstrong LE, Ganio MS, Casa DJ, *et al*. Mild dehydration affects mood in healthy young women. J Nutr. 2012 Feb;142(2):382–8. PubMed 22190027 ❐

    This research, funded in part by a giant corporation that sells bottled water, supposedly shows that surprising mild dehydration can make you a bit pissy and headachy.

    The level of dehydration studied here is similar to what it takes to provoke thirst, and the effects on mood are presumably milder at the lower end of the range. So if the effect on mood is significant, we are probably also thirsty ... and if we're not actually thirsty, the effect is probably pretty minor. That said, I might agree with the author's conclusion that "increased emphasis on optimal hydration is warranted," but I'm also guessing it's not that big a deal, and I'm inclined to be rather cynical about it, because the conclusion is just so pitch-perfect for a study funded by a water bottling company.

    Mood effects are not to be ignored, for sure, but they are also a lot less serious than the health effects that people tend to believe (mostly based on very successful fear-mongering by people selling 'water cures').

20. Pichonnaz C, Bassin JP, Lécureux E, *et al*. The effect of manual lymphatic drainage following total knee arthroplasty: a randomized controlled trial. Arch Phys Med Rehabil. 2016 Jan. PubMed 26829760 ❐

Testing manual lymphatic drainage is fairly easy and interesting, because it's supposed to have such an objective, measurable effect on swelling. So how did five doses of MLD work on 30 patients who'd just had knee surgery (total knee arthroplasty)? Compared to 30 others who got a placebo. It didn't work! No difference in swelling. MLD bombed this straightforward test. Alas.

(See more detailed commentary on this paper.)

21. Ezzo J, Manheimer E, McNeely ML, *et al*. Manual lymphatic drainage for lymphedema following breast cancer treatment. Cochrane Database Syst Rev. 2015;5:CD003475. PubMed 25994425 ❐

22. Ingraham. Does Massage Increase Circulation? Almost certainly not in a clinically important way, and definitely not as much as even a small amount of exercise. PainScience.com. 11473 words.

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