

# THE CHIROPRACTIC REPORT

Editor: David Chapman-Smith LL.B. (Hons.)

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## PROFESSIONAL NOTES

### Chiropractic Manipulation - Common Side Effects

Senstad O, Leboeuf-Yde C, et al (1997)  
*Frequency and Characteristics of Side Effects of Spinal Manipulative Therapy*, *Spine* 22(4):435-440.

This recent study in *Spine* is the first to quantify the common side effects of routine chiropractic practice. How do the results compare with your practice?

The study, from Norway and funded by the Research Council of Norway, the Norwegian Chiropractors' Association and the Swedish Chiropractors' Association, involved 1,058 patients of 102 chiropractors. Each chiropractor gave questionnaires to 12 consecutive new patients which the patients completed after each of up to 6 treatment visits.

- The goal was to make a systematic analysis of the type, frequency and characteristics of unpleasant side effects after chiropractic spinal manipulative therapy.
- Treatments given comprised chiropractic manipulation (38%), chiropractic manipulation plus soft tissue techniques (36%) and both of these plus other methods (25%).

*continued on page 6*

## THE SPINE AND THE NERVOUS SYSTEM

New Knowledge on Somatovisceral Reflexes Supports Chiropractic Theory

### A. INTRODUCTION

For teaching purposes the body's nervous system, which in reality is one single integrated system, is divided into three components:

- a) The central nervous system (CNS) - comprising the brain and spinal cord.
- b) The peripheral nervous system (PNS) - the nerves leading out from the spinal cord to the bones, joints, ligaments, muscles and skin of the soma or musculoskeletal system, and bringing back to the CNS messages of pressure, position, balance and pain. (Nerve fibers leading out are called *efferent* fibers, those returning *afferent* fibers.)
- c) The autonomic nervous system (ANS) - the nerves that regulate function of the internal or visceral organs (e.g. heart, liver, kidney, gastrointestinal system, sweat glands, etc).

2. Today no one familiar with the scientific literature has difficulty with the concept that chiropractic adjustment or manipulation is an appropriate and effective treatment for the relief of mechanical back pain.<sup>1,2,3</sup> It is widely accepted that one reason for effectiveness is reflex response to manipulation via nerve receptors in the spinal joint capsules and associated tissues.<sup>4</sup> These PNS nerve fibers communicate with the CNS (the spinal cord and brain) which sends reflex responses.

But at each vertebral level in the spine there are not only processing centres for the PNS (fed into by the spinal nerves at that level) but also processing centres for the ANS. This leads to a second and more controversial question. Can the manipulation that creates reflex effects in the PNS/CNS that relieves back pain also create reflex effects in the ANS/CNS to produce a clinically significant effect on a visceral function - such as blood pressure, or cardiac function, or respiratory function, or even improved immune function? There are three possible answers:

a) Yes. Many chiropractors and some medical doctors, fuelled by their clinical experiences and preliminary studies and case reports, have said the answer is yes. At present there is insufficient evidence to support this position - which is therefore unscientific.

b) No. The majority of medical doctors and others unfamiliar with the practice of spinal manipulation reject the idea as strange, even preposterous. They also have inadequate evidence for their position - which is equally unscientific.

c) Perhaps - anatomically it is quite possible, this is the likely explanation of some of the clinical results reported, but there needs to be much more good clinical research before any firm conclusions can be drawn. This is the correct answer.

3. In recent years there have been major advances in our understanding of how information from the soma or musculoskeletal system and its PNS (somatosensory information or input) can cause reflex responses in the ANS to alter visceral or autonomic function. This comes principally from animal experiments. Leading research centres since the 1970s have been those of Akio Sato MD PhD at the Department of the Autonomic Nervous System, Tokyo Institute of Gerontology in Japan and Ralph Schmidt MD PhD at the Institute of Physiology, Wurzburg University in Germany.

This year Sato, Schmidt et al have produced an exciting text *The Impact of Somatosensory Input on Autonomic Functions* which summarizes the new evidence and findings. In their words:

".....this is an appropriate time to review the vast amount of new literature (on the impact of somatosensory input on autonomic functions) ... and the clinical and most particularly the therapeutic consequences which these new findings imply. ....we hope that the research summarized here will have some impact on the application of somatosensory stimulation



to improve visceral functions in humans.<sup>5</sup>

In the words of Brian Budgell DC MSc, who has worked with Sato with funding from the Foundation of Chiropractic Education and Research (FCER) for the past three years:

"A close examination of basic scientific studies shows that many of the clinical observations of chiropractors are eminently sensible and deserving of further investigation. In particular it is perfectly reasonable to propose that noxious stimulation of the spine may disturb visceral function and that the relief of spinal dysfunction may have a therapeutic effect on the behaviour of internal organs.

Additionally, there is growing evidence to support the hypothesis that dysfunction at particular levels of the spine may preferentially provoke symptoms in specific organs.<sup>6</sup>

This issue of the Report reviews Sato et al's text on the basic science evidence. It also reviews the clinical evidence, tantalizing but still comparatively weak.

4. Firstly, however, to give these matters a human face and remind ourselves we are dealing with helping real people rather than debating abstract principles, consider the case of Mrs. M. Her case is chosen because it was investigated by judicial inquiry, was tested by medical cross-examination, and independent findings were made and reported.<sup>7</sup>

a) Mrs. M consulted a chiropractor for neck pain and headache after whiplash injury. A course of chiropractic manipulation was successful.

b) In giving her history Mrs. M had told her chiropractor that she had been taking daily medication for 15 years for moderate hypertension and a related water retention problem, for which she remained under regular medical care. He had suggested that in response to his treatment the hypertension and edema might improve, with less need for continuing medication. As Mrs. M said at the hearing, she was sceptical of this.

c) In fact, to the surprise of both her and her family physician, her blood pressure became normal and her anti-hypertensive medication was stopped, and her edema was greatly reduced requiring diuretic tablets once or twice a week rather than daily as previously.

d) The Commission recognized that no firm conclusions could be drawn in the circumstances. It was left with "facts and probabilities". Could chiropractic

manipulation, like the anti-hypertensive medication, affect transmission in the post-ganglionic adrenergic nerves in the ANS and produce a clinical result? The Commission concluded that "the probabilities are that the chiropractic treatment did have the effect both of relieving her hypertension and reducing her dependency on medication."

## B. BASIC SCIENCE RESEARCH

5. The autonomic nervous system (ANS) controls visceral organs in two ways:

a) **CNS Regulation.** Firstly organ control is by commands from the central nervous system (CNS), for instance as the result of emotions or simply the state of consciousness. CNS commands go to the visceral organs via the autonomic efferent nerve fibers. Results of these commands may be, for example, increases in the heart rate and blood pressure during emotional excitement; an increased skeletal muscle blood flow in preparation for exercise; and psychic sweating.

b) **ANS/PNS Regulation.** A second avenue of control of function in visceral organs comes from information picked up by peripheral nerves - both visceral and somatic. Information from these nerve receptors goes to the CNS which uses the data to emit control signals through the ANS.

i) **Visceral Sensory Receptors (ANS).** Well known examples of reflexes originating from visceral sensory receptors include the baroreceptor reflex modifying cardiovascular function and the reflex regulation of digestion.

ii) **Somatic Sensory Receptors (PNS).** There has been less information on the reflex regulation of visceral organs via somatic sensory receptors in the skin, skeletal muscle, tendons and joints. However this has been the field of investigation of Sato in Japan since the early 1960s, Schmidt in Germany since the early 1970s, and the more recently many others. Sato has been joined in the 1980s and 1990s respectively by chiropractic researchers Rand Swenson DC MD PhD and Brian Budgell DC MSc.

6. The research on PNS regulation of visceral functions via ANS reflexes has had two fundamental goals:

- Firstly clarifying the neural mechanisms of PNS-induced autonomic reflex responses (somatvisceral reflexes). If

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stimulation of a spinal nerve root causes alteration in heart rate or digestive function what are the exact spinal (i.e. not involving the brain) and supra-spinal (involving the brain) pathways.

- Secondly, discovering what segmental division or significance there might be. In other words, if there are neural pathways that link spinal stimulation and heart rate, are these arranged according to vertebral level or segmentation in the spine as chiropractors have believed?

7. Specific studies are discussed below. However, in summary, based on sophisticated animal experiments and "an entirely new interpretation and understanding" of the effects of somato-stimulation on autonomic function, Sato et al report that researchers have now:

a) Clarified and described the neural pathways whereby stimulation of somatic sensory receptors (nerve endings in the musculoskeletal system) produces visceral reflexes.

b) Determined that somatoautonomic reflex centers are located in the spinal



cord as well as the brain.

c) Determined that the centers in the spinal cord have a segmental arrangement that corresponds to specific target organs. There are larger visceral reflexes affecting a target organ if you stimulate somatic nerves "at the same or adjacent segmental levels".

d) Discovered that the contribution of supra-spinal and spinal reflexes differs from one organ system to another. For example somatically-induced cardiovascular reflex regulation is dominated by supra-spinal reflex influences. The spinal reflex component is strongly dampened by a descending inhibitory effect from the brain. In contrast somatically-induced reflex regulation of the bladder and gastric motility may be dominated by either spinal reflexes or supra-spinal reflexes depending upon the exact segmental area stimulated.

e) Spinal somatoautonomic reflex centers may show "a very strong segmental organization and ... the effects of target organs may be quite specific." This is particularly the case where spinal nerves have "the opportunity to synapse with spinal pre-ganglionic autonomic neurons."

f) Immune-related organs receive autonomic innervation, and "there is evidence that immune function is reflexly influenced by autonomic efferent nerve activity following somatic afferent stimulation" (i.e. PNS stimulation affects immune function.)

(Sato et al go into much greater detail, describing for example the four essential classes of central reflex pathways in somato-autonomic, somato-endocrine and somato-immune reflexes - the axon reflex, the spinal reflex, the medullary reflex and the supramedullary reflex.)

### Specific Studies

8. Sato et al reference several hundred studies which show that both innocuous and noxious stimulation of somatic tissues evoke reflex responses in autonomic efferent nerves and in the organs which they serve. Reflex effects have been demonstrated throughout the cardiovascular system and the digestive system, urinary system, endocrine system and immune system. General observation on the studies, which involved a number of animals but principally rats and rabbits are:

a) Most investigators have used anesthetized animals in order to eliminate the influence of emotional factors.

b) Cardiovascular responses have been measured and cited most frequently since they are relatively easy to obtain.

c) Popular experimental designs have used stimulation of limb afferents, either electrically or by mechanical means.

The principal reason for this is simply that the limbs of experimental animals are more accessible. However the research sponsored by FCER has also focused on stimulation of spinal tissues.

### 9. Cardiovascular Responses - Skin.

There have been many reports on cardiovascular responses to *noxious* mechanical stimulation of the skin in studies using anesthetized cats, rats and rabbits. Pinching of the skin has caused reflex increases or decreases in the heart rate and blood pressure. The site of the stimulus can profoundly and qualitatively effect the cardiovascular reflex response. By contrast *innocuous* mechanical stimulation of the skin, such as mere rubbing, has produced little or no response.

In a recent study using anesthetized rats Kimura et al<sup>8</sup> examined the effects on heart rate and blood pressure of pinching the skin at various segmental levels.

a) The noxious stimulation was 20 seconds of pinching at 12 different segmental areas of the body on left and right side - inputs to the brain (cheek), upper cervical (neck), lower cervical and thoracic (forepaw, medial side of arm, scapula, chest, upper back, abdomen) lumbar (rump, lateral side of thigh, hindpaw) and sacral (perineum) spinal cord.

b) To test for the comparative contribution or impact of:

i) Segmental reflex centers in the spine at the level of stimulation; and

ii) Supra-spinal reflexes (input or response mediated by the brain) some rats had their central nervous system intact (CNS-intact) while others had their spinal cords severed at the cervical level (spinalized rats).

c) Noxious mechanical stimulation of the skin produced significant responses in heart rate in both CNS-intact and spinalized rats.

d) With CNS-intact rats these responses showed a clear segmental tendency with the strongest responses coming approximately equally from stimulation of the hindpaws or forepaws.

e) In spinalized rats the segmental tendency was altered and exaggerated.

Hindpaw and forepaw stimulation still gave significant responses, but relatively weak. However stimulation in the thoracolumbar region produced much enhanced reflexes. And interestingly, stimulation on the right side gave a significantly greater response than stimulation on the left side.

### 10. Cardiovascular Responses - Knee Joint.

In anesthetized cats, Sato, Sato and Schmidt<sup>9</sup> have shown that movement of the knee joint within its normal physiological range has no effect on blood pressure or heart rate.

However, forced movement beyond the normal physiological range produces significant increases in both of these parameters. Furthermore, in the acutely inflamed joint, these responses are greatly exaggerated. In fact, in the inflamed joint, even movement within the normal range produces reflex increases in blood pressure and heart rate (Figure 2).

### 11. Cardiovascular Responses - Spinal Tissues.

Sato and Swenson,<sup>10</sup> then of the National College of Chiropractic, Chicago, investigated the effects of mechanical stimulation of the spine on blood pressure, heart rate and renal sympathetic nerve activity in anesthetized rats. Spinal segments from T-10 to T-13, or in other rats from L-2 to L-5, were isolated from surrounding muscle and forces of 0.5 to 3.0 kgs were applied to the lateral aspect of the mobile vertebrae or segments.

These forces, which were not large or reported as noxious, produced changes in all the monitored parameters, and these changes outlasted the length of stimulation. In CNS-intact rats there were large decreases in blood pressure and small decreases in heart rate. Following spinalization at the C1/C2 level the mechanical stimulation produced small increases in all parameters.

Recently Budgell, Hotta and Sato<sup>11</sup> have used noxious chemical stimulation of specific spinal structures and measured changes in sympathetic nerve activity and visceral function. Stimulation was by micro-injection of Capsaicin, a pungent component of hot peppers which selectively excites nociceptors (pain receptors) and can therefore be used as a natural form of pure pain stimulation.

Using this model, Sato's group has demonstrated spinovisceral reflex effects on cardiac function, sciatic nerve blood flow, adrenal nerve activity and

catecholamine secretion. Most interestingly, it appears that the reflex response is increased when stimulation involves afferent fibers entering the spinal cord at or close to the level of sympathetic efferent outflow to the target organ.

### Summary - Relevance to Chiropractic

12. Early less sophisticated animal experiments produced results that tended to contradict the observations of chiropractors concerning the specific effects of spinal lesions. Researchers studied limb stimulation, and this tended to produce broad and general sympathetic responses, with no significant differences between hind-limbs and fore-limbs.

More modern experiments, especially those using thoracolumbar stimulation, support chiropractic theory. They show a distinct segmental organization to somatoautonomic reflexes. According to Sato this is explained by what is now known about the precise architecture of the spinal cord (see Figure 1). He notes:

a) Information from somatic afferent fibers entering the thoracolumbar cord has the potential to produce a localized somatovisceral response. This is because the somatic afferents have the opportunity of synapsing directly with local preganglionic sympathetic neurons.

b) However there are cervical and lumbar enlargements of the spinal cord (see white areas marked C and L in Figure 1) that correspond with the limbs - these enlargements house or accommodate the somatomotor neurons serving the limbs. In these areas of the spinal cord the preganglionic sympathetic neurons are displaced. As a result afferent information from the limbs has little opportunity to synapse directly with preganglionic sympathetic neurons - information must be relayed to supra-spinal structures for an integrated reflex response.

Accordingly experimental studies involving stimulation of the limbs suggest a generalized response of the ANS. Experiments involving the thoracolumbar spine show a segmental and organ-specific response.

### C. CLINICAL SCIENCE RESEARCH

13. Well-designed randomized controlled trials have demonstrated the effectiveness of chiropractic manipulation in the treatment of musculoskeletal disorders such as low-back pain, neck pain and headache, but there is no comparable evidence to support the chiropractic management of visceral disorders.

We are at the point today where the value of chiropractic intervention in visceral cases is unproven - neither disproved nor proven. Interesting case studies abound and a large number of descriptive studies suggest that chiropractic manipulation can be quite effective. However, better controlled trials are now needed.

The chiropractic profession, quite rightly in practical terms, has devoted its resources to the category of patients most commonly seen in practice - those with musculoskeletal pain. Relatively few patients consult a chiropractor or are referred for visceral disorders. However now that there is a sound rationale for chiropractic intervention more quality research is needed.

14. Some valuable groundwork has been done and in summary:

a) *Generally.* Dhimi and DeBoer<sup>12</sup> have cited a list of organic disorders for which spinal manipulation has been reported to be effective - see Table 1.

b) *Hypertension.* Several studies prior to the mid-1980s were

reviewed by Crawford et al.<sup>13</sup> These suggested clinical benefit but were poorly controlled. Two subsequent trials, by McKnight and DeBoer<sup>14</sup> and Yates, Lamping et al,<sup>15</sup> are better designed and report benefit. However they only provide information on short-term effects and therefore have limited relevance to clinical practice.

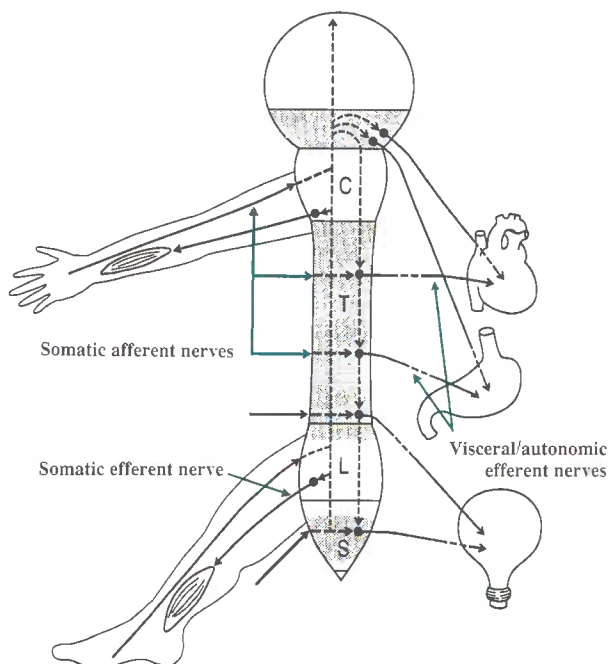
c) *Duodenal Ulcer.* A recent clinical trial by Pikalov and Vyatcheslav,<sup>16</sup> found that patients with duodenal ulcer receiving spinal manipulative therapy demonstrated significantly faster healing than a group receiving standard medical management. The number of patients (35) was rather small and there was no untreated group to control for trial effects and natural remission. However the data were quite convincing and should encourage further clinical trials.

d) *Infantile Colic.* A large well-designed study by Klougart, Nielsen and Jacobson, Denmark, provided impressive qualitative results.<sup>17</sup> 316 infants met the inclusion criteria and there was dramatic improvement in symptoms over a two week period. This study called for a full controlled clinical trial, which is now proceeding.

Figure 1

### Reflex Pathways for the Somato-somatic and Somato-autonomic Reflexes

(Adapted with permission from Sato, Sato & Schmidt (1997)<sup>5</sup>)



Somatic motor neurons innervating limbs are contained in the spinal cord at the cervical and lumbar enlargements. Limb afferents readily synapse with somatic motor efferents to elicit potent spinal reflexes. These spinal segments, however, are essentially devoid of autonomic preganglionic neurons. Thus somato-autonomic reflexes elicited by stimulation of limb afferents appear to be mediated mainly at the supra-spinal level (i.e. in the brain). On the other hand, stimulation of segmental afferents may elicit responses from both supra-spinal and spinal reflex centers. Spinally mediated somato-autonomic reflexes may show a very strong segmental organization and, under the appropriate conditions, the effects on target organs may be quite specific. Broken lines in this figure indicate synaptic pathways, not direct axonal pathways. Shadowed areas of the CNS indicate regions which contain the autonomic preganglionic neurons.



e) *Dysmenorrhoea*. A case series from Walsh et al in Australia demonstrated significant improvement of symptoms in women suffering from pre-menstrual syndrome.<sup>18</sup> This study again was intended to provide preliminary results only and test research methods for a subsequent randomized controlled trial - that trial is now proceeding.

f) *Nocturnal Enuresis*. Two prospective clinical trials have been performed but did not demonstrate results significantly better for chiropractic patients than those in the control groups.<sup>19,20</sup> Primary nocturnal enuresis is, of course, a complex problem which tends to defy analysis of the effectiveness of all isolated interventions and has a high spontaneous remission rate.

g) *Childhood and Adolescent Asthma*. The studies reported to date indicate subjective but not objective improvement.<sup>21,22</sup> However by far the best designed controlled trial in this field is now nearing completion in Canada with results to be reported this year.

h) *Human Studies - Somatoautonomic Effects*. Halfway between the animal experiments which look at specific reflex pathways, and the chiropractic research just discussed which examines effects of treatment on patients with specific conditions, lies the work of the US physiologist Irvin Korr PhD. Korr was widely published in the 1950s to 1970s with a large body of research testing the hypothesis that chronic segmental facilitation - his term for sustained impulses into the spinal cord at a specific vertebral level because of a mechanical dysfunction or subluxation - caused chronic ANS reflexes and visceral dysfunction. For example:

i) Korr found significant correlation between clinically diagnosed subluxation and hyperactivity of sweat glands, measured through electrical resistance of the skin.<sup>23</sup>

ii) Similarly he found significant correlation between subluxation and sustained spasm of skin blood vessels, reflected in lowered skin temperature readings at the level of vertebral subluxation.<sup>24,25</sup>

Somatoautonomic relations in the nervous system was the basis of his historic NINCDS Conference at Michigan State University in 1977<sup>26</sup> but sadly no one continued his work. The interesting next research question is whether subjects with chronic subluxation and autonomic reflex activity as documented by Korr, have a higher prevalence of segmentally-related visceral dysfunction. Korr followed a population and reported such a correlation, but this was never published in the peer reviewed literature.<sup>27</sup>

## D. CONCLUSION

15. The issue whether chiropractors have a role in the management of patients with visceral disorders is so sensitive politically, and open to exploitation by others saying this is evidence of unscientific practice, that some have questioned whether or not it might be better for the general advancement of the profession to jettison all claims in this area.<sup>28</sup> At one end of the spectrum some chiropractors continue to make outrageous claims, at the other end some avow that chiropractors should only treat patients for musculoskeletal pain.

Unfortunately this debate is taking place in the absence of substantial scientific evidence for or against either side and, in the rush to establish chiropractic's place among what are perceived as scientific health practices, there is a great danger of throwing out the baby with the bath water. These things can be said:

a) All claims made by the mainstream chiropractic profession

Table 1

Organic disorders reported to be related to spinal lesions or affected by chiropractic manipulation

Abdominal discomfort  
Asthma  
Barre-Lieou syndrome  
Cardiac arrhythmia  
Colic  
Constipation  
Dysmenorrhoea  
High blood pressure  
Low blood sugar and hyperinsulinism  
Migraine  
Pulmonary diseases  
Ulcers  
Vertebral autonomic dysfunction

From Dhami MSI and DeBoer KF. (1992).<sup>12</sup>

concerning the ability to influence visceral disorders and general health through correction of spinal subluxation have also been made by medical specialists familiar with manipulation.<sup>29,30</sup> They see the same unusual patients and thought-provoking results.

b) Neurological research has now established a clear anatomical basis for these claims, through somato-autonomic/somato-visceral reflexes.

c) There needs to be better controlled clinical research. In this regard there are obligations on both the chiropractic and medical professions. Cases like that of Mrs. M demand further investigation. In the words of the New Zealand Commission which heard her case and other similar ones:

"..... our view is that chiropractors are not unreasonable or unscientific in believing that their method of treatment may sometimes have a beneficial effect on a patient's visceral and/or organic disorder."

"There ought to be intensified research into why spinal manual therapy sometimes has the effect it appears to produce. It is no answer to accuse chiropractors of being 'quacks', to try to explain away their results or to try to sweep their results under the carpet on the ground that they have not been verified by scientific method."<sup>31</sup>

The Commission called for 'open-minded' medical doctors and chiropractors to work together in practice and research. That was in 1979. Now that a neurological rationale for results has been demonstrated by Sato, Schmidt and other chiropractic and medical researchers, it is time to answer the Commission's call. TCR

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### Professional Notes: continued from page 1

• There were no serious complications, and 3 of 4 (74%) side effects were gone within 24 hours. At least one unpleasant reaction was reported by 55% of patients at some time during a course of 6 treatments.

#### • Common reactions were:

- Local discomfort (53% of adverse effects).
- Headache (12%)
- Tiredness (11%)
- Radiating discomfort (10%)

#### • Uncommon Reactions.

- Dizziness (5%)
- Nausea (4%)
- Hot skin (2%)
- Other (2%)

In a commentary published with this study Scott Haldeman DC MD PhD, chiropractor and neurologist, Los Angeles, makes an interesting point of relevance to the main article in this issue of The Chiropractic Report, which is on somatovisceral reflexes and the visceral effects of chiropractic care.

Haldeman notes that it is easy to explain local or radiating discomfort after manipulation but "more difficult to explain why people would have systemic symptoms such as tiredness, nausea, hot or prickly skin .... diarrhoea, palpitation and heavy menstruation. This report raises the possibility of a visceral or systemic effect .... in response to manipulation." What chiropractors know from clinical practice is that, although it is not yet well documented, patients experience these visceral or systemic effects - both reactive and beneficial - very frequently.