Massage Does Not Reduce Inflammation

The making of a new massage myth from a high-tech study of muscle samples after intense exercise

Paul Ingraham • Mar 10, 2019 • 25m read

The news flash: Researchers at McMaster University claim to have discovered how massage treats muscle soreness after exercise [1] (delayed-onset muscle soreness, or DOMS). This is a pretty hot news item, as allegedly good massage science news always is — everyone loves to love massage! — but there is too much hype and not enough good science. Unfortunately, there are several major problems with the study and its interpretation. The last time I checked, it's just not safe to infer clinical mechanisms and benefits from a handful of biomarkers [2] in a (very) small sample.

Inspired by the doubtful notion that "massage *may* relieve pain in injured muscle" after intense exercise [3] researchers Crane *et al.* looked for changes in the proteins that cells constantly make ("gene expression" — more on this below). They compared muscle tissue samples with and without massage and concluded that "massage therapy appears to be clinically beneficial by reducing inflammation and promoting mitochondrial biogenesis." Mitochondria are the energy-producing organs of cells — cell power plants — so promoting their growth sounds super helpful. Contributor Simon Melov has been particularly enthusiastic in his pronouncements [video]:

> Our research showed that massage dampened the expression of inflammatory cytokines in the muscle cells and promoted biogenesis of mitochondria.

And the journal *Science Translational Medicine* summarized the article like this:

> Beneficial effects of massage on tired muscles **work** through anti-inflammatory and mitochondrial biogenesis pathways.

I have an entire article about DOMS, and an entire article about the science of massage therapy. See those articles for much more information on those topics. In this article, I consider only one scientific paper.

See also: In 2021, there was a bunch of hype about robot-mouse massage supposedly helping their little mousey muscles heal. See: "Robotic Mouse Massage: Is It "Regenerative" and "Anti-Inflammatory"? (Member Post)"

Sounds great, doesn't it? If only we could believe it! The results of this study were actually *negative*: the data showed that massage has *no significant effects* on gene expression muscle in cells, [4] and certainly none that clearly explain any therapeutic effect.

Several significant concerns about the study

- You can't find the cause of something that doesn't happen: we already know from clinical trials that massage doesn't work any miracles for soreness after exercise. We also know that exercise soreness probably isn't inflammatory by nature.
- The number of samples studied was extremely small, so changes in gene expression needed to be quite substantial to be convincing. They were not.
- Using an aging method of analysis, Crane *et al.* detected only *minor* changes in the production of just *five* proteins.
- Real changes in inflammation and mitochondrial growth were *not directly measured*: they were *inferred* from the five weak "signals" of altered gene expression.
- Meanwhile, exercise changed protein production *vastly* more than massage did — *about a thousand times more.*
- Opposite limbs were used as "controls" to compare to, an odd choice. That is, the untreated side was assumed to be neutral and uninvolved, which can be fine if you *know* that the treatment has only local effects… but that can't be ruled out here. An expert of my acquaintance called this "one of the goofiest methodological choices I have ever seen."

Exercise changed protein production vastly more than massage did — about a thousand times more.

The research was interesting and worthwhile, but the hype is much too thick. The authors, the journal, the media, and massage therapists everywhere are all talking like it's now a scientific fact ("It's science!") that massage "reduces inflammation" and "stimulates mitochondrial growth." But really, this is a flawed and limited study with an interpretation that is debatable at best, and it panders to what we'd *like* to believe about

massage. It tries to explain an effect that doesn't exist … an effect that massage didn't really need. Massage feels great, regardless of whether it does anything to inflammation or mitochondria.

This is how myths are made, and it could well fall just as flat as the lactic acid myth — which is so ironic, because this paper actually put a nail in the coffin of that myth. [5]

The most high-tech massage study ever? The technical details (translated)

The study was generally well-designed — the problems are almost entirely with interpretation. As massage studies go, it was clever, technical, and "science-y" and probably cost as much as a luxury sports car: Mark Tarnopolsky's team profiled *gene expression* in the damaged muscles of eleven athletes, with and without massage therapy. That's just cool, and newsworthy in itself.

1. Eleven young men worked out on an exercise bike with gradually increasing pace — enough to induce muscle damage.
2. After a 10-minute break, *one* of their legs was given simple Swedish massage for a few minutes, with a peak intensity of "firm."
3. Then the researchers took tissue samples — muscle biopsies, ouch, kind of a big deal [6] — from each leg, one immediately after, and another sample 2.5 hours later.

So what is gene profiling? It's a method of analyzing which genes are *active* — "expressed" — in a tissue sample. Genes are the code for proteins. So, this technique shows which proteins cells are busy cooking up. [7] Specifically, they found a *five-gene difference*: cells in massaged muscle were, *on average*, making a little more or a little less of *five proteins* than cells in un-massaged muscle.

Quick protein primer: *Proteins put the bio in biochemistry. Everything that happens in the human body is ultimately regulated by these absurdly complex molecules … which are all built from instructions in the DNA. Don't think of proteins as molecules so much as highly specialized chemical robots that do specific jobs with astounding speed and precision.*

But how much more? How much less? Do we know what those proteins do? And how does this compare to changes in gene expression with exercise alone? I cannot emphasize enough how *mind-bogglingly complicated* this biology is.

In fact, the differences were quite small. "None of them were particularly strongly turned on or turned off." [8]

Gene profiling is not a crystal ball

What can we really make of a handful of small differences in gene expression? Truly, *not much.* The physiology is too complex to assume that these signals add up to anything therapeutic (or even benign).

Gene profiling is certainly interesting stuff and has great potential to solve many difficult problems in biology, but it is many steps removed from clinical reality and the actual results of a massage. The conclusions of the paper are no more than some educated, highly debatable guesses about the biological and clinical significance of those proteins … based on an older, simpler method of profiling to boot. Dr. Gorski:

> These days, more sophisticated analyses, known as network analyses, are usually done. These involve looking for groups of genes that are turned on and off in synchrony that indicate broader pathways that are being turned on and off. **Single genes don't actually mean all that much.** It's the groups of genes going up and down together as part of a pathway that truly indicate specific pathways being turned on and off.

So it is one thing to know that a protein is being produced and quite another to know what happens to it after that, and what it means. The biological fate of any given protein depends on many factors. As with other high-tech diagnostic and research methods, gene profiling creates both a marvelous opportunity *and* the classic investigative hazard of "looking where the light is." [9] We tend to find and over-interpret whatever we *can* find and over-interpret. It's extremely likely that other researchers could attempt the same research and get different results and/or come to different conclusions.

Perspective: cells are much more affected by exercise than massage

Clearly, exercise changes muscle cells — body builders are living proof of it. What about massage? Squishing muscle cells *might* cause them to behave differently, and it was worth using this method to check. Cells are always making proteins — it's what they do, constantly — and if they change *which* proteins they are making after a massage, that could certainly be interesting science.

Crane *et al.* found a difference all right, but size matters — effect size. Bear in mind that there are *tens of thousands* of genes. [10] Five slight changes is no more than a biological blip.

It is all the more trivialized by a comparison to the effects of exercise. How much does a hard workout effect genetic activity? The effect of massage is simply *dwarfed* by the number of genetic changes — many hundreds, even thousands — caused by exercise alone. And what is the clinical significance of all those changes? Your muscles' cells are clearly doing things dramatically differently after exercise, and yet all you feel is "sore

and weak." In other words, it takes a lot of cellular changes to add up to a relatively minor change in your experience.

It makes all kinds of biological and evolutionary sense that exercise changes muscle, and we know that it does, and that is reflected in the genetics. In contrast, there's no particular reason to believe that massage would change cells much, and this data seems to clearly show that it doesn't — certainly not compared to exercise.

Inflammation: the villain!

> It is unclear how applicable knowledge of infection-induced inflammation is to other types of inflammation.
>
> ~ Ruslan Medzhitov, "Origin and physiological roles of inflammation"

A major premise of Crane *et al.*'s research is that intense exercise damages muscle and that the soreness we experience for a day or two afterwards — delayed-onset muscle soreness, or DOMS — is caused by "inflammation," and that's bad, and we should stop it if we can. Inflammation is always treated like a villain, but it is much too complex to assume that it is villainous … or even *present*. Classic inflammation is mainly an infection-fighting system, and may have little or almost nothing in common with other recovery and healing processes.

The study identified only a few minor changes in gene expression, but inflammation itself generally involves many large changes in cellular behaviour. If massage were truly anti-inflammatory, it would cause much more significant changes — more like the changes caused by exercise itself.

One of the supposedly anti-inflammatory signs was a reduced production of cytokines (a gross oversimplification, but the same one that the authors of the paper chose). A cytokine is a class of proteins, and some of them are considered inflammatory. But cytokines are a large family of molecules used constantly by most cells for literally countless other reasons — so a small reduction in a particular cytokine is not smoking gun evidence of "reducing inflammation." [11] But even if it was, the decrease was truly unimpressive in size.

There's an even more important, almost philosophical concern. DOMS isn't particularly "inflammatory" to begin with — it's radically different from classic acute inflammation. The immune system is not terribly worried about infection after a workout! Anti-inflammatory medications like ibuprofen are considered anti-inflammatory because they suppress classic inflammation, and yet their effect on DOMS is distinctly underwhelming. In particular, their effect is notoriously "shallow": they mask the pain without changing the

The immune system is probably not terribly worried

duration or severity of DOMS, and you're still just as weak.

about infection after a workout.

There's also evidence (and more pesky logic) that interfering with whatever is going on in sore muscles could actually have *negative* consequences. The pain may be a side effect of a necessary and natural recovery process that you don't really want to mess with much. Although exercise soreness is still officially quite mysterious, there is now fairly good evidence that it's basically "nerve growing pains" [12] [13] [14] [15] — that is, exercise develops our nerves, and apparently that's uncomfortable.

"Reducing inflammation" in this context may not be a meaningful therapeutic goal, or one that is entirely safe or free of unintended consequences — for instance, we know that icing muscles may disrupt adaptation to exercise. [16]

Assuming there's an anti-inflammatory effect at all.

This paper claims to have found an *explanation* for a therapeutic effect that doesn't clearly exist, and this is where the gap between basic biology and clinical reality is most glaring: in the real world, massage does not reduce the pain of DOMS reliably or much. [17] There is evidence that it helps, but the benefit is modest, "taking the edge off" at best. We can talk all day about cytokines and gene expression — whatever goes on in those cells, it does *not* add up to any significant pain reduction in people.

So we have here a classic case of an explanation in search of a phenomenon. And we're a long way from a safe conclusion of clinical benefit. Perhaps the mitochondria thing?

More mitochondria, more!

"More mitochondria" is not actually what the paper found, although it sure does keep getting reported *as if* it did [18] and is discussed in that spirit. Massage therapy bloggers everywhere seem to be celebrating *more mitochondria*. As with the inflammation, it's much ado about nothing.

What the authors actually reported is: "**potentiated mitochondrial biogenesis signaling**" and "**promotes mitchondrial biogenesis**." More specifically, they *might* have found "one molecule that promotes the development of mitochondria by 20% at most" (Gorski). They didn't find *more mitochondria* … they found a single mitochondrial growth *signal*. It's the difference between finding bigger plants or just a few bags of fertilizer. Potash in a farmer's barn does not mean there is a bumper crop.

Whether or not mitochondrial growth *actually happens* depends on *many* biological inputs (like everything else that our cells do). Inferring from one signal in a small sample that "massage increases mitochondria" is an enormously optimistic leap. Here's how another critic put it:

> They literally haven't shown that mitochondrial biogenesis is upregulated. Full stop. … There's boatloads of assays these guys could have run in order to probe for higher levels of mitochondrial biogenesis, not to mention a plethora of genes related to biogenesis, fission, and fusion whose mRNA levels were not analyzed. Weak sauce.
>
> ~ ScienceBasedMedicine.org commenter TheLabMix ("a researcher who works on mitochondria")

The mitochondria claim here doesn't make much biological sense, [19] but it doesn't explain anything about massage. There are no known effects of massage that have anything to do with growing more mitochondria. No such effect is even suspected or unwisely claimed. Since mitochondria provide energy to cells, growing more of them would improve muscle performance — a big deal. Imagine if that was true! Massaged athletes would have impressive, measurable advantages … which we already know is simply not the case. Massage is great stuff, but it's not the secret sauce of Olympic champions.

People don't get massage to treat inflammation

Simon Melov said of his research: "There's general agreement that massage feels good, now we have a scientific basis for the experience." We don't have any such thing: it's a few scraps of basic biology with *possible* but unproven and unlikely relevance to massage effects that are minor at best. That's half-baked. Over-interpretation of data like this is why "most research is wrong" — the more complex and further removed biology is from clinical outcomes, the more ways there are for it to get misinterpreted and distorted even by the researchers themselves (never mind science journalists and clinicians). [20]

More importantly, we *already have* a scientific basis for why massage *feels* good which is perfectly understandable [21] without resorting to a half-baked claim that massage treats inflammation, or even fully baked proof of it. Most people do not generally get massage to cure inflammation or DOMS! Post-event massage after intense exercise is fairly common among elite athletes, and doubtless that was the inspiration for the research, but such extreme exertions are irrelevant to most athletes, [22] Certainly this research has nothing to do why the average person buys massage. [23] Even if the paper is correct in every way — perhaps massage really is meaningfully anti-inflammatory — that would not remotely explain how *most* massage works.

About 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

- "Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage," the full article by Crane et al. in *Science Translational Medicine*, 2012. The full text is freely available from the journal with registration.
- **A Painful Biological Glitch that Causes Pointless Inflammation** — How an evolutionary wrong turn led to a biological glitch that condemned the animal kingdom — you included — to much louder, longer pain
- **Chronic, Subtle, Systemic Inflammation** — One possible sneaky cause of puzzling chronic pain
- **A Deep Dive into Delayed-Onset Muscle Soreness** — The biology & treatment of "muscle fever," the deep muscle soreness that surges 24-48 hours after an unfamiliar workout intensity
- **The Complete Guide to Muscle Strains** — Muscle strain (pulled muscle) and muscle pain explained and discussed in great detail, plus reviews of every imaginable treatment option, with lots of referencing
- **Guide to Repetitive Strain Injuries** — Five surprising and important ideas about repetitive strain injuries for patients and professionals

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.
- 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.

What's new in this article?

2019 — Described another methodological concern, and cited some newer exercise soreness science that casts even more doubt on the idea that massage reduces inflammation.

2012 — Publication.

Notes

1. 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 ❐ Here's the press release. The full paper is freely available from the journal with registration.

2. A biomarker is a chemical that is associated with a particular biological process, disease, state. Biomarkers can be really tricksy to interpret: the presence of a certain molecule often does not mean what we think (or hope) it means, because biochemistry is just too complicated, and most molecules have multiple overlapping functions — and their significances change with the context.

3. By "injured" they mean exhausted and sore from intense exercise, not traumatized by an accident. The researchers were looking specifically at *exercise-induced muscle damage*, which is not quite the same thing as *delayed-onset muscle soreness* — the former is technically a symptom or subcategory of the latter. DOMS is the more familiar clinical term, and patients are far more likely to seek massage for DOMS. For simplicity, I refer mainly to DOMS in this article, even though the paper was really about EIMD.

4. ScienceBasedMedicine.org [Internet]. Gorski D. Does massage therapy decrease inflammation and stimulate mitochondrial growth? An intriguing study oversold; 2012 Feb 13 [cited 12 Mar 9]. PainSci Bibliography 54451 ❐ Dr. Gorski writes:

> The proper conclusion of this study is that there was little or no significant effect in … gene expression from massage. That would have been perfectly fine as a conclusion. After all, negative studies happen and should be published. Yet that's not what was concluded. They did not report what was in essence a negative study.

Dr. Gorski's analysis is thorough and much more technical than mine — he has done gene-profiling research — but well worth at least scanning through. Agree or disagree, his criticisms are so numerous and serious that it's clear that the study can't be a slam-dunk.

5. From the editor's summary: " … one oft-repeated idea turned out not to be true. As others have shown, massage did not help clear lactic acid from tired muscles." Of course, we already knew that.

6. Actually, there are eyebrow-raising ethical concerns about using muscle biopsies without adequate justification from clinical data. It breaks one of the most basic ethical rules in research: never do *anything* invasive to human subjects unless other research has already clearly established that there is a good reason for it. In this case, you shouldn't do muscle biopsies because "massage *may* relieve pain in injured muscle" — you should do it only if massage *almost certainly* relieves pain in injured muscle. Studying the biology of a clinical phenomenon you haven't nailed down is called a scientific "fishing expedition," where you're just looking for whatever you can get. It's not hard to see how that might go wrong! Scientific fishing is perfectly justifiable in some contexts, but it is strongly frowned upon when doing it requires little chunks of people's thighs. A number of commentators on the Crane *et al.* study have marvelled that it got past an ethical review.

7. If you must know, "real-time reverse transcription–polymerase chain reaction (RT-PCR), protein signaling analysis, and metabolite quantification to more completely characterize the processes within skeletal muscle that are influenced by massage." Very impressive!

8. Dr. Gorski: "None of them were particularly strongly turned on or turned off. The gene most turned on only reached a level 1.68 times control at time zero after massage and was not detectably different from control by 2.5 hours. The gene most turned off only decreased to 0.73 times control, a 27% decrease. Not impressive, at least not to me."

9. The **streetlight effect** is the observational error of searching for something only where it is easy to search — such as looking for your dropped car keys only where the streelight shines. In science, it refers to our tendency to use powerful instruments and tools to look for answers, sometimes at the expense of the bigger picture. A major example in medicine is the overuse of MRI machines and their diagnostic red herrings — many things that show up on MRI are not actually a problem.

10. Not just for the impressive numbers, but because it puts "five small differences in gene expression" into greater perspective: The human genome consists of about **3.1 billion base pairs**, divided into about **30,000 genes**, which vary in size dramatically. The biggest known gene is about 2.5 million base pairs long — humungous! We used to think there might be 150,000 genes, but the human genome project knocked the number way down to 30,000. Only about **2% of the genes code for proteins**, but there isn't a tidy 1:1 ratio of genes to proteins, and there are (very roughly) **a couple million different proteins** in human biology, which we get by mixing and matching their recipes (the genes).

11. Consider an example of a misunderstood molecule in a small 2003 experiment: Howatson *et al.* measured levels of another inflammation/DOMS biomarker, plasma creatine kinase. It was "significantly lower" in subjects who did ice massage, but, alas, this *did not correlate* with a clinical benefit (which they also measured, the clever monkeys). In fact, ice massage had no detectable effect at all! So apparently having less creatine kinase in your blood is a big whoop-de-doo. If the study had *only* looked at creatine kinase, you can bet that many people would have leapt to the conclusion that less creatine kinase just had to be good and ice massage was therefore, obviously, "anti-inflammatory." But the clinical picture simply did not play nice with the assumptions about the biochemistry.

12. Murase S, Terazawa E, Queme F, *et al*. Bradykinin and nerve growth factor play pivotal roles in muscular mechanical hyperalgesia after exercise (delayed-onset muscle soreness). J Neurosci. 2010 Mar;30(10):3752–61. PubMed 20220009 ❐

13. Urai H, Murase S, Mizumura K. Decreased nerve growth factor upregulation is a mechanism for reduced mechanical hyperalgesia after the second bout of exercise in rats. Scand J Med Sci Sports. 2013 Mar;23(2):e96–101. PubMed 23134144 ❐

14. Murase S, Terazawa E, Hirate K, *et al*. Upregulated glial cell line-derived neurotrophic factor through cyclooxygenase-2 activation in the muscle is required for mechanical hyperalgesia after exercise in rats. J Physiol. 2013 Jun;591(12):3035–48. PubMed 23587883 ❐ PainSci Bibliography 52961 ❐

15. Mizumura K, Taguchi T. Delayed onset muscle soreness: Involvement of neurotrophic factors. J Physiol Sci. 2016 Jan;66(1):43–52. PubMed 26467448 ❐

    ABSTRACT

    Delayed-onset muscle soreness (DOMS) is quite a common consequence of unaccustomed strenuous exercise, especially exercise containing eccentric contraction (lengthening contraction, LC). Its typical sign is mechanical hyperalgesia (tenderness and movement related pain). Its cause has been commonly believed to be micro-damage of the muscle and subsequent inflammation. Here we present a brief historical overview of the damage-inflammation theory followed by a discussion of our new findings. Different from previous observations, we have observed mechanical hyperalgesia in rats 1-3 days after LC without any apparent microscopic damage of the muscle or signs of inflammation. With our model we have found that two pathways are involved in inducing mechanical hyperalgesia after LC: activation of the B2 bradykinin receptor-nerve growth factor (NGF) pathway and activation of the COX-2-glial cell line-derived neurotrophic factor (GDNF) pathway. These neurotrophic factors were produced by muscle fibers and/or satellite cells. This means that muscle fiber damage is not essential, although it is sufficient, for induction of DOMS, instead, NGF and GDNF produced by muscle fibers/satellite cells play crucial roles in DOMS.

16. Yamane M, Teruya H, Nakano M, *et al*. Post-exercise leg and forearm flexor muscle cooling in humans attenuates endurance and resistance training effects on muscle performance and on circulatory adaptation. Eur J Appl Physiol. 2006 Mar;96(5):572–80. PubMed 16372177 ❐

    It's only one study, but … *yikes!* This fascinating experiment done by Japanese researchers showed that regular icing for a few weeks after workouts resulted in a significant reduction in training effects: ice users didn't get as strong. This implies that icing may interfere with normal post-exercise muscle physiology and prevent the process of muscles adapting to stress. This finding is reinforced by Tseng *et al*.

17. See my main DOMS article for a full discussion of the DOMS physiology and treatments.

18. For instance, in the *Wall Street Journal*: " … an increase in production of mitochondria… ."

19. Not much happens in biology without some kind of adaptation logic, and I don't see it here. Why would massage cause muscle to grow more mitochondria? What are mitochondria for? In what other circumstances do mitochondria grow? What biological purpose could there be for growing more of them in response to massage? Certainly a lot happens in biology for reasons we don't understand, but the absence of a biological rationale raises the level of evidence needed here.

20. Ioannidis J. Why Most Published Research Findings Are False. PLoS Medicine. 2005 08;2(8):e124. PainSci Bibliography 55463 ❐

    This intensely intellectual paper — it's hopelessly nerdy — became one of the most downloaded articles in the history of the Public Library of Science and was described by the Boston Globe as an instant classic. Despite the title, the paper does not, in fact, say that "science is wrong," but something much less sinister: that it should take rather a lot of good quality and convergent scientific evidence before we can be reasonably sure of something, and he presents good evidence that a lot of so-called conclusions are premature, not as "ready for prime time" as we would hope. This is not the least bit surprising to good scientists, who never claimed in the first place that their results are infallible or that their conclusions are "true."

    I go into much more detail here: Ioannidis: Making Medical Science Look Bad Since 2005.

21. Hint: neurology! Human beings are wired for exquisite sensitivity. Touch signal processing is an extremely impressive threat detection system, and friendly "grooming" is extremely social, reassuring and pleasant for

most *homo sapiens*. The details are interesting, but the general outline of it is not rocket science. There might be more to massage, but the pleasure of touch would be good enough even if it was all there was.

22. Consider that every marathon has a massage tent, but only a small fraction of the runners avail themselves of the service. I doubt the utilization of massage is ever more than about 30% on a good day … and that's a more or less ideal situation.

23. Massage is most commonly sought out as a treatment for relaxation and *chronic* muscle soreness and stiffness — not for acute soreness after a workout. Although some patients ask about it and hope for relief from DOMS when it just happens to coincide with an appointment, few massage appointments are planned for DOMS — it's difficult to schedule that, and for every person who hopes it might help, there are three who correctly assume that it will be unpleasant and unhelpful.

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