AROMATHERAPY

the science

Henry Olders, MD, FRCPC
McGill University
Ste. Anne's Hospital

Olfaction

- Last month there was a journal club where I presented an article that talked about the five modes of chemical communication.
- Olfaction may be the most important determinant of animal behaviour of any of the senses.
- That may be true also in humans.

First, disclosure. I am not involved with any company or organization having anything to do with aromatherapy.

Animal species function very well without any conscious awareness. It is entirely possible that in humans, smells control much of our behaviour without us being consciously aware of it.

Uses for Essential Oils

- Cancer chemoprevention
- Cancer suppression
- Atherosclerosis
- Thrombosis
- Antibacterial
- Antiviral
- Antioxidant
- Antidiabetic
- Skin penetration enhancers
- Aromatherapy
- Massage

Edris AE. Pharmaceutical and therapeutic potentials of essential oils and their individual volatile constituents: a review. Phytother Res. 2007;21:308-323.

Aromatic plants have been used since ancient times for preservative and medicinal purposes.
The term “essential oil” was used in the 16th century by Paracelsus, who named the effective component of a drug, the “quinta essential”.
By the middle of the 20th century, the role of essential oils had been reduced almost entirely to perfumes, cosmetics, and food flavourings.
A number of techniques can be used to extract essential oils from various parts of the aromatic plant, including water or steam distillation, solvent extraction, expression under pressure, supercritical fluid and subcritical water extractions.
This review by Dr Edris refers to the scientific literature on the uses for essential oils. His bibliography includes 270 articles!

Routes of entry for essential oils

- olfactory system
- respiratory system (vapour inhalation)
- transdermally
  - massage, bathing
- orally
  - capsules, food additives, medical preparations

Mechanisms of Action

- Pharmacological - absorbed agents
- Pharmacological - acting on the olfactory systems
- Psychological - eg consciously remembered smells
- Classical conditioning

Aromatic essential oils relevant to cerebral function

Bergamot	*citrus bergamia*	antidepressant, calming, relaxing, sedative
Chamomile	*chamomelium nobilis*	analgesic, hypnotic, relaxing, sedative
Geranium	*pelargonium graveolens*	analgesic, antidepressant, uplifting
Jasmine	*jasminum grandiflorum*	antidepressant, euphoric, stimulating
Juniper	*juniperus communis*	analgesic, aphrodisiac, mentally clearing
Lavender	*lavandula angustifolia*	analgesic, antidepressant, anticonvulsant, anxiolytic, calming, hypnotic, relaxing, sedative
Lemon	*citrus limonum*	mentally stimulating, reviving
Mandarin	*citrus deliciosa*	sedative, uplifting
Marjoram	*origanum majorana*	analgesic, anxiolytic, aphrodisiac, comforting, sedating

Perry N, Perry E. Aromatherapy in the management of psychiatric disorders: clinical and neuropharmacological perspectives. CNS Drugs. 2006;20:257-280.

To give you some idea, this is a table of the traditional therapeutic uses for essential oils as it relates to the brain.

Melissa	*melissa officinalis*	anxiolytic, calming, hypnotic, sedative, stimulating, uplifting
Neroli	*neroli bigarade*	sedative, uplifting
Patchouli	*pogostemon cabin*	calming, sedative, uplifting
Rose (Egypt)	*rosa damascena*	antidepressant, aphrodisiac, relaxing, sedative, soothing, uplifting
Rosemary	*rosmarinus officinalis*	analgesic, anxiolytic, mentally stimulating, clarifying
Sage	*salvia officinalis*	nerve tonic
Spearmint	*mentha spica*	analgesic, stimulating
Ylang-Ylang	*cananga odourata*	analgesic, aphrodisiac, relaxing
Vetiver	*vetivera zizanoides*	calming, nerve tonic, sedative, uplifting

Effects of attitudes towards odours

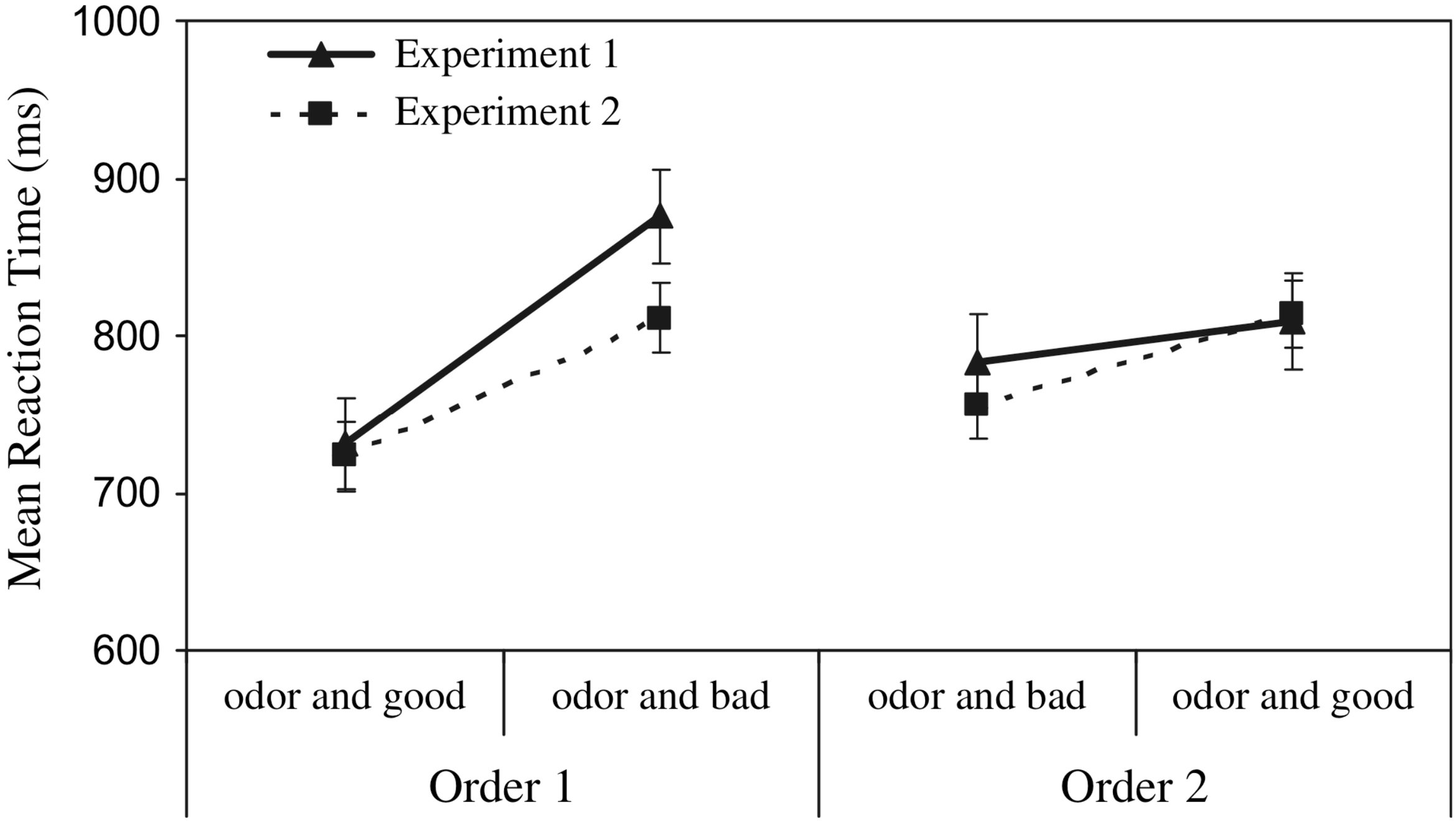
- People who believe that environmental odours have a negative effect on health:
  - report significantly more health effects
  - How: the belief triggers feelings of anxiety or stress
  - this results in closer monitoring of internal signals that may indicate potentially harmful effects
- Conversely, beliefs about the "healing" consequences of exposure to a certain odorant resulted in lower levels of symptom reports

Basically, we categorize odours as being either healthful or harmful. This happens very rapidly, and is clearly essential for survival. For example, it would prevent us from eating meat which smells rotten.
But these categorizations are all learned. Newborns apparently show equal responses to odours which adults classify as either pleasant or unpleasant.
Thus, learned attitudes about odours will influence behaviour.

Studying attitudes about odours

- Self-report questionnaires have limitations:
  - eg, embarassment re using aromatherapy products, or discomfort re revealing concerns about environmental odour exposure
  - may have never thought about the topic
  - may not be consciously aware of their attitudes

IAT: Implicit Association Test



Bulsing PJ, Smeets MA, van den Hout MA. Positive implicit attitudes toward odor words. Chem Senses. 2007;32:525-534.

The implicit association test

Subjects showed faster reaction times during testing blocks where the concept odour had to be associated with the concept good, compared to blocks where the concepts odour and bad had to be associated, and they made fewer errors.

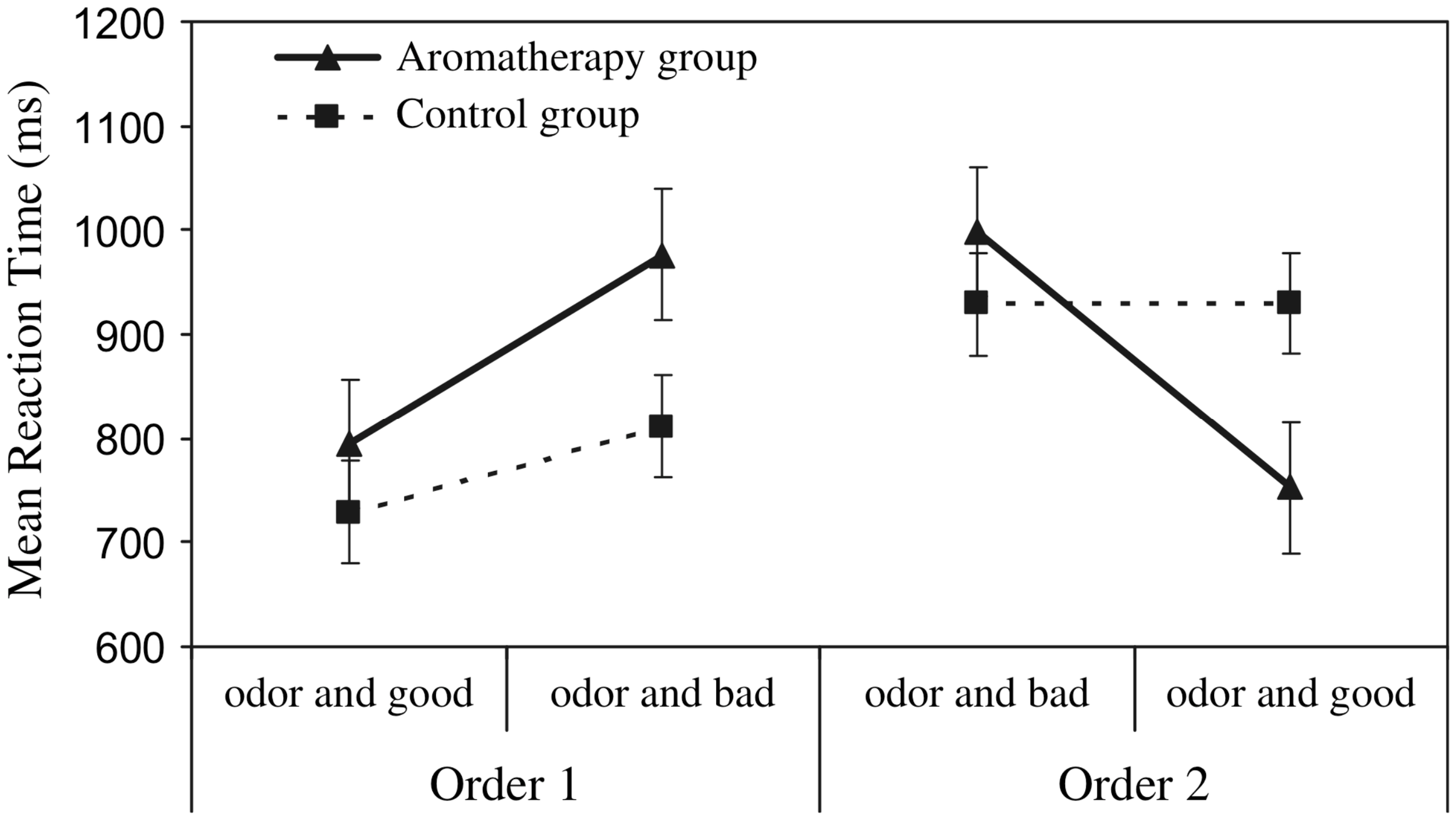
This unexpected finding showed that two independent samples of psychology students have a distinctly positive attitude towards the concept odour.

IAT and conscious preferences

- 285 students responded to a questionnaire re their preference for using scented consumer products as a means of relaxation
- example question: What will boost your energy after an exhausting day? (rank-order the responses)
    - my favourite music
    - a nice fragrance
    - cold wind
    - a refreshing walk
- the group with the highest scores was compared on the IAT to the group with the lowest scores

The high-scoring group was referred to as the aromatherapy group, and the low-scorers as the control group.

Aromatherapy group vs control group



The aromatherapy group showed significantly stronger positive attitudes towards the concept odour, on the implicit attitudes test, compared to the control group. But both groups overall showed positive attitudes.

The authors posited that there might be a gender difference, because about 82% of the subjects in all three experiments were female. So they did a gender-based analysis which showed that the female subjects were responsible for most of the positive attitude towards odour concept.

Could this have significance in the hospital setting where most of the clinical staff who are likely to implement aromatherapy are women, and most of the clients are men?

Pilot studies of aromatherapy: a review

- Wounds
- Nausea
- Agitation in dementia
- Agitation in elderly psychiatric residents
- End-of-life agitation

Buckle J. Literature review: should nursing take aromatherapy more seriously? Br J Nurs. 2007;16:116-120.

I thought I would start by telling you about this article which is a review by a nurse in the UK of the pilot studies on aromatherapy done in the US. She starts off by pointing out that in the UK, funding for aromatherapy studies is very hard to come by. She suggests that this may be because nurses aim to use aromatherapy primarily for patient comfort, and the cash-strapped National Health Service is unlikely to be impressed by having happier patients. The NHS managers might be more interested in studies targeting a decrease in morbidity, mortality, or length of hospitalization.
On the other hand, in the US system where competition for patients is important, patient satisfaction is considered a useful goal for research.

Wounds

- 5 patients with chronic wounds, unresponsive to conventional treatment
- 6% dilution of chamomile and lavender, applied bid around the wounds
- wounds had a slow but sustained improvement based on reviews of before-and-after photos by a third party

Of course, this is not primarily aromatherapy, but I thought I would include it because I found it intriguing, and it does use essential oils, there may be an olfactory component and maybe also massage, and attitudes and beliefs may be playing an important role.

Wounds 2

* 4 patients, either end-stage renal disease or diabetic
* MRSA-infected pressure ulcers (> 1 wound / patient)
* 15% tea tree diluted in aloe vera gel, applied directly into the wounds, other wounds on same patient treated conventionally
* after 1 month, treated wounds were reduced in size
* physician switched all the wounds to tea tree treatment

Here's another pilot study on wound treatment.

Nausea

- 100 surgical patients (case series)
- 5% ginger in grapeseed oil applied below the nose and on wrist pulse points by anesthetist prior to surgery
- intervention substantially reduced need for post-op anti-emetics
- 80% of patients with a prior history of post-op nausea and vomiting had none after the intervention

Agitation in dementia

- Ten elderly residents had their agitation, aggression, and level of restless physical movement recorded on a 10-point visual analog scale while in a common room between 3 and 6 pm, for one week
- A second week with lavender diffused in the common room
- reduction in agitation, aggression, restless physical movement; “a more peaceful atmosphere”

Agitation in elderly psychiatric residents

* 10 LTC residents requiring prn medications for behaviours, monitored during the 11 pm - 7 am shift
* 2 weeks baseline monitoring of: calling out repeatedly, trying to climb out of bed, wandering
* 2 weeks of intervention: 4 drops of bergamot on a 4 in square gauze; subjects asked to smell the gauze when target behaviour occurred
* 7 / 10 subjects had positive results
* prn use decreased from 12 doses (baseline) to none

In this study, aromatherapy was used instead of prn medication. So an important aspect would be the nurse's belief that the aromatherapy intervention would be effective.

End-of-life agitation

- 20 restless & agitated inpatients on IV PCA
- measured: pulse, respiration, tension (clenched hands, furrowed faces, body tension)
- 3% lavender applied topically to hand and foot using the “m” technique, for 20 minutes
- all patients had decreases in pulse and respiration rates
- 70% of family members noticed decrease in physical tension

The “m” technique refers to a technique of structured stroking which is used when the patient is too fragile for massage, or the caregiver is untrained in massage.

Pain in end-of-life care

- Terminally ill inpatients with moderate to severe pain in spite of conventional analgesia
- 3 patients received “m” technique to the hands with 1% frankincense in grapeseed oil
- 3 patients received “m” technique without frankincense
- touch plus aroma reduced pain more than touch alone, on a 10-point VAS

Buckle J. Literature review: should nursing take aromatherapy more seriously? Br J Nurs. 2007;16:116-120.

The studies that I’ve touched on, reviewed by Buckley in her article, led the involved hospitals to adopt aromatherapy.

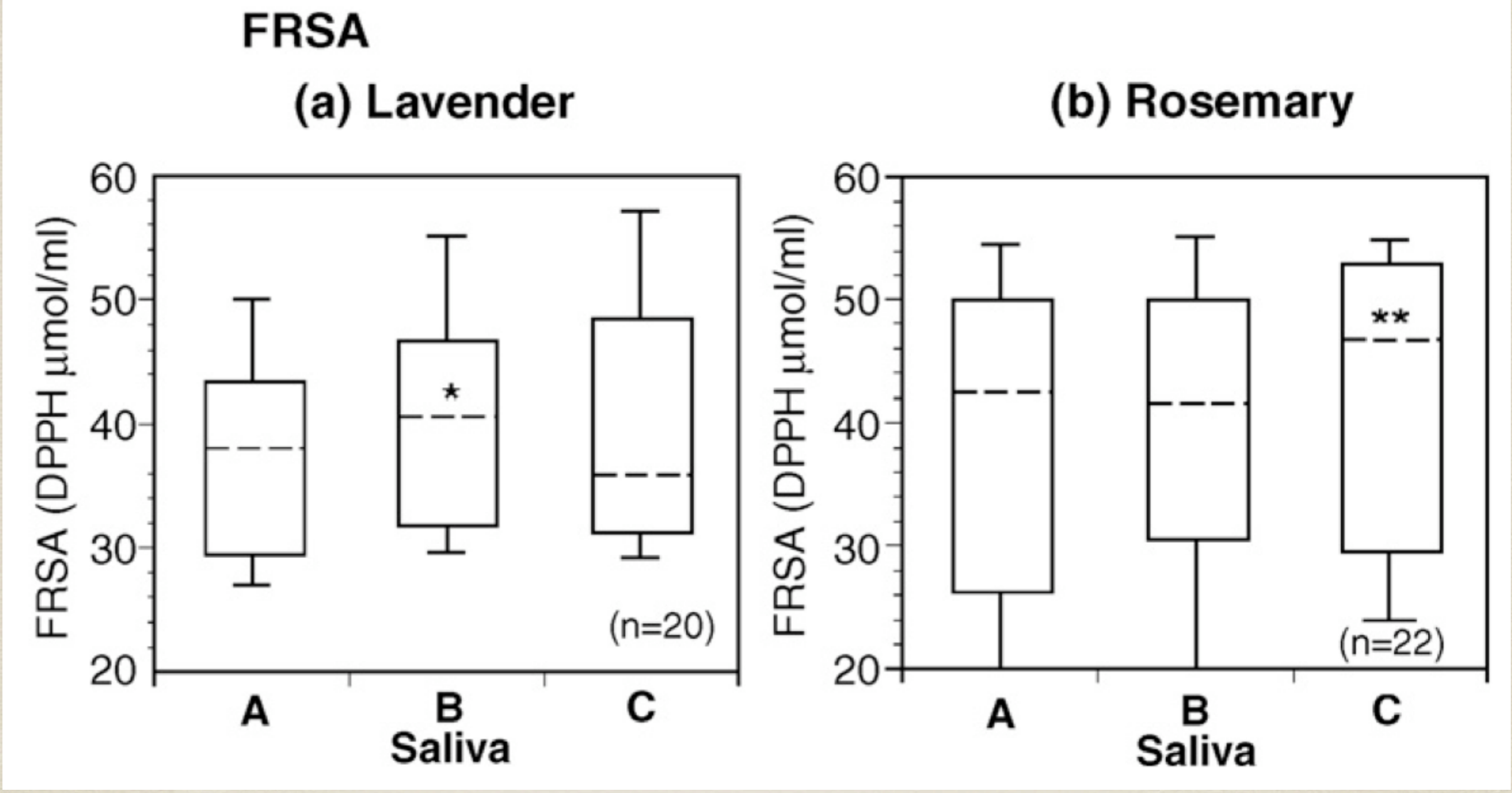
Studies of aromatherapy

- Three groupings:
  - studies of physiologic effects
  - studies where effects are reported by the subjects themselves (eg calming effects)
  - studies where effects are reported by others (caregivers or researchers), eg agitation in dementia

Given the size of the literature, I limited my search to very recent articles. Basically, studies can be classified into three groups.

Physiologic effects

Free radical scavenging activity



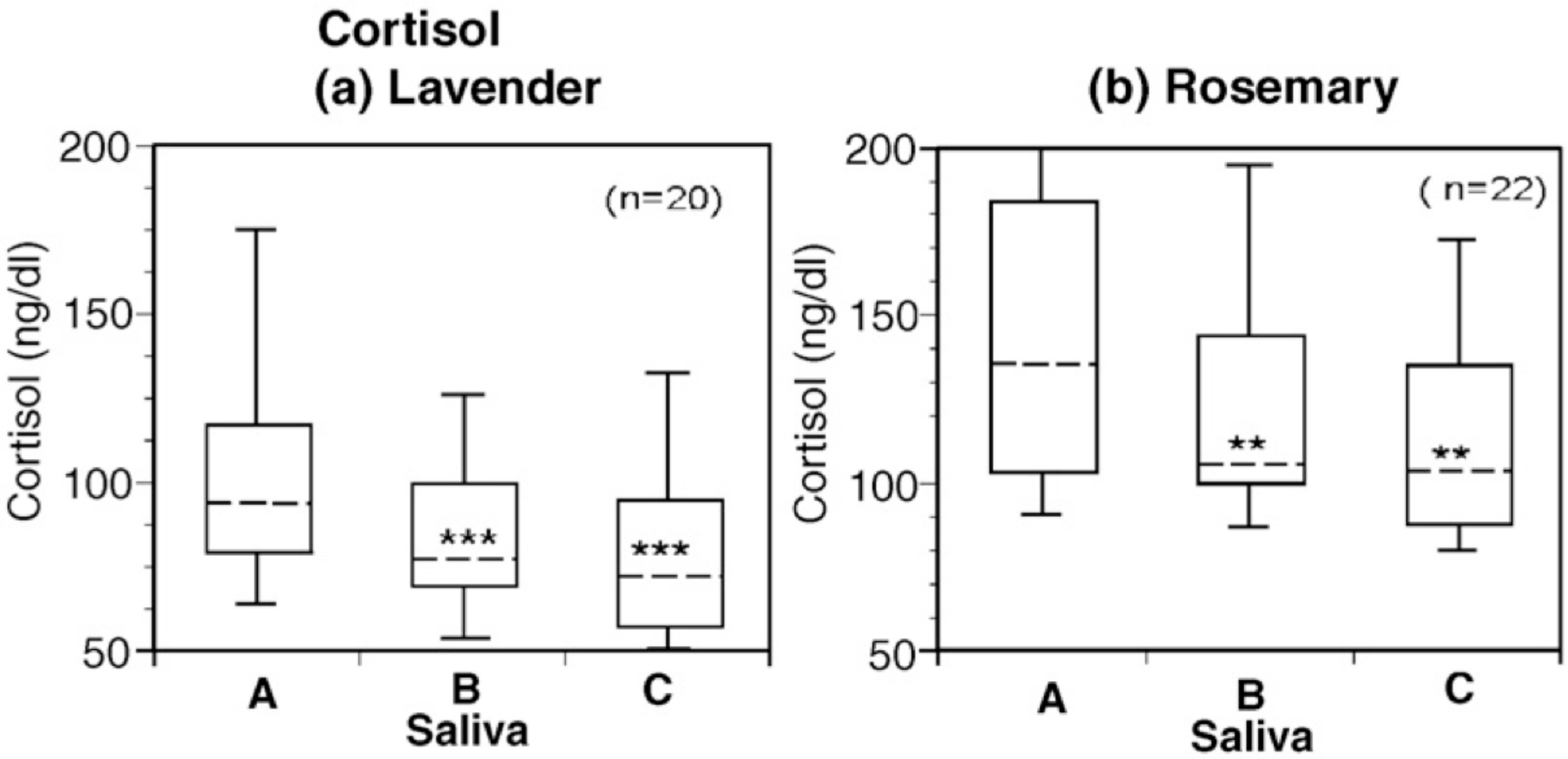
Atsumi T, Tonosaki K. Smelling lavender and rosemary increases free radical scavenging activity and decreases cortisol level in saliva. Psychiatry Res. 2007;150:89-96.

This was an experiment done with 22 healthy young volunteers, in which salivary levels of the total free radical scavenging activity, a measure of several antioxidant systems and thus of systems which are important for the prevention of oxidative stress, were measured. FRSA has previously been shown to decrease in response to physical stimulation such as the fatigue of exercise, and to increase in response to pleasant mental stimuli, for example watching a pleasant video.

In this experiment, a low concentration of lavender oil or a high concentration of rosemary oil led to an increase in FRSA. The researchers hypothesized that a high concentration of lavender failed to increase FRSA because it was experienced as unpleasant by many of the test subjects.

Cortisol level

Atsumi T, Tonosaki K. Smelling lavender and rosemary increases free radical scavenging activity and decreases cortisol level in saliva. Psychiatry Res. 2007;150:89-96.



In the same experiment, salivary cortisol levels were also measured. Cortisol is a stress hormone, thus a reduction in cortisol is felt to reflect decreases in perceived stress levels. Interestingly, both low and high concentrations of lavender and rosemary resulted in cortisol decreases compared to the control condition.

Breast milk odour & feeding behaviour

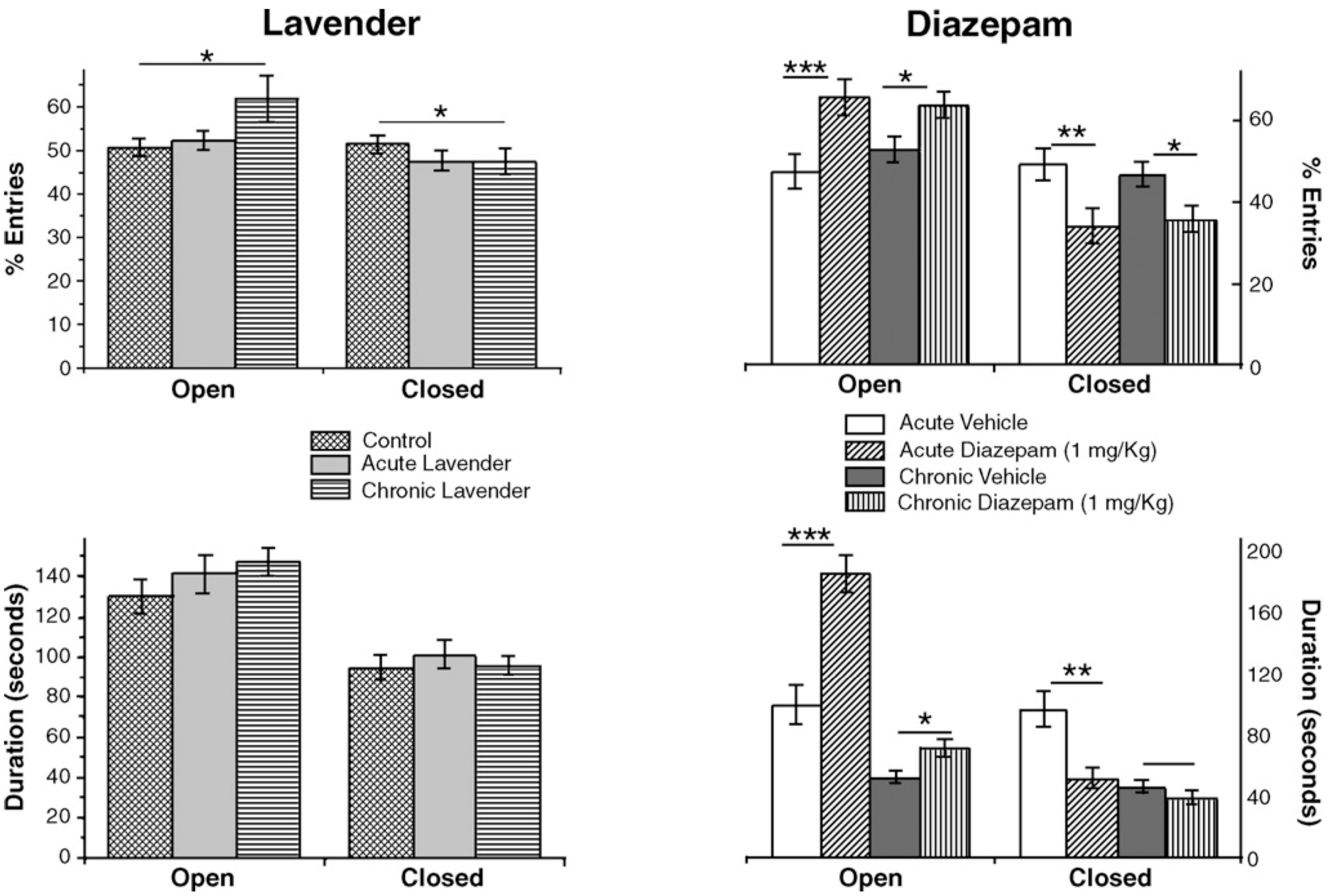
- Exposing premature babies to breast milk odour stimulates sucking behaviour
- More sucking behaviour has been shown to improve feeding skills and shorten hospital stays
- Can we employ this principle to improve appetite and eating in our patients?

Bingham PM, Churchill D, Ashikaga T. Breast milk odor via olfactometer for tube-fed, premature infants. Behav Res Methods. 2007;39:630-634.

For example, if we have patients who are eating poorly, would it be worthwhile to do as the maître d' does in a fancy restaurant - keep the food dish closely covered and remove the cover with a flourish just under the nose of the patron, to stimulate not only appetite but also appreciation of the food?

Lavender vs diazepam: anxiety in gerbils

- The Mongolian gerbil is more similar to humans than rats or mice, in terms of neuro-endocrine systems
- Exposure to lavender odour was via an electronic vapouriser and aroma stone, using 4 drops of essential oil, 3 times a day
- Diazepam was injected into the peritoneum
- Anxiety reduction measured using number of entries, and time spent in, either the open (unprotected) or closed (protected) portions of an “elevated plus maze”



Bradley BF, Starkey NJ, Brown SL, Lea RW. Anxiolytic effects of Lavandula angustifolia odour on the Mongolian gerbil elevated plus maze. J Ethnopharmacol. 2007;111:517-525.

You can see that the effects of lavender odour are in the same direction as for diazepam, but not nearly as pronounced. Of course, I would be tempted to say that in the case of diazepam, as for benzodiazepines in general, what we see in the disinhibiting effect: the gerbils are showing impaired judgment in going into the unprotected areas. And one could make a case that staying longer in either the closed or the open areas with acute diazepam is a reflection of sedation; with chronic diazepam, tolerance to the sedating effects has developed, so the gerbils spend less time in both open or closed areas.

Bottom line: it is very difficult to do studies in the area of anxiety.

Lavender, HRV, and cerebral activity

- 10 healthy female volunteers, 20 to 27 years old
- a plaster of lavender for aromatherapy was attached to the right shoulder
- subjects rated their own stress using the 18-item Stress Response Scale, both before starting the study and after the PET scan
- Holter monitoring was done for heart rate variability
- 40 min infusion of 18-fluorine labeled fluorodeoxyglucose, then a PET scan

Duan X, Tashiro M, Wu D et al. Autonomic nervous function and localization of cerebral activity during lavender aromatic immersion. Technol Health Care. 2007;15:69-78.

- Heart rate variability (HRV) is a measure of autonomic nervous system tone
- Lavender resulted in increases in the high frequency component of HRV, and decreases in the ratio of low frequency to high frequency components
  - this reflects increases in parasympathetic tone, a measure of relaxation
- PET scans showed regional metabolic activation in orbitofrontal, posterior cingulate gyrus, brainstem, thalamus, and cerebellum (ie, arousal, possibly improved cognition)
  - there were reductions in activation in the pre/post-central gyrus and the frontal eye field (physical relaxation)

Lavender and sleep

- A number of small, uncontrolled studies using subjective evaluations have shown improved sleep in elderly and demented subjects after lavender presentations
- Other essential oils have produced similar effects in young and older adults
- this study looked at the effect of lavender oil on 16 men and 15 women, ages 18-30, good sleepers, in good health
- 3 nights polysomnography in a sleep lab: 1 night baseline or adaptation, 2 nights of stimulus or control (crossover)

Goel N, Kim H, Lao RP. An olfactory stimulus modifies nighttime sleep in young men and women. Chronobiol Int. 2005;22:889-904.

The lavender stimulus was by having the subjects hold a vial of lavender oil at chest level for the first 2 minutes of each 10 minutes between 23:10 and 23:40, while breathing normally with eyes closed.

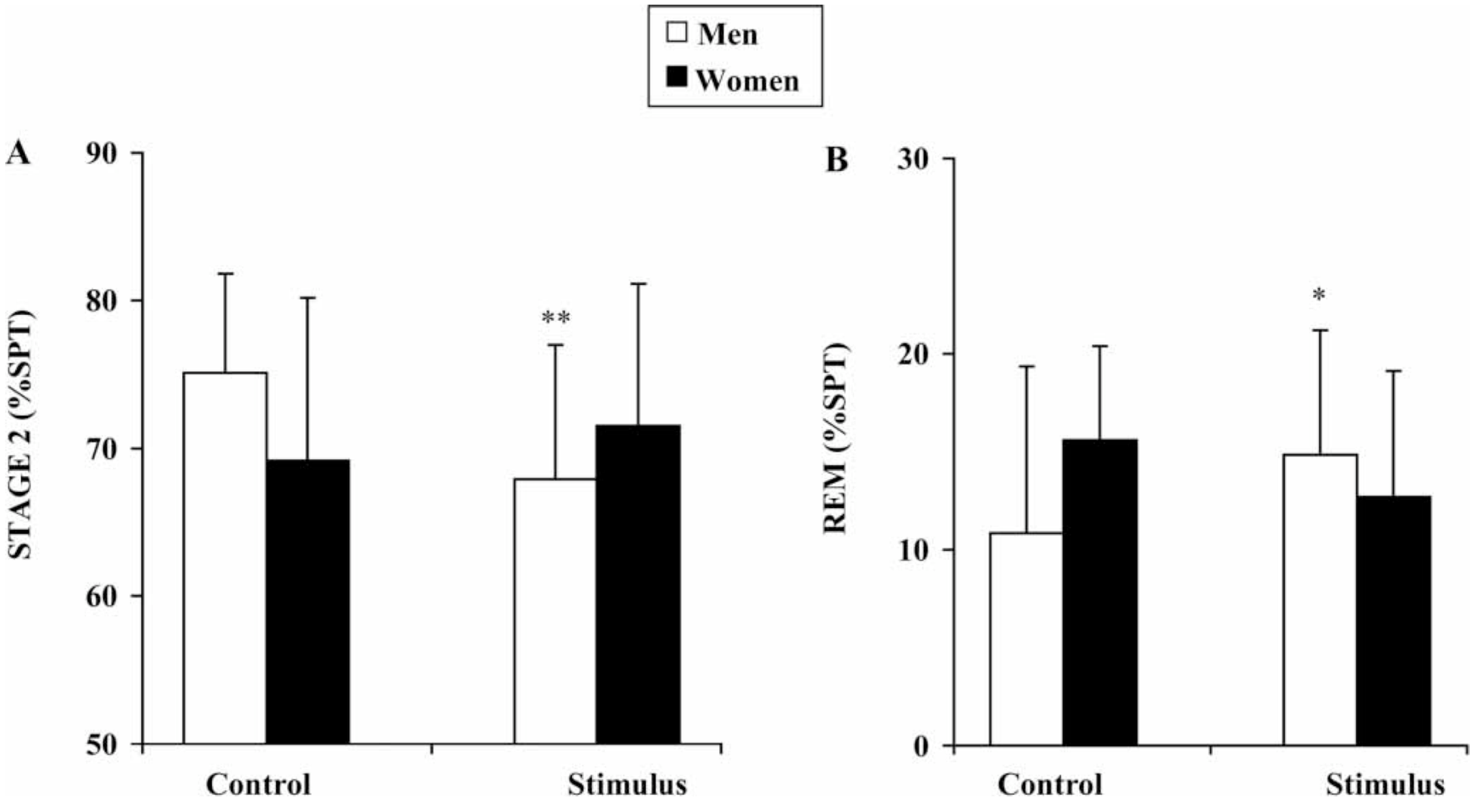


FIGURE 2 Significant session × gender interactions in the first half of the night for (A) Stage 2 %SPT and (B) REM %SPT (mean ± SD). Men showed significant differences in these measures between the control and stimulus nights ($^{*} = p < 0.05$; $^{**} = p < 0.001$).

The most important result of lavender treatment was an increase in slow wave sleep. Slow wave sleep is considered to be the restorative and refreshing part of sleep, so more is good. It is also associated with increases in threshold for musculoskeletal pain, which suggests that lavender treatment may also help in improving pain.

The graphs in this slide show that there was a gender-specific effect also: in men, lavender decreased stage 2 sleep and increased REM sleep, while having the opposite effect in women, although in women the changes were not significant.

In both men and women, there was a significant increase in vigor the morning after treatment, compared to control. There were no significant differences in sleepiness scores.

Olfactory identification dysfunction

- Current neurobiological models of PTSD implicate the orbito-prefrontal cortex (OFC) in emotion modulation and conditioning
- OFC dysfunction is implicated in aggressive and impulsive behaviour, like that seen in PTSD
- lesioning and neuroimaging studies implicate the OFC in olfactory identification
- thus, researchers are attempting to use olfactory identification deficits as a measure of OFC integrity

What about olfaction in war veterans?

US war veterans with PTSD

- Vietnam war vets with PTSD exhibited significant OIDs relative to veterans without PTSD, and to matched controls
- These effects were independent of war zone exposure in a study of Gulf War vets (ie ruling out a possible neurotoxic effect)
- Question: does OID correlate with aggression/ impulsivity in war vets with PTSD?

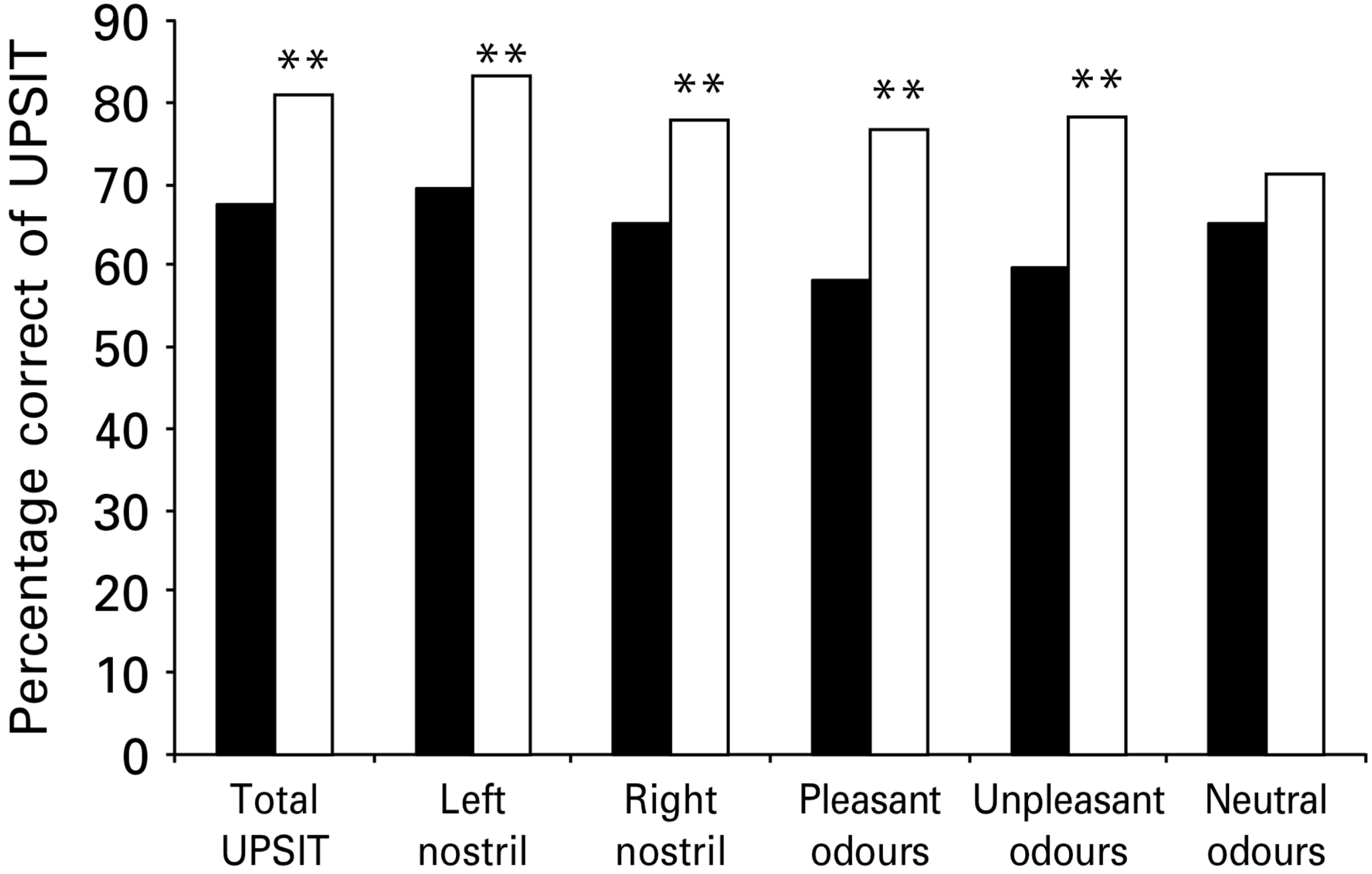


Fig. 1. Comparison of war veterans with PTSD (■) and age- and gender-matched controls (□) on the University of Pennsylvania Smell Identification Test (UPSIT) (** $p < 0.01$).

This is a study done with 31 male Vietnam war vets with a primary diagnosis of PTSD, recruited from an veterans psychiatric unit outpatient clinic. 31 healthy age-matched males served as controls.

All but one of the vets were on some form of medication: 67% on antidepressants, 21% anxiolytics, 12% mood stabilizers, 12% medication for sleep problems.

Olfactory identification was done with a 40-item suprathreshold 'scatch and sniff' multiple-choice test. There were 17 pleasant, 10 unpleasant, and 13 neutral odours.

Dileo JF, Brewer WJ, Hopwood M, Anderson V, Creamer M. Olfactory identification dysfunction, aggression and impulsivity in war veterans with post-traumatic stress disorder. Psychol Med. 2007;1-9.

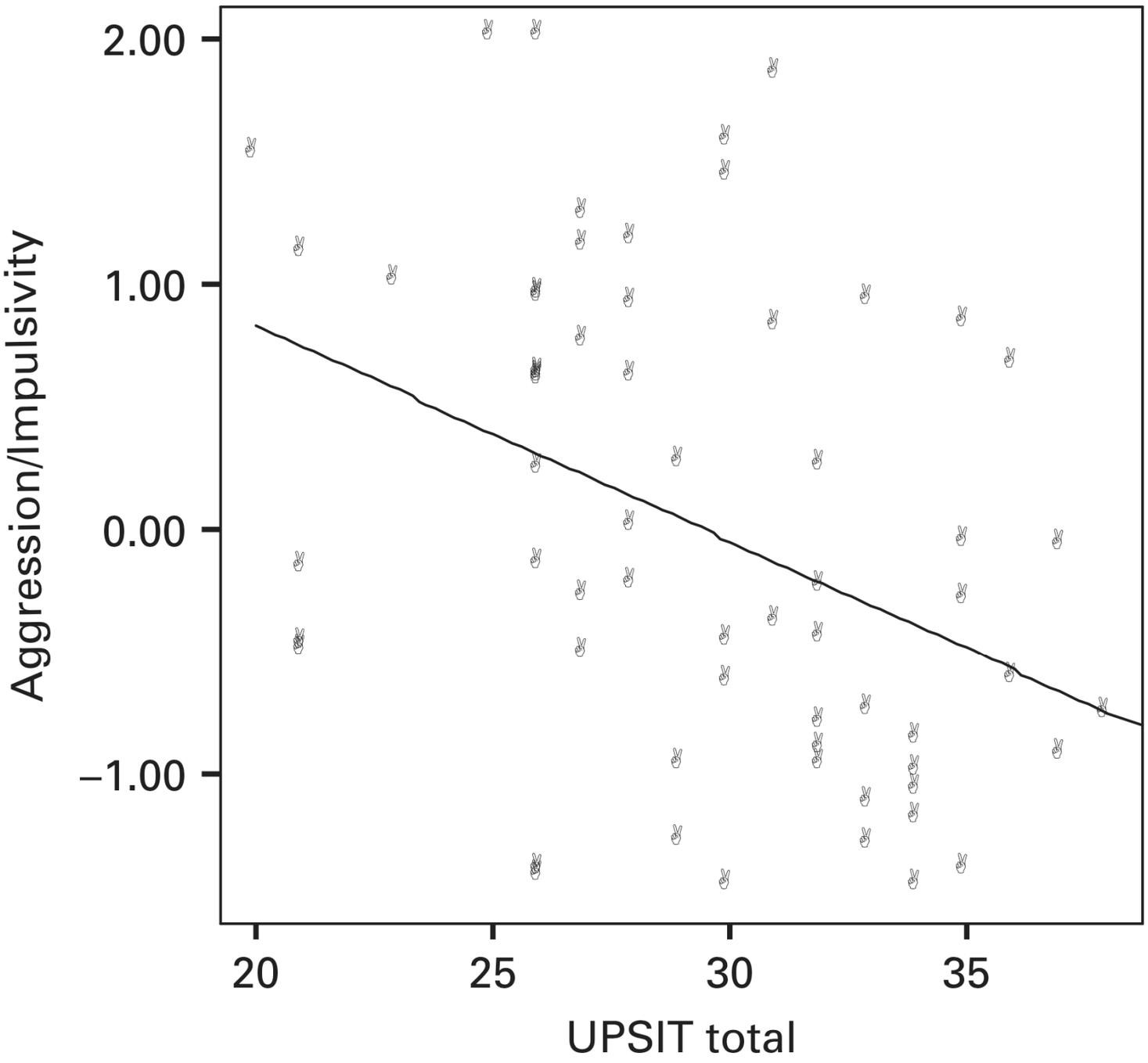


Fig. 2. Negative linear relationship between total University of Pennsylvania Smell Identification Test (UPSIT) scores and the Aggression/Impulsivity composite score. Aggression/Impulsivity = 2.60 + −0.90 × UPSIT ($R^2 = 0.16$).

The Buss and Perry Aggression Questionnaire, a 29-item self-report questionnaire, was used to rate physical aggression, verbal aggression, anger, hostility, and overall aggression.
Eysenck's Impulsivity Questionnaire is a 54-item self-report questionnaire which profiles individuals on measures of impulsivity, venturesomeness, and empathy.
This scatterplot shows that there is a negative correlation between olfactory identification scores and a composite score of aggression and impulsivity.
This is not a particularly high correlation, but it was significant at the $p < 0.01$ level.

Cognition enhancers

- herbs with pan-cultural traditions as treatments for cognitive deficits:
  - sage (*Salvia lavanulaefolia/officinalis*)
  - lemon balm (*Melissa officinalis*)
  - rosemary (*Rosmarinus officinalis*)

Kennedy DO, Scholey AB. The psychopharmacology of European herbs with cognition-enhancing properties. Curr Pharm Des. 2006;12:4613-4623.

Sage

- extracts of sage possess anti-oxidant, estrogenic, and anti-inflammatory properties
- specifically inhibit butyryl- and acetyl-cholinesterase
- acute administration improves mnemonic performance in healthy young and elderly cohorts
- a chronic regime attenuates cognitive declines in AD patients

Although there are over 700 species of Salvia, the two most common European members are Salvia officinalis, or garden sage, and salvia lavandulaefolia, or Spanish sage. Extracts of garden sage contain a toxic compound which can cause convulsions, so Spanish sage is thought to be safer and probably equally efficacious.

Lemon Balm

- extracts bind directly to both nicotinic and muscarinic receptors in human brain tissue
- this varies with strain of plant and extraction method
- mnemonic enhancement restricted to an extract with high cholinergic binding properties

Records concerning the medicinal use of lemon balm date back over 2000 years. No adverse side effects have so far been reported for this herb.

Effects on mood, autonomic, endocrine, & immune function

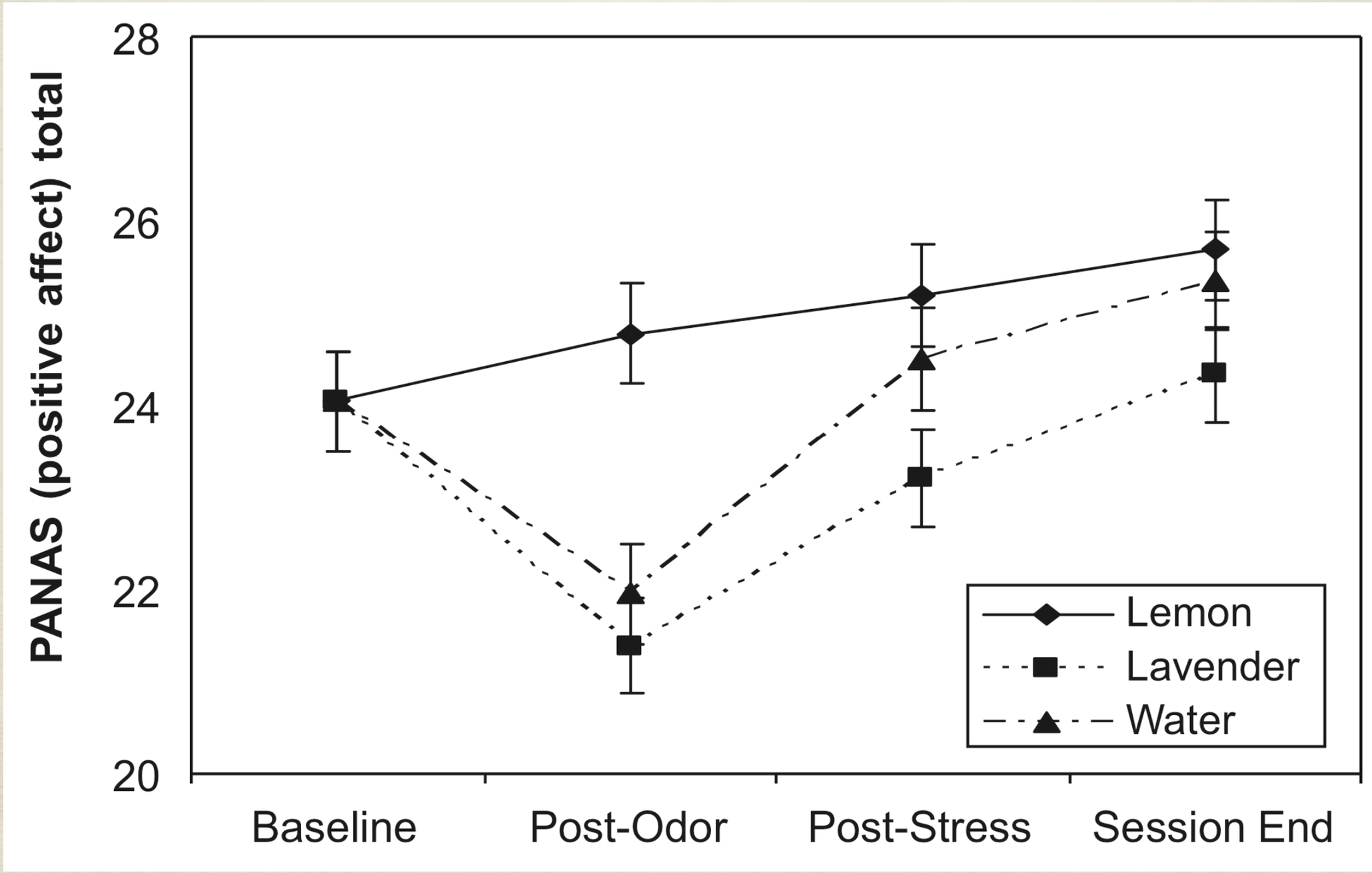
- randomized controlled trial involving 56 healthy men and women
- exposed on 3 separate visits to lavender, lemon, or water
- both blind and "primed" conditions were studied

Kiecolt-Glaser JK, Graham JE, Malarkey WB, Porter K, Lemeshow S, Glaser R. Olfactory influences on mood and autonomic, endocrine, and immune function. Psychoneuroendocrinology. 2008

This study was just published, and probably represents a high point in study design and methodology.

Mood

* lemon oil reliably enhances positive mood compared to water and lavender, regardless of expectancies or previous use of aromatherapy.



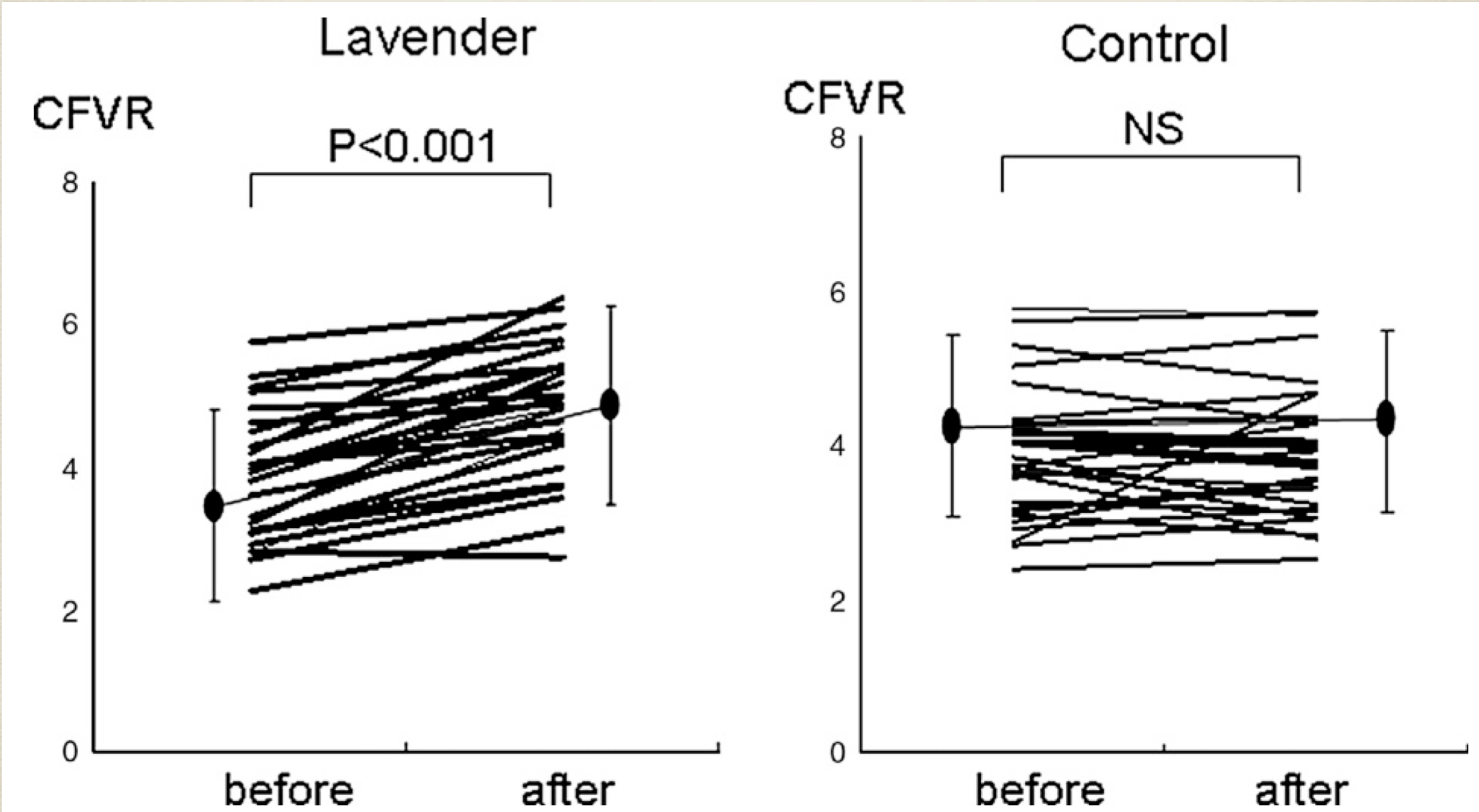
Note, though, that the scale for this graph is very restricted. Is there any real, clinical difference between a score of 21.5 and 24.5?
In spite of this possibly marginal result, it still was the most robust finding of this study.
Neither lavender nor lemon oil had any useful influence, in comparison to the water control, on autonomic, endocrine, or immune function.

Coronary flow velocity and lavender aromatherapy

- mental stress impairs coronary circulation (is a risk factor for cardiovascular events)
- this study was the first to look at lavender aromatherapy effect on coronary circulation
- 30 healthy young men, coronary flow velocity reserve measured by transthoracic Doppler echocardiography using an IV infusion of ATP to induce hyperemia
- baseline and after 30 min of therapy, or without aromatherapy on a different day

Shiina Y, Funabashi N, Lee K et al. Relaxation effects of lavender aromatherapy improve coronary flow velocity reserve in healthy men evaluated by transthoracic Doppler echocardiography. Int J Cardiol. 2007

Results: coronary flow velocity reserve



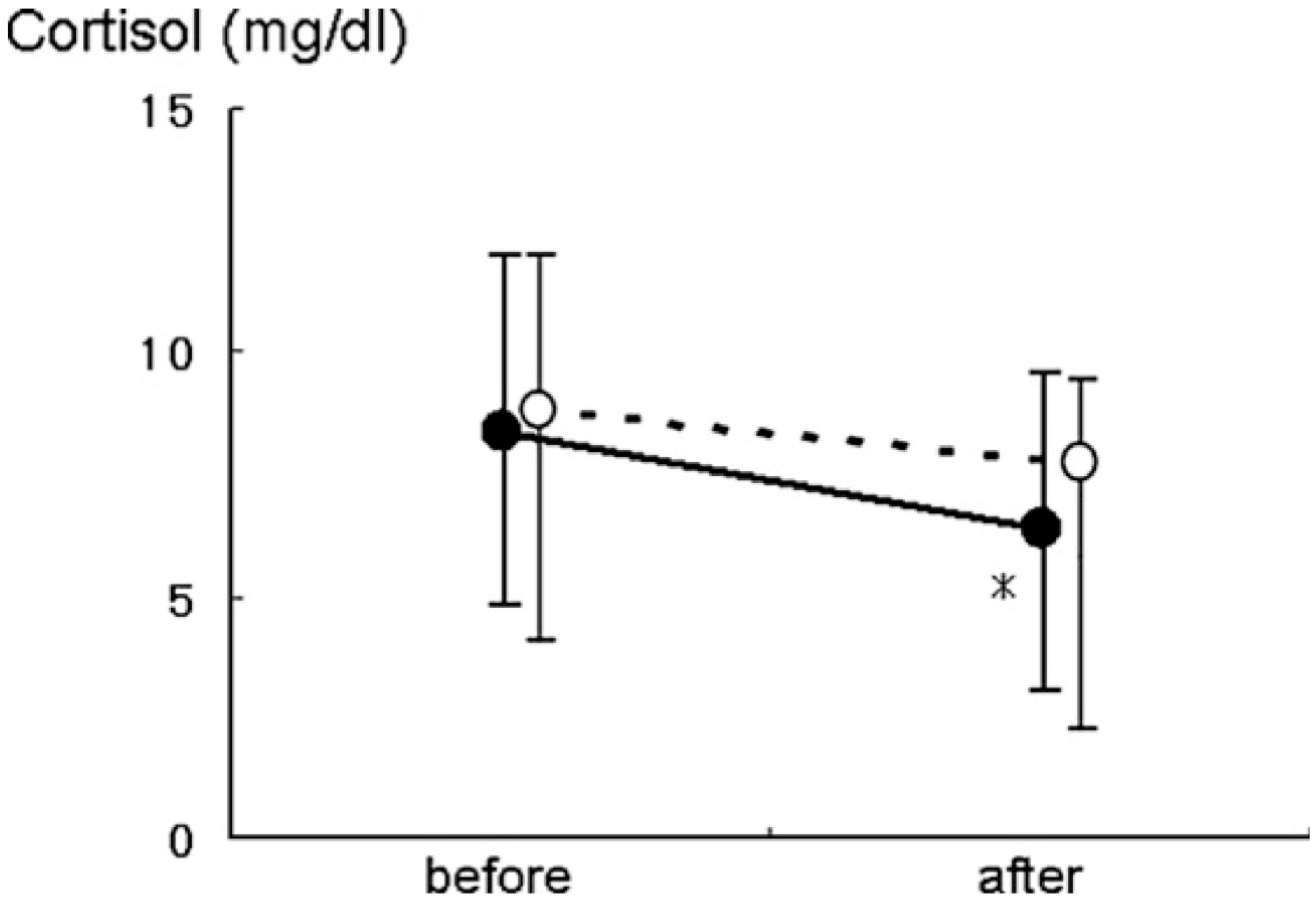


Fig. 1. Serum cortisol in aromatherapy group (closed circles) and control group (open circles). In the lavender aromatherapy subjects, cortisol was significantly reduced after aromatherapy. *$p<0.05$ vs. before aromatherapy.

There were no effects on heart rate or blood pressure responses to infusion of ATP.
This graph shows the effects on serum cortisol levels.

Effects reported by subjects

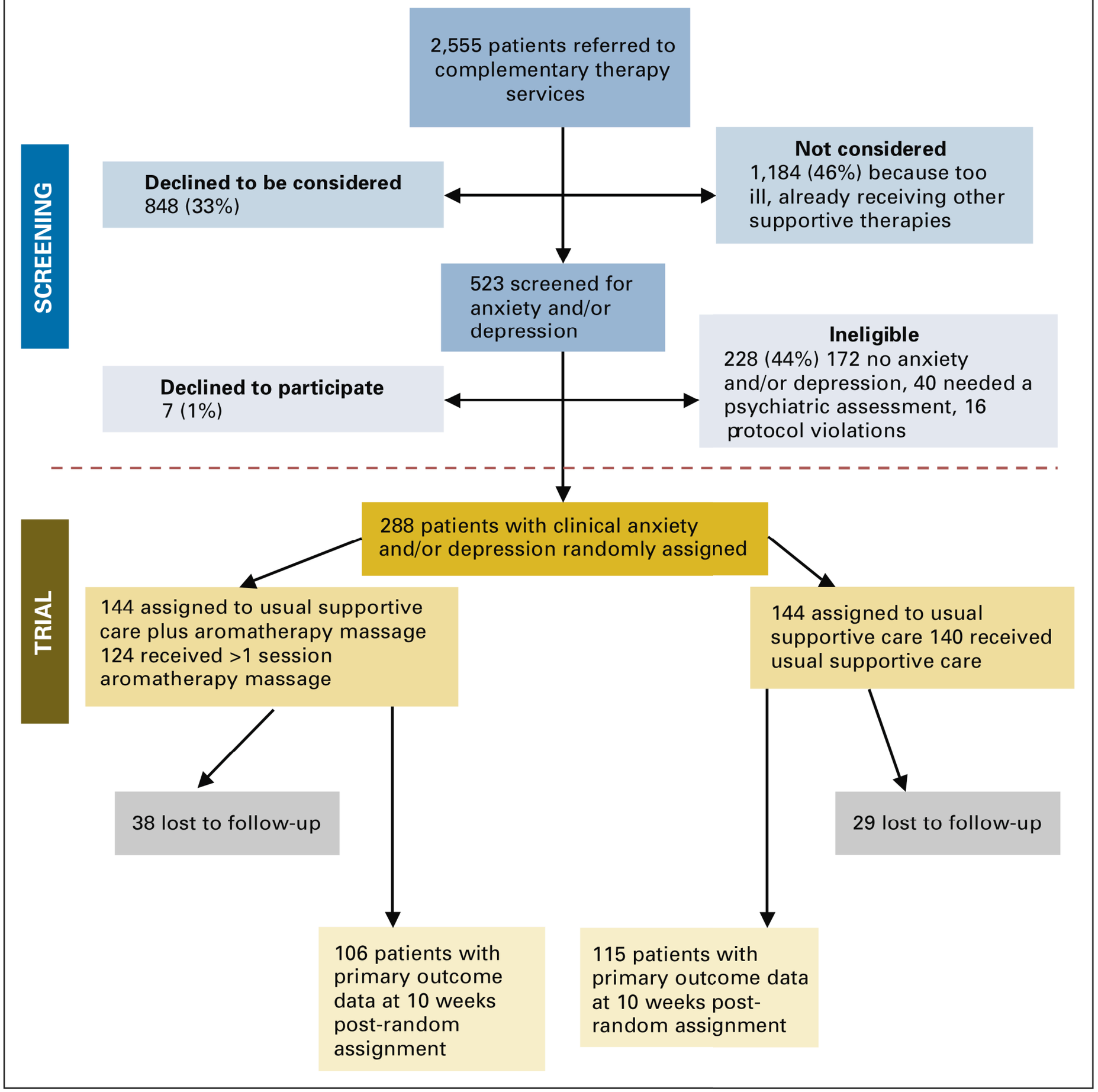
- expectations, attitudes, and beliefs play a very important role
- blinding of the subjects is impossible

Anxiety and depression in patients with cancer

- 288 cancer patients, randomized to a 4-week course of aromatherapy massage or usual supportive care alone
- weekly 1-hour treatments administered by 12 therapists
- up to 20 essential oils, massage strokes, style, and timings were agreed to by therapists
- therapy was individualized

Wilkinson SM, Love SB, Westcombe AM et al. Effectiveness of aromatherapy massage in the management of anxiety and depression in patients with cancer: a multicenter randomized controlled trial. J Clin Oncol. 2007;25:532-539.

Most studies of subjective effects have small numbers of patients and poor study design, making it difficult to draw conclusions.
However, I found a recent study published in the prestigious journal of Clinical Oncology, which was sufficiently powered, meaning it enrolled a sufficient number of patients, and was well designed.



This graphic from the study charts the flow of patients into and through the trial.

Results

- clinical anxiety and/or depression was improved in the treatment group at 2 weeks post-intervention
- the improvement was no longer statistically significant at 6 weeks post-intervention
- patients taking psychotropic drugs at baseline were less likely to improve

Effects reported by others

Behavioural problems in dementia

- aim: to review the evidence supporting the use of aromatherapy for BPSD (behavioural and psychological problems in dementia)
- search turned up eleven prospective randomized controlled trials
- wide variation in oils tested, methods of administration, outcome measures used
- interpretation of results difficult

Nguyen QA, Paton C. The use of aromatherapy to treat behavioural problems in dementia. Int J Geriatr Psychiatry. 2007

Results of review

- data supporting efficacy are scarce
- both positive and negative consequences were reported for the patients and for caregives
- side-effect profile of commonly used oils is virtually unexplored
- we should apply the same expectations regarding efficacy and tolerability as we do for conventional treatments (eg antipsychotics)

Only 3 of the 11 studies had a large enough sample to be able to detect even a large difference between treatment and control. Lavender was the most frequently used treatment. There was no support for the idea that the choice of oils should be individualized to each patient. Since many patients with dementia have anosmia (ie no sense of smell), it is unclear if this would affect outcome. Only one study looked at this; no differences were found between participants with more and less intact olfactory abilities.

Lavender for agitation in dementia

* Dementia patients in Hong Kong nursing homes
* 70 patients, 59% women, 63% with AD, 30% vascular dementia, 7% other
* randomized crossover trial: 3 weeks lavender (1 hour while asleep) vs 3 weeks sunflower oil by aroma diffuser

Lin PW, Chan WC, Ng BF, Lam LC. Efficacy of aromatherapy (Lavandula angustifolia) as an intervention for agitated behaviours in Chinese older persons with dementia: a cross-over randomized trial. Int J Geriatr Psychiatry. 2007;22:405-410.

Table 3. Treatment effects upon different category in CNPI

	Before treatment mean (SD)	After treatment mean (SD)	Level of significance
Delusions	0.16 (.53)	0.16 (.53)	
Hallucinations	0.71 (.35)	0.71 (.35)	
Agitation*	6.5 (3.09)	5.63 (2.81)	$p < 0.001$
Depression/Dysphoria	0.22 (.57)	0.14 (.46)	$p = 0.03$
Anxiety	0.26 (.81)	0.23 (.71)	$p = 0.32$
Euphoria/Elation	0.71 (.31)	0.71 (.64)	$p = 0.3$
Apathy/Indifference	0.34 (1.08)	0.13 (.59)	$p = 0.12$
Disinhibition	0.17 (.64)	0.14 (.49)	$p = 0.32$
Irritability/Lability*	5.39 (3.05)	4.61 (2.91)	$p < 0.001$
Aberrant motor behavior*	4.81 (3.9)	4.53 (3.63)	$p = 0.01$
Night-time behavior*	6.57 (3.36)	5.29 (3.2)	$p < 0.001$
Appetite/eating change	0	0	

*$p \leq 0.01$.

subcategories of CNPI	before	after	p
agitation	6.5	5.63	<0.001
depression/dysphoria	0.22	0.14	0.03
irritability/lability	5.39	4.61	<0.001
aberrant motor behaviour	4.81	4.53	0.01
night-time behaviour	6.57	5.29	<0.001

Here are the results of active treatment. Five of the 11 subscales of the Chinese version of the Neuropsychiatric Inventory showed statistically significant improvement. I've reproduced the numbers from the table for these five subscales so you can read them.

While achieving statistical significance, the absolute numbers showed only a modest improvement. Bottom line: don't expect miracles.

Possible harmful effects of aromatherapy

- Mis-identification of herbal plants or species
- Adulteration
- Ineffective therapy due to poor quality products
- Inappropriate use
- Risks to caregivers, other patients, visitors, animals
- Allergic reactions and skin irritations
- Medication interactions

Mis-identification of harmful plants or species

- The incorrect plant species or variety may have been harvested
- Labelling errors during the trans-shipment of raw plant parts
- Labelling errors or identification errors at the oil extraction stage
- Labelling errors when repackaged for the consumer

Adulteration

- "invisible" adulterants - undetectable by gas chromatography under usual quality control testing
  - eg rapeseed oil, mineral oil
- visible adulterants:
  - eg, benzyl alcohol, benzyl benzoate, carbitol, diacetone alcohol, dipropylene glycol, isopropyl myristate, etc.

http://www.naha.org/articles/adulteration_1.htm

Ineffective therapy due to poor product quality

- What can impact quality?
  - growing conditions
  - processing
  - packaging and handling
  - storage

The quality of essential oils can be compromised in a number of ways. For example, if plants are grown with pesticides or other chemicals, or with suboptimal soil conditions, rainfall, or altitude. Essential oils may be extracted using inappropriate processes, or with poor quality control. Diluents or excipient ingredients may be added. Chemical degradation can occur with exposure to heat, light, or oxygen. Quality may suffer when products are stored for too long, or in inappropriate conditions.

Inappropriate use

- topical use of products intended as scents only
- oral use of products intended for topical or scent use
- dosing: too little or too much
- bad massage technique
- flammable oils used near open flames
- poorly trained aromatherapists

Some oils used as scents, can cause phototoxicity if applied to the skin. For example, citrus oils on the skin followed by sun exposure can cause severe burns or skin cancer.

Many people believe that if some is good, lots is better. But for essential oils just like for anything else, too much can be harmful.

Doing massage incorrectly can damage muscle or connective tissue.

Hazardous essential oils

- There are companies in the aromatherapy business that supply hazardous essential oils without any significant warnings or with inadequate warnings
- oils that are prohibited for resale to the public: American wormseed, savin oil, croton oil
- oils which are dangerous for topical application: expressed bergamot, benzoin, cinnamon bark, expressed lime, verbena, and others (might be acceptable in candles, or in heating oil)

It seems that some traders produce price lists where the safe essential oils for use in aromatherapy are mixed in with hazardous oils intended for other uses, without appropriate warnings or cautions. This is potentially dangerous.

Risks to caregivers, other patients, visitors, children, or animals

Allergic reactions

- Strong potent allergens:
  - oakmoss
  - treemoss
  - iso eugenol
  - cinnamic aldehyde
- Less potent allergens:
  - cinnamic alcohol
  - hydroxycitronellal
  - HMPCC
- Rarely found as allergens:
  - amyl cinnamic aldehyde
  - citral
  - eugenol
  - farnesol
  - lilial
  - methyl heptine carbonate

http://www.naha.org/articles/alleged_allergens.htm

It has been charged that a piece of published research which identified these substances that are found naturally in a number of essential oils, was funded by the synthetic fragrance industry in an attempt to discredit essential oils and thereby expand the market for their own products. The research is said to be flawed; nevertheless, the article was used by European Union legislators to impose labelling requirements on all sorts of cosmetics, fragrances, creams, etc. containing essential oils, as well as the oils themselves. The result was a marked drop in demand and therefore in production, with a number of companies going out of business.

Essential oils that can irritate skin

- basil
- benzoin
- birch
- black pepper
- cassia
- clove
- cinnamon
- ginger
- lemon
- lemongrass
- lemon verbena
- oregano
- peppermint
- pimento berry
- pine
- tagetes
- red thyme
- wintergreen

Medication interactions

* Very little research
* one example: Eucalyptus oil was shown to greatly enhance the skin absorption of 5-fluorouracil (an anticancer drug)

http://takingcharge.csh.umn.edu/therapies/aromatherapy/are_essential_oils_safe