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The journal of the Canadian Association of Naturopathic Doctors

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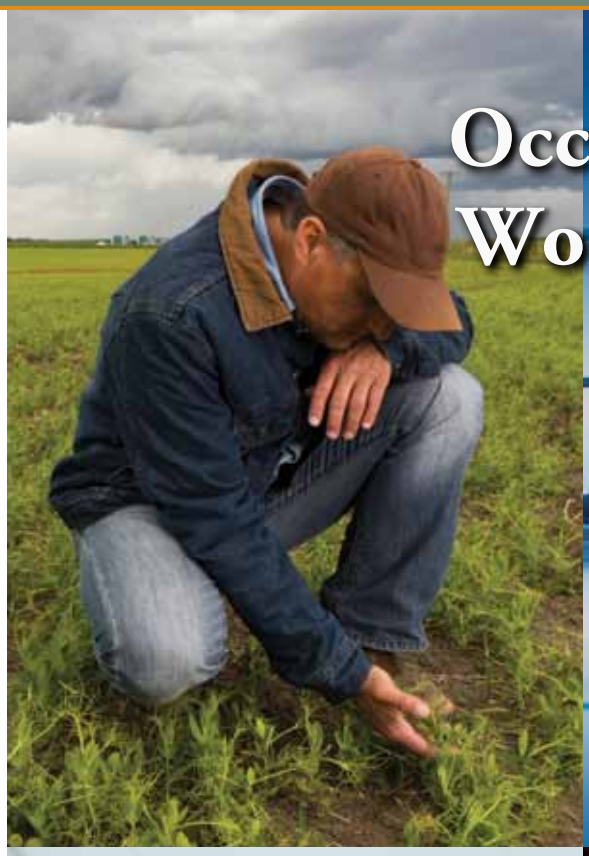

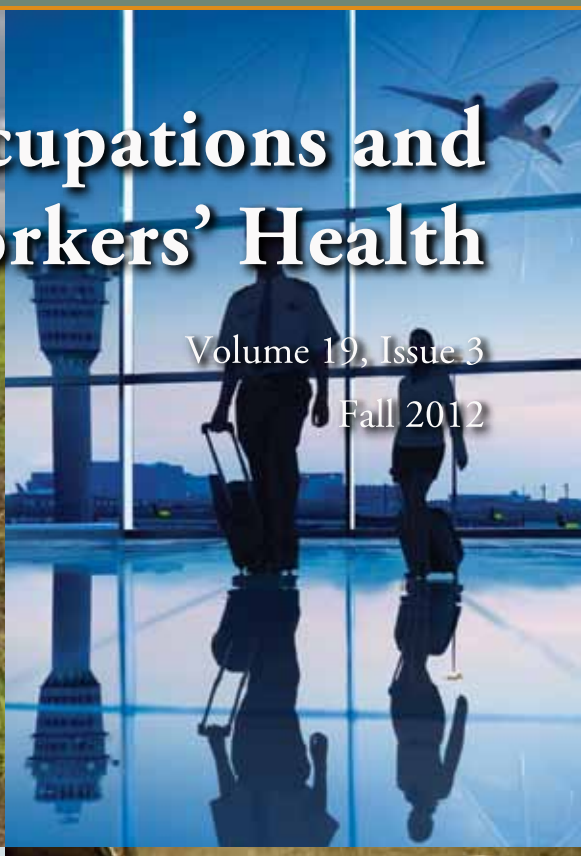

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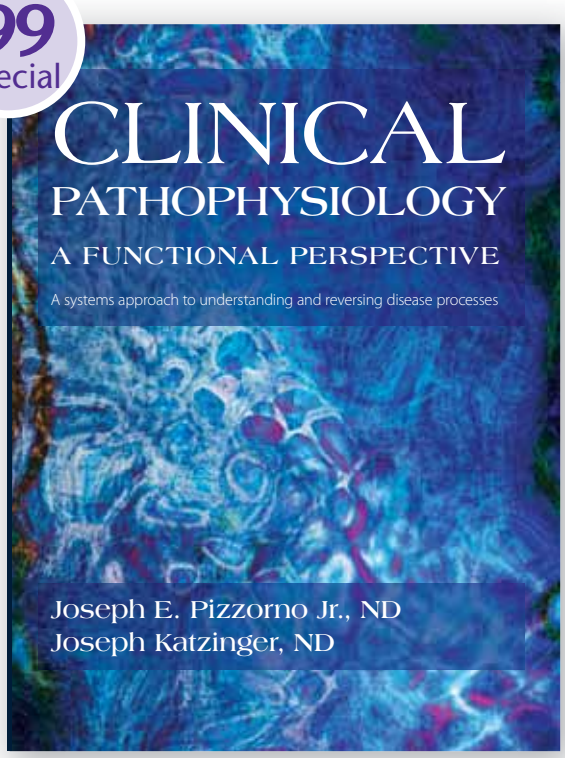

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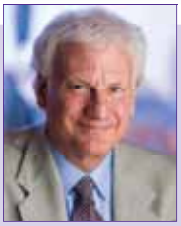

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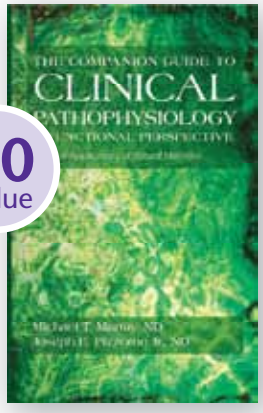

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The *Vital Link* is the professional journal of the Canadian Association of Naturopathic Doctors (CAND). It is published primarily for CAND members and features detailed reviews of specific causal factors: philosophical and research-based papers, clinical practice articles and case reviews, as well as international updates on the profession. The *Vital Link* has an outreach to other health care professions and promotes qualified naturopathic doctors to corporations, insurance companies and the Canadian government.

Forthcoming Themes

Spring 2013 Environmental Contaminants
Summer 2013 *Health Fusion Edition* – Lifestyle and Health
Fall 2013 Smoking and Health

Submissions
When writing for the *Vital Link*, keep in mind its broad readership and outreach to other professions. Your contribution to the *Vital Link* will benefit the naturopathic profession as a whole and provide you with personal professional exposure. Previously unpublished material is preferred. Please contact the managing editor for submission guidelines.

Circulation
The *Vital Link* is published three times per year and is distributed to over 2000 qualified Canadian NDs and students of CNME-accredited naturopathic programs in Canada and the U.S. The *Vital Link* is also distributed to the CAND's corporate members and in our media kit. The journal is available in print and e-formats, by paid subscription.

Advertising
Professional vendors providing NHPD/Health Canada-compliant products or other services to NDs are encouraged to advertise in the *Vital Link*. The CAND's advertising partners enjoy unequalled exposure to qualified Canadian naturopathic doctors.

Naturopathic Notes

Dr. Iva Lloyd, BScH, RPE, ND

Identifying the causes of disease often involves taking an in-depth look at the patient's occupational history, sometimes also their parents' occupations, and the resultant exposures and impact that those occupations may have had on the patient's lifestyle and their health. People spend an enormous amount of time at work, yet the correlation between occupation and symptoms or diseases is not always given the necessary attention. In this edition we examine some common occupations and their impact on health and disease.

Dr. Verna Hunt provides a review of a webinar conducted by the Canadian Women's Health Network entitled "Endocrine Disruptors in the Workplace, the case of women and automotive plastics manufacturing." This review highlights the correlation between conditions such as breast cancer and manufacturing jobs.

Dr. Patrice dePeiza provides a practical series of ergonomic tips for the home and workplace. It focuses on how workplace ergonomics can affect a person and highlights changes that can make it easier and healthier for a person to do their job.

The topic of linking shift work with the development of chronic diseases is explored by naturopathic doctors Elaine Lewis and Anthony Moscar along with naturopathic candidates Carly King and Kelly Hogan. With approximately one third of the population engaged in shift work, whether it is rotating work hours, irregular schedules and evening or night shifts, there is a tremendous need for naturopathic doctors and patients to fully appreciate the associated symptoms and conditions, including sleep dysfunction, cognitive impairment, psychological strain, poor work performance, sexual dysfunction and neurological complaints. The article also explores how shift work predisposes a person to the development of obesity, cardiovascular and gastrointestinal disease, psychological disorders and cancer.

Naturopathic students Olivia Greenspan, Jessica Sangiuliano, Shannon Sutter and Alisha Rawji provide an in-depth look at female healthcare workers and how this occupation impacts fertility. The fact that the rate of infertility has doubled during the last 10 years warrants a detailed look at some of the factors contributing to the increase. The authors provide a detailed look at the correlation between circadian rhythm disruptions, diet and lifestyle behaviours of healthcare workers and occupational exposures on fertility rates and infertility concerns.

Dr. Jonathan Tokiwa draws both from the literature and first-hand experience to explain the health risks faced by first responders.

Pilots and air crews are another category of occupations associated with unique risks. Dr. Taryn Deane explores the health risks for flight personnel and frequent fliers, as well as the role of melatonin in those who are sleep deprived (a common symptom in this population).

To round off this edition, naturopathic doctors Brian Casteels and Aisling Lanigan and naturopathic student Jessa Haldane cover the topic of chronic pesticide exposure in farmers. They explore not only the increased risk of specific diseases but some options for farmers to decrease these health risks.

The information in this issue prompts an important discussion about the vital role that naturopathic doctors have in exploring the impact that a patient's occupation has had on their health. It also provides valuable information that naturopathic doctors can share with their patients to increase their awareness and understanding of the link between lifestyle and occupational choices and current state of health. Many naturopathic doctors and naturopathic students have contributed to this edition and it is wonderful to have so many in the naturopathic community adding to the Profession's wealth of knowledge.

We welcome your comments and contributions.

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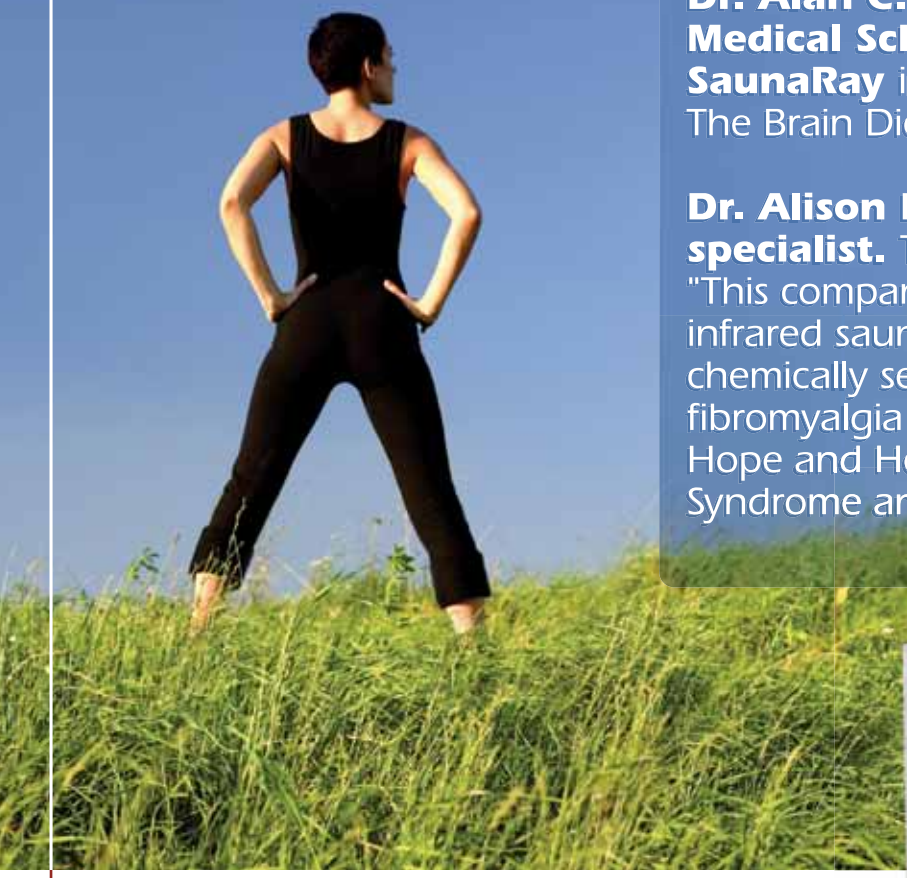

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Four Corners: Updates on the Profession

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Recently, the ND Profession reached another milestone. After years of hard work, Alberta NDs rejoiced as their regulations were finally proclaimed as of August 1, 2012. Naturopathic doctors are now regulated in five provinces and a total of six provinces have legislation (Nova Scotia's Act provides title protection but not regulation). Shortly after Alberta's announcement the CAND contacted the Department of Finance to advise them that the profession now met their criteria of full regulation in five provinces and request a review of the CAND application for GST/HST exemption for services provided by NDs. The provincial associations have submitted letters indicating their ongoing support of our application and the review is underway.

In the last issue of the *Vital Link*, we advised that the CAND had undertaken a search for an experienced government relations firm to assist us in reaching our goals with the federal government. We are pleased to report that Hill & Knowlton (H+K), one of the top ten public relations/affairs firms in Canada has been retained. Our Government Relations Committee is currently engaged with the team at H+K on a perception audit that will help to inform the development of our national PR strategy.

On September 23, 2012 the CAND held its Annual General Meeting in Halifax in conjunction with the NSAND conference. We greatly appreciate NSAND's having made time in the schedule for our AGM and we thoroughly enjoyed the time spent with our Maritime colleagues. The information presented by the CAND was enthusiastically received and we welcomed three new Directors to our Board: Dr. Mike Nowazek, ND (Alberta), Dr. Suzanne Danner, ND (Manitoba) and Dr. Alison Danby, ND (Ontario). For the first time, members from across Canada were able to attend and participate in our AGM via webcast. Feedback about the webcast has been positive and we intend to continue the practice for future meetings.

The fall season has been busy with new graduates having received their NPLEX results and become professional members. The CAND's professional membership is now over 1,500 and growing! The office is engaged with planning Health Fusion 2013 in Ottawa, making revisions to the Association's By-Laws (as required under the new Canada Not for Profit Act) and rolling out membership renewal.

Council on Naturopathic Medical Education (CNME) *www.cnme.org*

The Council on Naturopathic Medical Education (CNME) accredits naturopathic doctoral (ND) programs in Canada and the U.S., and graduation from a CNME-accredited or pre-accredited ND program is a requirement for taking the NPLEX exam and becoming licensed or regulated as a practitioner. Currently, the CNME accredits two ND programs in Canada and five in the U.S.

At its meeting in October 2012, the Council granted initial accreditation for a period of four years to the ND program offered by National University of Health Sciences, a multipurpose institution located in Lombard, Illinois, that was originally founded as a chiropractic college. In 2013, the Council will be conducting onsite visits for reaccreditation to four ND programs, including the ND programs offered by Boucher Institute of Naturopathic Medicine and Canadian College of Naturopathic Medicine.

The Council has begun exploring the issue of whether to allow naturopathic medical programs to utilize distance/online education to deliver a portion of the ND training. These delivery approaches would be limited to didactic courses and didactic course material, since clinical training and labs generally require in-person instruction. The Council has not yet made any decisions on this important issue, and will carefully consider all options with the goal of enhancing the quality of naturopathic education and making it more accessible.

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Webinar Review

Endocrine Disruptors in the Workplace: The Case of Women and Automotive Plastics Manufacturing

Dr. Verna Hunt, BSc, DC, ND

Speakers:

- Sari Sairanen, Canadian Auto Workers (CAW)
- James Brophy and Margaret Keith - chief researchers, "Women, Plastics and Breast Cancer Project"
- Gina Desantis - auto worker, Windsor ON

Moderator:
Anne Rochon Ford, Executive Director, CWHN

Canada has among the highest rates of breast cancer in the world. The breast cancer risk to women workers, especially those in blue collar jobs, has been largely overlooked by scientists. In addition, workers and their organizations have not received much support in understanding the risks associated with working with chemicals and in taking steps to prevent harm.

Addressing this gap, a team of researchers has been examining the occupational breast cancer risk for women working in the automotive sector in the Windsor area, a highly industrial region of Southwestern Ontario. Animal studies have demonstrated that rates of breast cancer are higher in those exposed to certain chemicals, particularly those that can disrupt the endocrine system. There is a growing body of epidemiological evidence showing that humans are likewise affected.

Endocrine disruptors thought to play a role in breast cancer and carcinogens are present in many occupational environments. Exposure to hormone disrupting chemicals can be particularly significant for women during certain key windows of vulnerability. Such chemicals can be released during various plastics processing procedures, such as heating, pouring, grinding, assembly and decorating.

In this webinar the invited researchers, working with colleagues at the National Network on Environments and Women's Health, spoke about their research, and for the critical need for more attention to this area of study.

Sari Sairanen of the CAW, represents over 200,000 union workers of which 33% are female. Sari said that most of the problems of plastics manufacturing impacting on breast health is in the automotive plants where a large number of women work, but that it is difficult to identify what specific chemicals are dangerous.

Drs. Brophy and Keith have done extensive research of how plastics injection molding production causes breast cancer due to the high exposure to plastic dust and vapors during manufacturing. The yearly world production of plastics is 125 million tons. Every car made is 10% plastics by weight (search for report 'Toxic at any Speed').

Often it is difficult to accurately test the exposure workers experience and while under the constant threat of job loss due to plant closure in the current economic climate. The chemicals contained in plastics act as endocrine disruptors which send negative signals interfering with normal functioning within many systems: nervous, immune, reproductive, even at very low levels. For example, it has been known since 1936 that bisphenol-A is an endocrine disruptor even at low exposure affecting the person and their offspring. Common symptoms of plastics manufacturing workers include: headaches, nausea, lung problems, numbness, nose bleeds, skin and hair problems, dizziness, tiredness, fertility issues and cancer.

Gina Desantis, an auto worker herself, explained how the high heat of the injection machines coupled with the poor ventilation makes the hazard much worse.

The webinar is well-worth viewing. A recording of the webinar is available at www.cwhn.ca.

I recommend that all naturopathic doctors join the CWHN and link the www.cwhn.ca site to their own website/e-news to keep your patients informed.

About the Author

Dr. Verna Hunt, BSc, DC, ND has been practicing as a Chiropractic and Naturopathic Doctor, for over 30 years. She owns and operates The Centre for Health and Well Being in Toronto established in 2005. She acts as a medical advisor to colleagues and companies, which service holistic health care. She has served on the CAND and OAND boards and received awards from both organizations. Dr. Hunt writes, speaks and teaches presenting through her organization Being Well Communications. Contact her through verna@healthandwellbeing.info or www.healthandwellbeing.info.

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Lightening the Load: Minimizing Risk of Back Injury in Healthcare Workers

Dr. Patrice de Peiza, BSc, OT Reg.(Ont.), ND

Definitions

Ergonomics is defined as the science of matching the job to the worker or product to the user.[1] It focuses on how the work affects the worker and often involves adapting the environment to make it easier for the person to do their job.

Body Mechanics refers to the use of proper movement and positioning in daily activities, to prevent and correct problems associated with poor posture.[2] Good body mechanics are essential during functional activities to enhance coordination, increase endurance and optimize work performance. Ergonomics focuses on the environment, whereas body mechanics focuses on the person.

Manual Material Handling (MMH) involves using the human body to lift, lower, push, pull, fill, empty, hold or carry loads or objects.[3] Incorporating ergonomics and good body mechanics into MMH tasks, decreases risk of injury and increases productivity in the workplace.

Why should naturopathic doctors be concerned about physical injuries in healthcare workers?

Healthcare workers are at risk of developing musculoskeletal disorders (MSDs) due to the ergonomic hazards of their occupations. MSDs are caused by repetitive wear and tear on tendons, muscles, nerves and bones.[4] The nature of the work in healthcare fields may include frequent bending, twisting, lifting, pushing, pulling or other repetitive movements. However, the main ergonomic risks to healthcare workers are related to lifting and transferring patients.[5]

Workplace injury statistics for Ontario

In Ontario, the Workplace Safety and Insurance Board (WSIB) produces a statistical supplement summarizing work-related injuries in various industries. Upon analysis of their most recent published findings (2010), 13.3% of all WSIB lost time claims were in the healthcare sector.[6] In fact, there were more injuries resulting in lost time from work in healthcare than in the construction and manufacturing sectors, which totaled 7.0% and 11.3%, respectively. When categorized by the nature of injury/disease, the vast majority (48.5%) of WSIB injuries reported in 2010 were due to MSDs, such as sprains and strains.

A review of the trends from 2001 to 2010 shows that sprains and strains were the primary cause of injuries reported to WSIB in this period. Percentages range from a low of 39.1% in 2003 to a high of 50.5% in 2008. The back was the most common body part affected that required time off of work. Out of the 26.8% lost time claims associated with the back, 20.1% were low back injuries (to the lumbar, sacral, or coccygeal areas). Overexertion was the number one cause of lost time claims (at 21.8%) when the data was analyzed by event.

Is there a link between MMH and back pain in Canadian workers?

According to the Canadian Centre for Occupational Health and Safety, MMH is the most common cause of low back pain and work-related fatigue.[7] Approximately three quarters of workers whose jobs involve lifting, carrying and handling loads experience back pain at some point in their career. These back injuries account for one third of total lost work hours and related compensation costs. If MMH is repeatedly performed incorrectly, it can lead to chronic back pain (lasting greater than three months).

Back pain is most commonly caused by strains or spasms in the back muscles and does not usually arise from direct damage to the discs or vertebrae when associated with lifting or carrying tasks. A single event, such as lifting too heavy a load, slipping/falling or receiving a blow to the back may result in a back injury to the worker. However, in most cases, it is the repetition of lifting and carrying tasks that essentially leads to back injuries. Performing MMH tasks continually, even at a moderate intensity, causes mechanical stress to the back to accumulate, and increases the likelihood of injury. Eventually, even mild exertion can result in disabling back pain. Recovery from back injuries may take a long time and cumulative microtrauma to the area may make the problem worse.

Participating in MMH tasks can be strenuous on the body and often results in fatigue. Therefore, it is important for workers to pace themselves and to ensure that they have enough time between repetitions of a task to recover their energy. Fatigue tends to be cumulative and can result in poor posture, decreased alertness, and inattention to safety issues. Constant lifting without a break, even at a moderate pace below the maximum recommended weight, rapidly increases fatigue levels and contributes to back injury.[7]

Although strength decreases with age, statistics show that back injuries among workers over 45 years of age are less frequent than among 20-45 year olds.[7] Work experience seems to counterbalance decreasing physical capacity. As workers age, they typically demonstrate improved skills and safety awareness. However, older workers are at greater risk of injury when performing tasks that require sheer physical strength.

Many employees with low back pain or injury end up with permanent disabilities that prevent them from ever returning to work. Chronic back pain places a financial burden on the healthcare system and affects the person's ability to engage in meaningful, productive activities.

Back Belts

Back belts and other lightweight supports have become increasingly popular. These elastic belts are typically worn around the low back when performing work tasks. In theory, these supports help to minimize risk of injury by reducing the forces on the spine, improving the management of the load when lifting and providing a reminder to the worker to avoid awkward postures and heavy loads.

Despite widespread use of back belts in industry, there is a lack of evidence to support the claim that wearing them improves back safety.[8] In 1992, the National Institute for Occupational Safety and Health (NIOSH) in the United States formed a Back Belt Working Group to review and evaluate the existing data. They concluded that back belts should not be considered as personal protective equipment nor should they be recommended for use in occupational situations.

These statements were generated out of concern that use of back belts may:

- Increase the strain on the cardiovascular system
- Limit mobility and reduce the suppleness and elasticity of muscles and tendons, potentially contributing to back injury
- Create a false sense of security, increasing the risk of lifting excessive loads

Although back belts may be useful in providing support after acute injury, they should be worn in moderation and used in conjunction with an appropriate core and back strengthening program.

Prevention

IMPLEMENT THE FOLLOWING RECOMMENDATIONS TO MINIMIZE RISK OF BACK INJURY DURING FUNCTIONAL ACTIVITIES AND MMH TASKS:

- Maintain neutral postural alignment (i.e., the natural curves of the spine)
- Keep physically fit. Include cardiovascular activity, strengthening and flexibility exercises in your fitness program
- Stretch throughout the work shift. Take short but frequent rest breaks (at least 5 minutes per hour) and change positions at least once every 45 to 60 minutes
- Wear comfortable shoes or stand on a cushioned, anti-fatigue mat to enhance shock absorption and comfort with prolonged standing
- Use high-low treatment tables and other height adjustable equipment to optimize good body mechanics
- When lifting, stand close to the load and avoid twisting the spine
- Keep feet flat, knees bent and use feet and legs to turn
- Avoid lifting objects above shoulder level or below waist height
- Use lifting devices such as carts or dollies to decrease the load
- Tighten core muscles and use both arms to lift, carry, push or pull objects

Training is an important component of back injury prevention. Clinical staff and patients should be educated about correct lifting techniques (specific to their job demands), and the dangers associated with suboptimal positioning. By teaching individuals about proper body mechanics and strategies to enhance their workstation ergonomics, naturopathic doctors can assist people in minimizing their risk of injury when performing MMH at work or in their personal lives.

About the Author

Patrice de Peiza BSc, OT Reg.(Ont.), ND is an Occupational Therapist (OT) and Naturopathic Doctor (ND). Dr. de Peiza has over 13 years of clinical healthcare experience and has worked in Canada and the USA. She holds degrees from McGill University, University of Toronto and graduated as the 2007 class valedictorian from the Canadian College of Naturopathic Medicine.

Dr. de Peiza is currently practicing as an OT and an ND in the Toronto area. Her naturopathic special interests lie in occupational health, environmental medicine, women's health, physical medicine and the treatment of autoimmune diseases. She is a member of several professional organizations, such as the Ontario Association of Naturopathic Doctors and Canadian Association of Naturopathic Doctors.

In her career as an Occupational Therapist, Dr. de Peiza has had extensive experience in addressing ergonomic and return to work issues. She has helped patients who sustained traumatic brain injuries, burns, amputations or complex musculoskeletal injuries in the workplace to overcome barriers to returning to work. Dr. de Peiza is skilled at completing functional capacity evaluations, job site analyses and physical demands analyses of numerous occupations in the healthcare, construction and industrial sectors. She completed the Roy Matheson Functional Capacity Evaluation certification in addition to their WorkSafe Ergonomic Solutions training. Periodically, she is a guest lecturer and lab facilitator on the topic of ergonomics at the University of Toronto. Dr. de Peiza can be reached via email at pdepeizaND@gmail.com

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Shift Work and Development of Chronic Disease

Dr. Elaine Lewis, ND, **Dr. Anthony Moscar,** ND, **Carly King,** ND (cand.), & **Kelly Hogan,** ND (cand.)

Shift work is a widespread means of employment in modern society as the effort to provide round-the-clock service continues to be valued. This practice may include rotating work hours, irregular schedules and evening and night shifts, all of which have long been implicated in a host of health concerns.

In 2005, 28% of Canadian employees (4.1 million people) reported being shift workers, the majority of which were men (57%).[1] Approximately 15-20% of total workers worldwide (more than 2.5 billion people) are shift workers, two-thirds from the Asian continent (IARC).[2] This article focuses on highlighting select chronic diseases that have been linked to shift workers by reviewing relevant evidence in this population.

The various health conditions that have been associated with shift workers include sleep dysfunction, cognitive impairment, psychosocial strain, poor work performance, sexual dysfunction, and neurological complaints.[3,4] In addition to these, shift work may predispose to the development of obesity, cardiovascular and gastrointestinal disease, psychological disorders, and cancer, all of which will be further investigated in this paper.[5,6]

A likely mechanism contributing to the development of chronic disease in the shift worker population involves circadian system disruption. Circadian rhythm is modulated by the suprachiasmatic nucleus (SCN) of the hypothalamus, located superior to the optic chiasm. This collection of neurons is sensitive to environmental signals, predominantly light changes, but also impacted by exercise, food availability, temperature and social demands. SCN neuronal firing is also chemically influenced by melatonin secretion from the pineal gland and from serotoninergic (5-HT) pathways ascending from the raphe nucleus.[7] These neurotransmitter and hormonal interactions are likely factors in the pathophysiology of chronic disease in shift workers.

In addition to circadian disruption, shift workers appear to suffer greater oxidative stress both in the short and long term.[8] This may be due to impaired melatonin secretion, resulting in decreased antioxidant function systemically, or from frank increases in physical and psychological stress leading to elevation in oxidative stress markers.[9] This burden is likely implicated in their development of chronic disease, although evidence to directly match oxidative stress to particular health conditions in this population has not been conducted.[10]

Sleep Disorders

Shift workers commonly suffer from a range of sleep dysfunctions including disturbed sleep, fatigue on waking and insomnia.[11] Cortisol secretion is impaired in shift workers, likely due to irregular sleep patterns. Whereas in normal individuals, cortisol levels are high in the daytime and low at night, this pattern is generally reversed in shift workers.[12] Cortisol levels are also generally elevated in shift workers, mimicking a chronic stress state.[11] This disturbance further exacerbates sleep dysfunction and fatigue, and is likely involved in the manifestation of various other health conditions, given the multitude of roles played by cortisol in the body.

In addition to common symptoms of sleep dysfunction, many shift workers suffer from Shift Work Sleep Disorder (SWSD), which involves significantly greater sleep disruption.[13] SWSD is typically implicated in individuals who work rotating and night shifts, with prevalence up to 32% in shift workers.[14] The two main symptoms associated with this condition are excessive sleepiness at night (the wake period) and insomnia during the day (the sleep period).[15] Some relief of symptoms is achieved in individuals who are able to maintain normal sleep/wake function on non-work days.[13]

Shift Work Sleep Disorder is associated with a host of other conditions, including fatigue, irritability, decreased attention, impaired productivity, neurological concerns, peptic ulcer disease, cardiovascular disease, and mood disorders. SWSD sufferers often experience impairment to their activities of daily living, including a propensity to avoid participation in social events and to miss work.[14] Many of the negative effects experienced in this group are thought to be associated with their chronic fatigue.[13] The poor recognition and treatment of this condition may lead to significant deterioration in physical, emotional and psychosocial factors in an already predisposed population of shift workers.

Obesity

Numerous studies have shown that obesity levels are significantly higher in shift workers than in regular day workers.[16] There is a direct dose-response relationship between short sleep duration

and body mass index (BMI), with obese individuals working significantly longer hours and sleeping fewer hours each day.[16,17] The disruption of normal sleeping, eating and exercise patterns seen in shift work interferes with a range of physical, social and metabolic processes, which may collaboratively lead to increased obesity rates in this population.

Eating behavior appears to be altered by working shifts, especially when night work is involved, due to a number of concomitant factors. It has been suggested that night work causes a disruption between socially determined meal schedules and the biological circadian rhythms of hunger, satiety and metabolism.[18] Several studies report a greater tendency to eat small amounts more frequently during night shifts.[18] Eating schedules also tend to be more irregular during the night shift period, with a tendency for more calorie-dense, carbohydrate-rich foods. [18] It is noted that food selection may also be influenced by limited availability during night shifts.[18]

Additionally, short sleep duration has been associated with several metabolic changes, which are linked to the increased risk of obesity. Insufficient sleep is correlated with both decreased leptin and increased ghrelin, hormone changes that are associated with increased hunger and appetite, which may lead to overeating and subsequent weight gain.[17] Reduced leptin levels have also been linked to the interruption of endogenous circadian rhythms and behavioural patterns, independent of the effect of deficient sleep.[18] Night workers also demonstrate impaired glucose tolerance and increased insulin secretion following nighttime meals, which disrupts glucose and fat metabolism, further contributing to obesity risk.[19]

An additional consideration is that the long work hours employed by shift workers may directly reduce time available for physical activity or may interfere indirectly via fatigue, making exercise less appealing.[16] It has also been shown however, that short sleep duration is directly linked with obesity, independent of physical activity level.[20] Furthermore, it does not appear that the physical demands of shift work have a significant impact on BMI overall.[16] It is apparent that shift workers have a number of occupational elements that interfere with the body's ability to maintain a BMI within the normal range; long hours, lack of sleep and altered schedules are associated with a disruption in the body's normal metabolic functioning and an increased risk of obesity.

Cardiovascular Disease

Shift work has been associated with an increased risk of cardiovascular disease with chronic circadian misalignment proposed to cause adverse metabolic and cardiovascular effects.[21] Specific morbidities implicated include an increased risk of myocardial infarction, stroke and coronary events; however no increased risk of mortality from these events has been confirmed.[22] A review of 17 related studies noted a 40% increased risk of cardiovascular diseases in shift workers.[23] Another review found that shift workers had a relative risk of ischemic heart disease 25-35% higher than matched controls.[24]

Studies investigating contributing factors to cardiovascular disease found some differences in shift workers that may explain their elevated cardiac risk. Although there is inconclusive evidence to determine an increased blood pressure in this group, both cholesterol and triglyceride levels were found to be significantly raised in shift workers.[23] In addition, despite similar nutrient and caloric intake between day and night workers, postprandial glucose response is exaggerated in night workers.[21,25] There is also a decrease in leptin, increase in glucose and insulin, increase in mean arterial blood pressure and reduced sleep efficiency in shift workers.[21] A pilot study comparing daytime and rotating shift workers found rotating shift workers have higher daily elevated cortisol production with flatter diurnal cortisol slopes and decreased heart rate variability, suggesting neuroendocrine dysregulation due to work stressors may contribute to early signs of heart disease such as reduced endothelial functioning.[26]

Metabolic syndrome risk is also elevated in this population, with the presence of three or more risk factors significantly more common.[27] In addition, rotating shift work is associated with a modestly increased risk for type II diabetes mellitus.[28] A prospective cohort study found a history of rotating night shift work >10 years to be associated with a 64% increased risk of type II diabetes.[28] Once analysis was adjusted for BMI this association disappeared, however women with >20 years of shift work still had a 44% increased risk of developing type II diabetes.[24]

Most studies were limited in definition of shift work and classification of cardiovascular diseases. As well, there are numerous risk factors for cardiovascular disease and so far the literature has not encompassed all of them when assessing shift work. Mismatches between circadian rhythm and sleep, disturbed social support, stress and behavioural changes are all likely to affect metabolic and cardiovascular biomarkers, leading to adverse effects on cardiovascular risk factors.[23]

Gastrointestinal Disease

Various gastrointestinal disturbances have been implicated in shift workers. A recent systematic review investigated the impact to gastrointestinal disease development and found a robust relationship where shift workers suffered increased incidence of peptic ulcer disease and functional GI disease. Other gastrointestinal disorders that were associated to shift work included chronic inflammatory bowel disease, gastrointestinal cancers, and gastroesophageal reflux disease.[3] Vague symptoms such as nausea, constipation, appetite changes, bloating, indigestion and abdominal pain may also be linked in this population.[29,30]

It is possible that the mechanism leading to gastrointestinal symptomology involves impaired eating patterns in shift workers.

These variations are likely not due to increased overall caloric intake, but rather the irregular distribution of food intake through the 24-hour day. In addition to shift workers consuming minimal food during their workday, they typically consume greater quantities of alcohol.[31] Shift workers also report higher use of tobacco and caffeine in order to facilitate wakefulness during their shift, both of which contribute to various gastrointestinal diseases.[32–34] The link between shift work and GI complaints has been well studied and is considered a strong association, despite inadequate evidence to confirm pathogenesis.

Mental Health

Shift workers are typically at increased risk for a variety of mental health conditions, however, evidence is generally focused on the development of depression in this population. Circadian disruption due to shift working is largely thought to be implicated in the pathogenesis of affective disorders, especially in unipolar and bipolar depression. This theory suggests that the sleep pattern disruption elicited by shift work causes neurobiological changes, likely from serotonin and melatonin dysfunction at the hypothalamus, leading to a propensity for development of affective change.[7] Another possible mechanism may be a non-biological but rather social pathway, whereby shift work influences social dynamics that subsequently lead to mood dysfunction.[35] A third theory proposes that the insomnia, which often results from sleep cycle disruption, causes an exacerbation of underlying depressive tendencies.[7]

Short-term impact to psychological state after shift work seems to be a robust relationship, with measures of depression, anxiety, anger and confusion all significantly impacted. This trend is seen after both day and night shifts, with night shift workers suffering greater.[36] On the other hand, evidence regarding the relationship between shift work and development of depression long-term is inconclusive. In a study of 60 male paramedics, mild and moderate depression was implicated in 37% of responders based on the Beck Depression Inventory;[37] however, a prospective cohort study found minimal impact of shift work to development of depression over a 10-year period.[38] A large survey of 704 general practitioners found that the number and frequency of on-call duties undertaken by this group of physicians predicted higher scores of both anxiety and depression.[39]

Higher levels of stress have also been reported in shift workers and their families, according to a survey of 1817 general practitioners.[40] This relationship is typically exacerbated in those working late afternoon, evening and night shifts.[41] While it is reasonable to expect stress levels to be elevated in this population, evidence to confirm the association is notably sparse.

Although a conclusive review of evidence implicating mental health does not yet exist, a trend toward depressive, anxiety and stress symptoms does seem to appear in shift workers, particularly in those that work night rather than day shifts. Whether this tendency is due to neurobiological effects from melatonin and serotonin dysfunction, social impact or frank insomnia may require further investigation.

Cancer

The link between cancer development and shift work is an advancing area of research. In 2007, an International Agency for Research on Cancer (IARC) concluded that circadian disruption from shift work is probably carcinogenic in humans.[42] The Ontario Cancer Research Centre considered shiftwork a specific exposure risk and calculated that Ontario shiftworkers comprise 745,000 to 1,051,000 of the affected population.[43] In order to understand this relationship in greater detail, analysing risk associated with specific neoplasm development can be useful.

An industry based retrospective cohort study found an increase in risk of prostate cancer in shift workers, though these results were below statistical significance.[44] A case-controlled study using a Danish nurse population found that nurses who worked rotating shifts had significantly increased odds rations for breast cancer.[45] In a large prospective study, no association between duration of rotating night shift-work and ovarian cancer was exhibited.[46] Given that much related evidence is epidemiological in nature, significant flaws exist. According to the IARC, these include a typical focus on single professions, limited ability for adjusting for confounders, minimal ability to adjust for detection bias, and inconsistent and broad definitions of shiftwork.[42]

There are many hypothesised mechanisms of action explaining shiftwork and cancer development. One key proposal involves increased light at night and reduced melatonin production.[47,48] Melatonin has an anti-metastatic effect because it is likely able to enhance cell surface adhesion molecule expression, and other epigenetic effects that are protective against breast cancer.[49] Fritschi et al. hypothesised other mechanisms of action to explain the connection between shiftwork and cancer. These include sleep disruption and the resulting immune suppression, phase shift (the change in organ and cellular rhythmic processes) resulting in intra-cellular disruption, lifestyle disturbances which cause metabolic changes, and a decrease in sun exposure leading to decreased vitamin D status.[50] The link between cancer and shiftwork is not completely understood, but current evidence suggests that shiftwork could have an effect on cancer risk. The completed studies are a starting point for future work allowing for greater insight into the shift-work and cancer connection.

Conclusion

Beyond the development of sleep disorders, obesity, cardiovascular and gastrointestinal disease, psychological conditions, and cancer, shift work has been linked to a multitude of other health concerns. These include, but are not limited to, fatigue, headaches, menstrual

irregularities, inattention, cognitive impairment, poor productivity and impaired sexual performance. Naturopathic principles and interventions can be enormously valuable in the management of the many health consequences of shift work, several of which have been supported by evidence.

Interventions are typically targeted towards the management of sleep and circadian rhythm dysfunction, given that many health manifestations are thought to stem from these disorders. Circadian rhythm disruption can be addressed by behavioural modification such as planned napping, both before night shift work and during the shift to increase wakefulness. Given that light stimulus is the most potent inducer of melatonin secretion and circadian rhythm, bright light exposure during shift work can also be utilized to promote circadian regulation. This is coupled with morning light avoidance in night shift workers to facilitate circadian shifting.[51] Shift workers must also be educated in sleep hygiene techniques in order to maximize their ability to attain restful sleep.

Melatonin supplementation prior to sleep can be recommended, although the ability of supplementation to influence endogenous production of the hormone is uncertain.[52] In addition to melatonin's role in circadian rhythm regulation, it also provides an oncostatic benefit, which is relevant given this population's increased cancer risk. Other natural sleep aids may be used, namely magnesium, 5-HTP, GABA, L-theanine, and herbal hypnotics and sedatives such as *Matricaria recutita*, *Valerian officinalis*, *Passiflora incarnata*, *Melissa officinalis*, and *Humulus opulus*. Daily exercise may also be important in promoting circadian adaptation in this population.[53]

Pharmacological melatonin receptor agonists are being considered as emerging conventional treatment for insomnia in this population.[51] Current conventional therapies include the pharmacological prescription of hypnotics such as benzodiazepines and benzodiazepine receptor agonists. Stimulant drugs such as modafinil, typically used to treat narcolepsy, may also be used to promote wakefulness during shift work.[51]

Beyond the management of sleep and circadian dysfunction, naturopathic medicine can intervene in reducing the risk of chronic disease development. Dietary and lifestyle counselling should be highlighted to address the elevated risk of cardiovascular and gastrointestinal disease, obesity, mental health conditions and cancer. While evidence that addresses specific dietary guidelines in shift workers is sparse, it can be expected that known interventions for managing disease risk would apply in this population. There are well-established nutritional protocols for managing cholesterol, triglycerides and glucose levels. In addition, supporting the neuroendocrine system to correct variations in cortisol and stabilize insulin responses is important to reduce biochemical changes leading to early signs of heart disease, as well as supporting the individual from a psychosocial perspective. In addition to whole foods consumption, probiotic supplementation may be important for gut health, but also in the prevention of respiratory and gastrointestinal infections in shift workers.[54]

As is typical in naturopathic care, an individualized approach is valuable in treating shift workers. Given that an array of shift types are possible, it can be expected that the level of circadian disruption and chronic disease risk also varies. What is certain is that this population is at risk of developing a host of health conditions based on their impaired circadian function, which naturopathic medicine is well equipped to manage effectively.

KEY FACTS

- 28% of Canadian workers perform shift work
- Cortisol levels are higher in shift workers, mimicking a chronic stress state
- Up to 32% of shift workers suffer from Shift Work Sleep Disorder (SWSD)
- There is a direct dose-response relationship between short sleep duration and body mass index
- Studies show a 40% increased risk of cardiovascular disease in shift workers
- There is an increased incidence of peptic ulcer disease and functional GI disease amongst shift workers
- Shift workers are the most prevalent occupational risk group in Ontario for cancer development

About the Authors

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Elaine Lewis graduated from the Canadian College of Naturopathic Medicine in 2012. She is currently a full-time Research Resident at CCNM, dividing her time between mentorship opportunities and evidence-based medical research. Her clinical interests lie in the management of chronic diseases in the adult population. She is currently involved with research in cardiovascular and metabolic diseases. Elaine maintains a private practice at Back to Play Chiropractic and Sports Injuries in Mississauga Ontario, and at the Integrated Healthcare Centre (IHC) in North York Ontario.

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Female Healthcare Workers and Fertility: Risks and Mitigating Factors

Olivia Greenspan, ND (Cand.), **Alisha Rawji,** ND (Cand.), **Jessica Sangiuliano,** ND (Cand.), **& Shannon Sutter,** ND (Cand.)

In the last ten years, the rates of infertility among couples in Canada have doubled to a rate of 16%.[1] The associated conditions are numerous and include ovulatory disorders, hormonal causes (anovulation, hypothalamic amenorrhea, luteal phase defects, etc.), tubal disease, endometriosis, chromosomal abnormalities, cervical factors, sperm factors (such as sperm count, motility, morphology) and unexplained infertility.

Increased attention should be paid to health care workers and fertility issues considering the variety of factors that may contribute to impaired reproductive health in this population. These factors include shift work and long hours, psychological stress, diet, exercise, radiation, chemical exposure, the use of stimulants, and smoking. Considering the variety of factors that may contribute to impaired reproductive health in this population, awareness of the potential risks may help to motivate female healthcare workers, along with their workplace, in adopting corrective behaviors and practices to minimize risk and maintain optimal reproductive health.

Shiftwork and Circadian Rhythm Disruption

The movement towards a round-the-clock society makes shift work more of a reality for many people, especially for those who work in healthcare. In 2005, about 45% of healthcare workers were shift workers and 37% of women in the workforce worked shift work.[2] The healthcare and social assistance sectors have the largest number of women (n=334,000) working shift work, which includes regular night and evening work, rotating and split shifts, and casual or on-call jobs. So, for many women working in healthcare—doctors, nurses, paramedics, and midwives—this is the reality of their chosen profession and this type of work schedule poses many health risks, including impaired reproduction.[4] Limited research has been done on the reproductive risks associated with shift work, and the results are conflicting. The studies that have compared those working regular night work and rotating night/day shifts with individuals working straight days found a correlation between shift work and spontaneous abortion.[5,6] In a large cohort of nurses, those working a steady night schedule (with most work hours between the hours of 12 am and 8am), were at a 60% increased risk of spontaneous abortion;[6] however, in another study using a large cohort of midwives, risk for spontaneous abortion was found to be increased but not significant.[5] Increased time to pregnancy, defined by the number of menstrual cycles[8] or the number of months[7] of unprotected intercourse before conception, was also found for women working rotating and fixed night schedules compared to those working daytime hours, even after corrected for confounding variables: age, gravity, oral contraceptive use, frequency of intercourse, previous fertility problems, smoking, alcohol, coffee, tea, and work hours.[7,8]

The mechanisms for these reproductive challenges are unclear but postulated mechanisms may include disruptions in circadian rhythms or psycho-social stress and sleep deprivation.[9] The circadian clock in the suprachiasmatic nucleus (SCN) of the hypothalamus plays an important role in orchestrating the neuroendocrine secretion of hormones and influencing hypothalamo-pituitary-gonadal (HPG) axis functioning.[10] Human studies looking at the effects of shift work on reproductive hormones are lacking, but some research suggests an important link between the SCN on ovulation and maintenance of pregnancy.[10] Some data also suggests a correlation between shift work, melatonin secretion and an alteration in reproductive hormones such as estradiol and progesterone.[11]

Diet and Lifestyle

Healthcare workers, who are subjected to shift work and long hours may often adopt diet and lifestyle habits that are not ideal for optimizing fertility. From a naturopathic perspective, diet is one of the most important lifestyle factors, along with physical activity, weight control and substance use, to consider when trying to conceive.[12] Due to time constraints, lack of nutritious options, and circadian rhythm changes that alter hunger and satiety signals, healthcare workers may adapt to a diet of minimal nutritional value: high trans fats, high-glycemic index carbohydrates, and foods low in vitamin/mineral content such as candy bars, greasy/fried foods, cookies, muffins, doughnuts, pre-packaged microwavable dinners, high-sugar breakfast cereals, etc.[12] This type of diet, which consists of high-glycemic index foods, high trans-fat, and low micronutrient status is not optimal in creating an environment ideal for reproductive health, conception, and proper maintenance of pregnancy.[12, 13, 14]

One particular study followed a cohort of 17,544 female nurses without a history of infertility over eight years as they tried to

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become, or succeeded in becoming, pregnant. They found that following a "fertility diet" protocol in general (consisting of plant-based proteins, non-heme iron sources, high fat dairy, low-glycemic index carbohydrates, and a higher intake of multivitamin use) was associated with a lower risk of ovulatory disorder infertility and infertility due to other causes.[12]

Additionally, some research has demonstrated compelling evidence for the association of shift work amongst healthcare workers with the development of type 2 diabetes and obesity.[15] Potential mechanisms that underlie this association may be due to the disruption of circadian rhythms which regulate metabolic and cardiovascular systems, poor diet and exercise habits, and poor quality and quantity of sleep.[16] Shift workers may gain or lose weight due to various reasons such as eating under time constraints, eating alone without family or friends, eating poorly during the day (due to lack of nutritious meal availability, time to plan, prepare and cook meals, eating on the go from vending machines, etc.) as well as over-eating on night shifts (when digestion processes are slowed), and consuming higher-fat foods.[17] It has been shown that a single night of sleep deprivation causes decreased circulating leptin (satiety hormone) levels and increased grehlin (hunger hormone), leading to overeating and increased risk of obesity and glucose intolerance.[18]

It is understood that maintaining an optimal weight is critical for ensuring female fertility. Compared with women with a normal BMI (20-24.9), overweight women (BMI 25-29.9) and women with a BMI below 20 had a similarly higher risk of ovulatory disorder infertility, while obese women (BMI >30) had greater than double the risk.[12] In this population, it may be difficult to adhere to a consistent exercise regimen. The amount of exercise suggested for optimal reproductive health is unclear. One particular study noted a reduced risk of ovulatory infertility with an increase in vigorous (not moderate) activity; each additional hour of exercise per week of vigorous exercise demonstrated a 7% lower risk, and a 5% reduction in risk remained when adjusted for BMI. Among American women, this data suggests that overweight and sedentary lifestyles attribute to an increase in ovulatory infertility, compared to being underweight and overexertion[19]; however, other research suggests that five hours or more per week of vigorous exercise has a positive correlation to delayed time to pregnancy in all subgroups of women, except those that were overweight and obese and subsequently at higher risk of infertility (for whom any type of exercise may improve fertility), while moderate activity was associated with a slight increase in fecundability regardless of BMI. This suggests that lean women who substitute vigorous exercise with moderate exercise may also improve their fertility.[20] It is possible that maintaining a healthy BMI may improve ovulation and fertility by increasing insulin sensitivity.[12] Women undergoing an exercise and diet regimen for 6 months lost an average of 10.2 kg/m2. Sixty of the sixty-seven, anovulatory subjects resumed spontaneous ovulation, fifty-two achieved a pregnancy (eighteen spontaneously) and forty-five delivered a live baby. The miscarriage rate decreased from 75% to 18% after program completion.[21] This is of importance for women with diabetes and PCOS.

Vitamin D plays an important role in the health of pancreatic cells and improves insulin sensitivity. A marked vitamin D deficiency has been shown in insulin-resistance, and in combination with obesity increases the risk of diabetes dramatically.[22] Compared to healthy controls, subjects with type II diabetes have been observed to have significantly lower circulating 25(OH)D concentrations, as vitamin D is stored in adipose fat tissue.[23] Multiple mechanisms of how vitamin D affects insulin secretion/resistance exist: (1) 1,25(OH) D activates transcription of the human insulin receptor gene,[23] (2) improves insulin sensitivity of the target cells,[22] (3) activates peroxisome proliferator activator receptor-δ (nuclear hormone receptor that controls the proliferation of peroxisomes produced by the cells and acts in the development of diabetes) (4) stimulates insulin receptor expression,[23] (5) protects beta-cells against immune attack,[22] and (6) enhances insulin-mediated glucose transport,[23] just to name a few. Normal vitamin D range is between 30.0 to 74.0 nanograms per milliliter (ng/mL). Vitamin D deficiency in diabetic patients is defined as a serum 25-hydroxyvitamin D level below 50 nmol/L, and not the usual 25nmol/L.[22]

Stress and obesity also leads to estrogen dominance, which in turn depletes melatonin and increases infertility. The increased need for cortisol depletes progesterone levels used in making cortisol. As more progesterone is required to make cortisol, less is available to balance estrogen levels.[24,25]

Increased consumption of caffeine, and increased likelihood of smoking have been reported in the Nurses' Health Study, as well as a higher BMI for those working nights.[7] Healthcare workers may consume more caffeine in an attempt to stay awake during their long shifts, in particular during night shifts.[18] Caffeine causes blood vessel constriction reducing uterine blood flow and preventing eggs from implanting to the uterine wall. Caffeine inhibits the muscular movements of the fallopian tubes, and causes hormonal changes such as decreased estradiol but increased progesterone.[26,27] Caffeine consumption has also been associated with other causes of infertility such as endometriosis.[28]

Smoking, a habit very common in healthcare workers, has been associated with changing the microenvironment of the follicles, shorter and more variable cycle lengths, reducing progesterone levels in the luteal phase, increasing FSH levels during the luteal-follicular phase transition and creating a short follicular phase which has been linked to decreased fecundability and earlier menopause.[29, 30,31] In addition, smoking increases the thickness of the zona pellucida, making it more difficult for sperm penetration.[32,33]

Caffeine and nicotine also cause nutrient deficiencies. Caffeine depletes thiamin and other B vitamins, calcium, magnesium, potassium, iron and zinc [34] while nicotine causes a depletion of vit C, B vitamins, and calcium; deficiencies which contribute to infertility and spontaneous abortions.[35]

The combined effects of several negative lifestyle factors have been associated with a progressive reduction in fertility. A progressive increase in the time taken to become pregnant was found with increasing numbers of negative lifestyle factors (Figure 1).

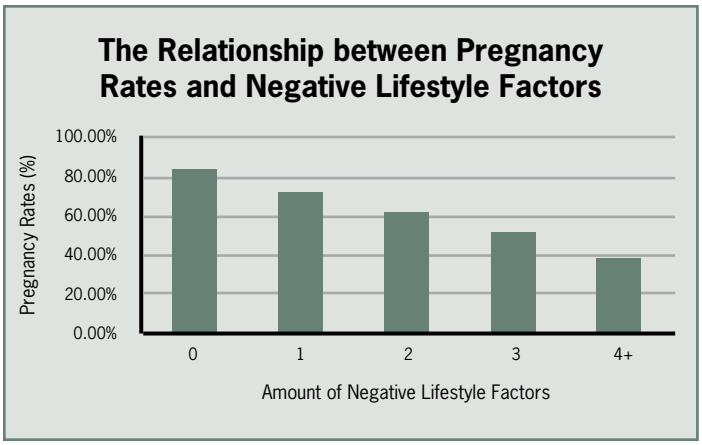

Figure 1

Pregnancy rates in percentage amongst those who have been subjected to no negative variables, one negative variable, two negative variables, three negative variables and four or more negative variables. This data shows an inverse relationship between pregnancy rates and negative lifestyle factor exposure. Negative lifestyle factors measured included women's smoking >15 cigarettes/day, women's coffee or tea intake >7 cups/day, women's weight >70 kg, social deprivation score >60, women's age >35 years and/or partner's age >45 years at the time of discontinuing contraception, and also male partners alcohol and cigarette use.[36]

Overall dietary and lifestyle habits aimed at increasing the intake of certain micronutrients and improving insulin sensitivity through the modification of diet composition, increased physical activity, and weight control may help prevent ovulatory infertility.

Psychological Stress

Stress is prevalent among healthcare workers and has been shown to negatively impact fertility within this population[37]. Healthcare workers who regularly encounter highly emotional situations are impacted the most, especially those working in fields related to mental health and trauma: counsellors, psychotherapists, social workers and nurses.[37] Those with the greatest risk of 'burnout' are healthcare workers who experience emotional stress on a regular basis, such as mental health workers and nurses within institutions.[37] Burnout is more prevalent when these workers are not actively participating in coping mechanisms outside of the workplace, or if they feel unsupported by their peers and colleagues.[37]

The human body is innately balanced, and largely controlled by hormones and chemical regulators, many of which play a key role in conception. A study of 274 women aged 18-24, showed that women who had increased levels of adrenaline, measured by salivary alpha-amylase as a biomarker, demonstrated a significant decrease in overall fertility compared to women with lower adrenaline levels.[38]

Adrenaline is released during times of acute and short-term stress, which may be indicative for many healthcare workers, especially those working in acute care settings dealing with high volumes of patients and traumatic cases. In the same study, higher cortisol levels were not significantly associated with decreased fertility.[38] Adrenaline and cortisol are both produced and released by the adrenal glands during times of stress; however, cortisol plays a role in managing the body's long term, moderate stress response over a period of time. This seems to indicate that long term moderate stress levels over time may not play a major role in fertility, but rather, it is the times of extreme stress, and the surges in adrenaline that pose a greater potential risk.[38]

Cortisol, secreted by the adrenal cortex, regulates energy expenditure by selecting the right type and amount of substrate (carbohydrate, fat, or protein) the body needs to meet the physiological demands placed on it. When cortisol is elevated over prolonged periods of time, it has a detrimental effect on weight management by increasing appetite and blood sugar, and inhibiting the production of insulin to prevent glucose from being stored. When situations of persistent stress exist, the body remains in an insulin-resistant state, therefore increasing risk of diabetes.[39] In addition, elevated cortisol increases thyroglobulin-releasing hormone and down-regulates its receptor, thereby blunting thyroid-stimulating hormone (TSH) response. Thyroxine (T4) to triiodothyronine (T3) conversion is also inhibited by elevated cortisol; furthermore, T3 acts as a feedback on the pituitary to produce elevated TSH.[40] Subclinical hypothyroidism may be associated with ovulatory dysfunction and adverse pregnancy outcome.[41]

Another factor essential to fertility is the function of hormones in the overall regulation of health and balance in the human body.[42] Progesterone is an important hormone that plays a key role in the development and maintenance of the uterus for proper implantation of a fetus.[42] Because of this, adequate progesterone levels are essential for the development of the fetus to reach its full-term growth.[42] As stated in a study conducted by Johnson et al, 1992, hormonal balance, or homeostasis, is achieved when the body adapts to constant changes in physiology caused by internal or external stress.[43] Therefore, it is important to maintain a healthy level of stress in order for the body to adjust to these changes in a timely and regulated manner.[43] This study continues to explain that if stress levels are elevated above normal levels, one's regulating system may not function as efficiently. This may result in dysfunctional or maladaptive stress responses which would lead to a decrease in overall hormonal regulation.[43] This could lead to drastic changes in sexual function, mood and affect, and would pose a great risk to one's sexual health and fertility.[43]

It is therefore important for anyone in a demanding job position to make time for oneself not only to increase their chances of fertility,

but also to bring one's body and mind back to its natural and balanced state. Practices such as yoga, acupuncture, meditation or any other techniques designed to bring the body back down from stressful periods are useful and highly recommended. In a systematic review, it was found that acupuncture may play a key role in regulating the function of the hypothalamus.[44] Acupuncture was also demonstrated to increase overall uterine blood flow, thereby improving fertility.[44] A study examining the impact of yoga on stress in pregnant women indicated that yoga lowered the perceived stress response by 31.57% as compared to the control group.[44] Yoga techniques were also shown to play a strong role in regulating the adaptive stress response in pregnant women.[44]

Occupational Exposure

Healthcare workers are exposed to a multitude of substances that can cause menstrual disorders and have detrimental effects on fertility. Common exposures include, but are not limited to, toxic chemicals, chemotherapeutics, radiation, heavy metals and anesthetics.

There is significant evidence to suggest that continuous and prolonged exposure to endocrine disrupting chemicals is a risk factor for reduced fertility and fecundity in women, although this evidence is shown in general terms, not specifically to healthcare workers. We must, however, consider the possible exposure that these women encounter within their working environments.[45] An endocrine disruptor is a substance found outside of the body that has a profound effect on the endocrine system, potentially interfering with fertility in both males and females.[46] Endocrine disruptors that may be found in medical equipment include DDT, PCB and BPA in plastics, PBDEs in flame retardants, phthalates in equipment, flooring and air fresheners, and alkyl phenols from detergents.[46] All of these items are common in the hospital environment and can lead to an accumulated exposure over time. These toxic chemicals are lipid soluble and therefore can cross the placenta and affect the developing fetus.[46]

The exposure to chemotherapeutic agents has also been seen to affect fertility in nurses. One study showed that dermal exposure of female nurses to anti-neoplastic drugs caused a significant delay in conception.[47] Exposure to chemotherapeutic agents was also shown to cause premature delivery and/or low birth weight in many of these nurses.[47] These drugs did not have an effect on spontaneous abortion, stillbirth, and congenital anomalies.[47]

Though not limited to the healthcare field, heavy metals also have a negative impact on fertility. The effects of heavy metals on the female reproductive system are not well studied in order to reach any firm conclusions as most research targets the male reproductive system.[46] The small amount of available evidence is mainly based on lead exposure, but it does not confirm this in medical providers. One study suggested that heavy metal induced hormonal and immunological changes might be important factors in the pathogenesis of repeated miscarriages and that these heavy metals might have effects on the female reproductive system affecting the ovary as well as hormonal production and release.[48] The main sources of heavy metal exposure come from the environment. Heavy metals include mercury found in many fish species, cadmium found in cigarettes, and lead from power plants and exhaust fumes.[49,50]

One of the biggest things that women in the health field may be concerned with is the risk of anesthesia exposure to fertility. There have been numerous studies correlating an increased risk of spontaneous abortion with exposure to nitrous oxide and other inhaled anesthetics.[49] The primary concern is with the waste anesthetic gas (WAG)[49] that leaks out of the equipment, and if not properly scavenged can lead to an increased exposure.[49] A meta-analysis showed that WAGs are indeed associated with increased risk of spontaneous abortion.[50] This included 19 studies from different health fields including anesthetists, operating room physicians and nurses, dental assistants, operating room workers, and other hospital workers.[50]

Patient Education

Naturopathic doctors (NDs) are ideally suited to address the lifestyle factors and occupational hazards encountered by female healthcare workers. NDs can offer advice on how to optimize the diet to increase fertility and provide recommendations on how/when/what to eat to maintain nutrition and manage body weight.

Conclusion

Facing difficulties in conceiving can be extremely distressing for couples and many will seek naturopathic advice in order to work through their reproductive challenges. It can be particularly challenging for practitioners to effectively treat infertility within the context of the woman's working environment. The body is forced into a state of disharmony when stressed from working long hours, working overnight, poor lifestyle choices, and exposure to toxic chemicals, making it difficult to become pregnant. It is difficult to disentangle the direct effects of shift work on fertility from other associated factors; however, what is known is that the disruption in the normal sleep/wake cycle carries significant physiological impacts due to disturbances of circadian rhythms and neuroendocrine balance. It may be advisable for patients to consider switching to a regular day shift if at all possible. Diet and lifestyles that are undesirable for reproductive success are superimposed on an already compromised milieu. Educating patients in making small but dramatic changes can substantially help to increase the odds of attaining conception and maintaining a healthy pregnancy.

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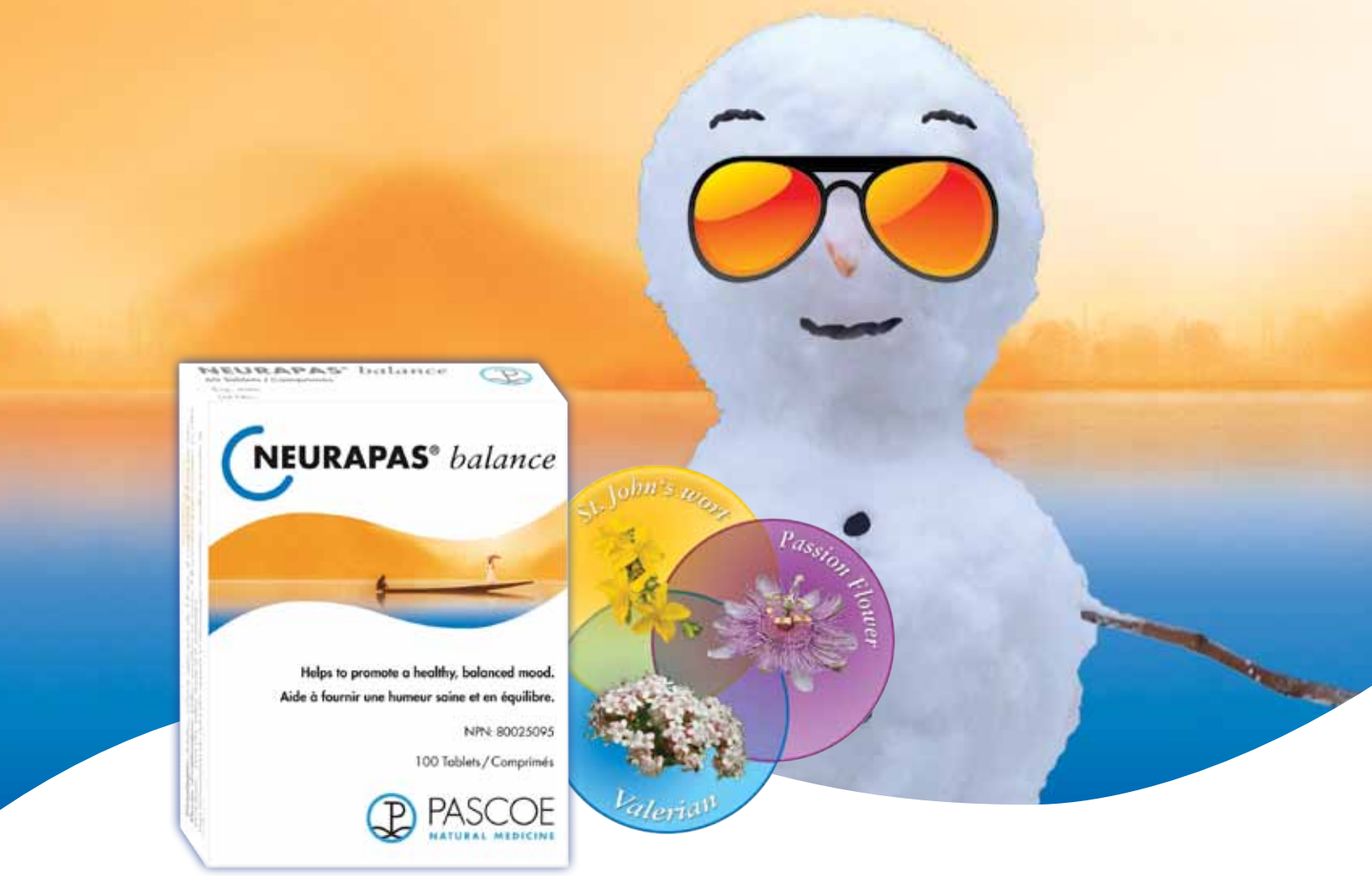

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However, given that not all lifestyle modifications will be practical for each individual, it is important to have organizational supports that provide workers with real alternatives to problematic working conditions, including irregular hours/nightwork, which may adversely affect their reproductive health or put them at risk.

Appendix

TABLE 1
Chemical Exposure and Effect on Reproductive Health

Chemical	Negative effect
Endocrine disrupting chemicals (Dioxin, PBB and PCBs, DDT, phthalates, BPA, heavy metals)	Reduced fertility and fecundity, increase risk for miscarriage, alter hormone levels, menstrual disorders such as amenorrhea and anovulation[46]
Chemotherapeutic drugs such as alkylating agents, antimetabolites, mitotic spindle inhibitors, antitumor antibiotics and hormones[42]	Delay in conception, premature delivery, low birth weight[49]
Heavy metals i.e. aluminum, arsenic, cadmium, lead, mercury	Hormonal and immunological changes, repeated miscarriage[48]
Inhaled anesthetics	Spontaneous abortion[49,50]

TABLE 2
Suggested Mealtimes and Healthy Tips

Afternoon Shift Workers (approx. 3pm-11pm)	Eat at regular times during the day
Night Shift Workers (approx. 7pm-7am)	Eat main meal before shift starts, preferably at regular dinner hour (5pm-7pm). Snack lightly through shift and eat a small meal at midnight break (with protein)
After shift, before you sleep (approx. 7am)	Eat a small, light snack high in carbohydrates and lower in protein (e.g. oatmeal) and fat to aid with sleep
Additional suggestions:	Be sure to sleep in dark space with no light entering the room; use ear plugs

TABLE 3
Do's and Don'ts When Deciding What to Eat

DO	DON'T
Make healthy, high protein choices for meals and snacks and limit carbohydrates until a few hours before sleep	Don't choose meals from a vending machine or package
Choose "whole" foods like nuts, seeds, fruits, veggies, whole grains, eggs, lean animal protein and low fat dairy products to get you through a shift and decrease chemical burden on your body	Avoid high chemical containing foods such as diet sodas and processed foods that can have a negative effect on fertility, also discontinue smoking if you are a smoker
Stay hydrated with fresh water, add lemon for extra flavor and detoxifying effect	Stay away from sugary soda and energy drinks, avoid high amounts of caffeine, and avoid caffeine at least 4 hours before sleep
Plan your meal times, space them out at proper intervals and try to eat at a similar time each day	Avoid getting hungry to avoid dips and spikes in blood sugar
Get on the most stable schedule possible	When trying to conceive or during pregnancy, avoid taking shifts that are on extreme ends of a time frame, such as switching night and day shifts frequently, as this disrupts circadian rhythm
Exercise when off shift and maintain an optimal weight to increase fertility odds	Staying sedentary when not on shift
Avoid use of heavy cleaners, bleaches, and detergents, use gloves when you are not able to avoid them	Don't use chemicals without putting gloves on, having proper air circulation, and wearing a surgical mask
Take all precautions when working with potential toxic exposures and anesthetics such as wearing gloves and surgical masks	Don't inhale toxic chemicals, heavy metals, and handle chemotherapeutics when trying to conceive or after conception
Take time for yourself before, after, or during your shift if possible. Practice techniques such as acupuncture, yoga, meditation or anything that makes your body and your mind feel grounded and centered.	Don't isolate yourself from your peers and colleagues. Talk to each other whenever possible to establish an environment centered around emotional support and connection

About the Authors

Olivia Greenspan, ND (Cand.) is finishing her 3rd year at CCNM. She currently holds a Bachelor of Health Sciences degree through the University of Western Ontario and a Bachelor of Science in Nursing Degree through the University of Toronto, and currently works as a registered nurse, specializing in cardiac critical care. She has also spent time working in an expanded nursing role on First Nations Reserves in Northern Ontario. Once completing her education at CCNM, she hopes to integrate her knowledge of nursing in the conventional health care system with naturopathic medicine.

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Jessica Sangiuliano, ND (Cand.) is a clinical intern at the Robert Schad Naturopathic Clinic in Toronto, Ontario. Her focus is in General Family Medicine and Pediatrics, and is currently developing an integrative medical clinic with a focus in Women's Health and Pediatrics. She is an active member of the CAND, OAND, AANP, OncANP, and PedANP, and has worked alongside various practitioners throughout Ontario, the United States, and in Kenya, Africa. She continues research in areas of oncology, pediatrics, fertility, and overall health maintenance.

Shannon Sutter, ND (Cand.) is a 4th year clinic intern at the Robert Schad Naturopathic Clinic originating from the US. She has a bachelor's degree from the Pennsylvania State University in Biology with a concentration in Ecology. She has travelled abroad twice to the Amazon Rainforest of Peru and Ecuador to study the medicinal properties of indigenous plants and has a strong interest in using botanicals in her future practice. She currently plans to focus on diabetes management and other endocrine disorders and fertility, and continues with research in such areas.

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Rescue 911: Responding to Our First Responders

Dr. Jonathan J. Tokiwa, BScN, RN, ND, LAc

There is total darkness. You hear the sound of sirens blaring in the background. You are surrounded by glimpses of images from an accident. You hear a voice — "You've been in an accident. Don't move. We're here to help." The next instant, you see the image of the hospital with doctors and nurses running towards you ready to provide treatment. You would probably assume that we are talking about the casualty. However, what if I tell you this is the recurrent scenario that would awaken a former emergency response colleague from sleep?

First responders are trained to respond to an emergency and provide the initial medical care necessary to stabilize the casualty/casualties in order to preserve life, prevent illness/injury from worsening, and promote recovery.[1] This includes police officers, fire fighters, paramedics, or other rescuers trained to attend emergencies. In emergency situations, most of the care and emphasis is placed upon the casualty. However, it is always important to keep in mind the health and welfare of those first responders who attend these situations on a regular basis. Based upon the nature of the work and the inherent occupational demands, such as high stress and irregular work hours, first responders are prone to developing certain health conditions.[2, 3] This article will highlight the various health considerations first responders face as part of the nature of their work.

Health Considerations Related to Exposure to Substances and/or Pathogens

The first component taught to all emergency responders is "safety first". This encompasses safety from dangers within the environment and protecting oneself by using appropriate personal protective equipment (PPE).[1] However, inherent to the nature of the work, exposure to potential hazardous substances and pathogens represents an ongoing risk.

Over the years, many articles focused upon researching the effects of the World Trade Center disaster on the first responders attending the scene. Exposure to carcinogens such as asbestos, dioxin, lead, polycyclic aromatic hydrocarbons, glass fibers, hydrochloric acid, polychlorinated biphenyls, and other caustic chemicals are hazards those first responders exposed themselves to.[3] As a result, many of them continue to suffer from respiratory, cardiovascular, dermatologic, ophthalmologic, and oncologic conditions.[3, 4]

First responders experience an increase risk of exposure to potential communicable diseases.[1] This results from a direct exposure to possible airborne, blood-borne, and droplet transmitted conditions, such as tuberculosis, HIV, hepatitis, and meningitis.[1, 2]

In addition to potential exposures from toxins or communicable diseases, first responders need to continuously monitor their surroundings for changes that may put them at risk from situational dangers. This includes traffic, fires, weather conditions, and violent individuals, to list a few.[1, 2]

First responders need to have access and appropriately use the necessary PPE designed to reduce their risk from exposure to these hazards. This encompasses the use of gloves, eye protection, gowns, hazard suits, and any other protective equipment necessary to prevent and reduce exposure risk.[1] In fact, the need has been emphasized for improved protection of the health of disaster workers by increasing comprehensive exposure assessments, providing more protective hazard control, emphasizing precautionary principles, focusing upon worker training, and enforcing preventative standards.[5]

KEY POINT

The health hazards resulting from exposure to potential toxins and pathogens represent an inevitable occupational risk associated with the role of a first responder. However, these risks are greatly reduced and potentially avoided by ensuring proper training, providing appropriate protective equipment, and emphasizing preventative measures to ensure the safety of the first responder as the utmost priority.[1, 2, 4, 5]

Health Considerations Related to the Development of Psychological Concerns

First responders face a number of psychological conditions as a result of the nature of their work. These include depression, anxiety, stress, and post-traumatic stress disorder (PTSD).[1, 3, 4, 6]

Depression represents one of the major psychological concerns that first responders may experience due to continuous exposure to traumatic situations. This may affect quality of life by interfering with the ability to work, sleep, eat, and enjoy pleasurable activities.[6, 7, 8] Strongly linked with the depression is the feeling of anxiety which results in an unexplained frequent and constant worry.[6, 8] This leads to difficulty concentrating, irritability, restlessness, hypersensitivity, insomnia, and fatigue.[3, 4, 6] In order to cope, some first responders may experience an increased risk of substance abuse if these feelings are not addressed and managed in an appropriate manner.[6, 8]

As well, resulting from the exposure to these traumatic situations, it is common for first responders to experience some form of critical incident stress. This may result in muscular tremors, upset stomach, excessive perspiration, flashbacks, nightmares, and withdrawal/isolation.[1, 8] It is common for these symptoms to occur and last over 1 to 2 months.[1, 6, 8] However, if it continues to persist or affect quality of life, most likely it has progressed to PTSD.[1, 8] At this stage, more professional medical assistance is required to help the first responder cope with this condition. The prevalence of PTSD exhibited has no significant gender difference over time but substantially increased the amount of co-morbidity with other mental health conditions.[7] Further, in a study of emergency workers attending the World Trade Center disaster, the strongest predictors of ongoing PTSD included trauma history, presence of major depressive disorder, and the extent of occupational exposure.[9] These first responders will, therefore, require appropriate medical care in order to help cope and regain a sense of well-being.

Given the high probability of first responders encountering psychological concerns, it is necessary to inquire about sleep patterns, changes in mood or energy, recurrent flashbacks, nightmares, suicidal thoughts, and the impact of stress on their health, personal relationships, and performance. Furthermore, it is important to ensure appropriate and adequate support networks, formal debrief sessions, and coping strategies are in place to help assist first responders in managing these psychological issues.[8]

KEY POINT

Due to the likelihood of first responders experiencing some form of psychological impact from their exposure to traumatic situations, it is important for naturopathic doctors to investigate for the presence of depression, anxiety, critical incident stress, and post-traumatic stress disorder.[1, 3, 4, 6, 7, 8]

Health Considerations Related to the Development of Cardiovascular Conditions

In addition to psychological concerns, first responders are at an increased risk of developing cardiovascular conditions. In particular, they are prone to experiencing hypertension and cardiovascular disease.[10, 11, 12]

High blood pressure is common in first responders due to the physical and psychological rigors associated with the occupation.[10, 11] Nearly ¾ of emergency responders have either pre-hypertension (125-139/80-90 mmHg) or hypertension (≥140/90 mmHg) (Table 1).[11] Irregular physical exertion, unhealthy diet, shift work, noise exposure, post-traumatic stress disorder, and high job demand/low decisional control represent key occupational risk factors that contribute to elevated blood pressure in emergency responders (Table 2).[11] In fact, it is expected that hypertension among emergency responders will increase as a result of the obesity epidemic.[10,11]

Cardiovascular disease encompasses coronary artery disease, heart attacks, angina, and stroke.[12, 14] Emergency responders are at an

increased risk of mortality from cardiovascular disease as compared to the general public due to the episodic and sudden shifts from low activity to the high degree of intense and strenuous activity necessary when responding to emergencies.[11] The combination of drastic activity shifts with the additional occupational health risks and the responders' personal health risks, increases the morbidity and mortality on their health and well-being.[10, 11, 12, 14] Further, individuals with existing coronary artery disease who are exposed to acute stress are at a greater risk of suffering heart attacks than those with coronary artery disease and no stress exposure.[13] Hence, the heightened stress faced by first responders may exacerbate pre-existing minor cardiovascular conditions to a fatal cardiovascular event.

Thus, it is important to assess first responders for the presence of hypertension and their risk of developing cardiovascular disease. A focus upon improving modifiable risk factors, such as smoking cessation, diet, exercise, weight, and stress are essential in improving the health and well-being of our first responders.

KEY POINT

First responders are at an increased risk of hypertension and cardiovascular disease as a result of the physical and psychological demands associated with their occupation. This, in conjunction with their own personal health risk factors, may place them in a high category for morbidity and mortality. Thus, appropriate measures are required to address the modifiable risk factors, such as smoking cessation, healthy nutritional intake, regular physical activity, weight management, and stress reduction, in order to decrease the heighten occupational risk of morbidity and mortality in this population.[10, 11, 12, 13]

TABLE 1
Prevalence of pre-hypertension and hypertension in emergency responders

Population	Mean age (± s.d.)	% Prevalence of pre-hypertension	% Prevalence of hypertension[a]
Career fire-fighters	39 (±7)	58	20–23
Volunteer fire-fighters	Not available	47	30
Police	47(±8)	—	24[b]
EMT and paramedic recruits (unpublished observations)	26(±4)	59	9

a≥140/90 mm Hg, diagnosis of hypertension, or antihypertensive medication use, unless otherwise noted.
b≥160/95 mm Hg or antihypertensive medication use.

Cited directly from Kales, S. N., Tsismenakis, A. J., Zhang, C. & Soteriades, E. S. Blood pressure in firefighters, police officers, and other emergency responders. *American Journal of Hypertension*. 22(1), 11-20. (2009).

TABLE 2
Occupational risk factors for blood pressure elevation among emergency responders

Risk Factor	Comments
Irregular physical exertion	Relative inactivity between emergencies, long sedentary periods, lack of formal exercise programs and fitness requirements at work. High prevalence of overweight and obesity.
Unhealthy diet and shift work	Expediency, convenience of "fast food" as a choice during work-time. Tradition of communal meals at fire stations rich in saturated fats and simple, refined carbohydrates. Sleep disruption and sleep deprivation, alarms and dispatches during on-duty sleep, overtime work and second jobs, which can promote insulin resistance and the metabolic syndrome.
Noise exposure	Alarms, sirens, vehicle engines, mechanized rescue equipment.
Post-traumatic stress disorder	Increased resting heart rate, diastolic blood pressure and vaso-reactivity to traumatic stimuli (increased "startle response").
High job demand, low decisional control	In the 'Demand-Control" model of occupational stress, high demands and lower decisional latitude are associated with more stress. (Low demand and a high degree of control are associated with less stress.)

Cited directly from Kales, S. N., Tsismenakis, A. J., Zhang, C. & Soteriades, E. S. Blood pressure in firefighters, police officers, and other emergency responders. *American Journal of Hypertension*. 22(1), 11-20. (2009).

Health Considerations Related to the Development of Metabolic Conditions

Another main health consideration affecting first responders is metabolic conditions. In particular, these metabolic conditions include obesity and diabetes.[11, 15]

More than 75% of first responders are overweight or obese due to interrupted dietary and sleep patterns associated with shift work.[11] As a result of obesity, first responders experience a further increased risk of hypertension, coronary heart disease, dyslipidemia, cerebral vascular disease, degenerative conditions, cancers, and reproductive health complications.[15]

In addition to the prevalence of obesity related to shift work and other occupational factors associated with first responders, the risk of developing diabetes remains high in this population.[11, 16] Diabetes increases the risk of many serious health problems, such as hypertension, vision loss, kidney disease, and neuropathy.[16] As well, people with diabetes suffer a significantly increased risk of developing cardiac events, such as coronary artery disease, angina, or heart attacks.[16]

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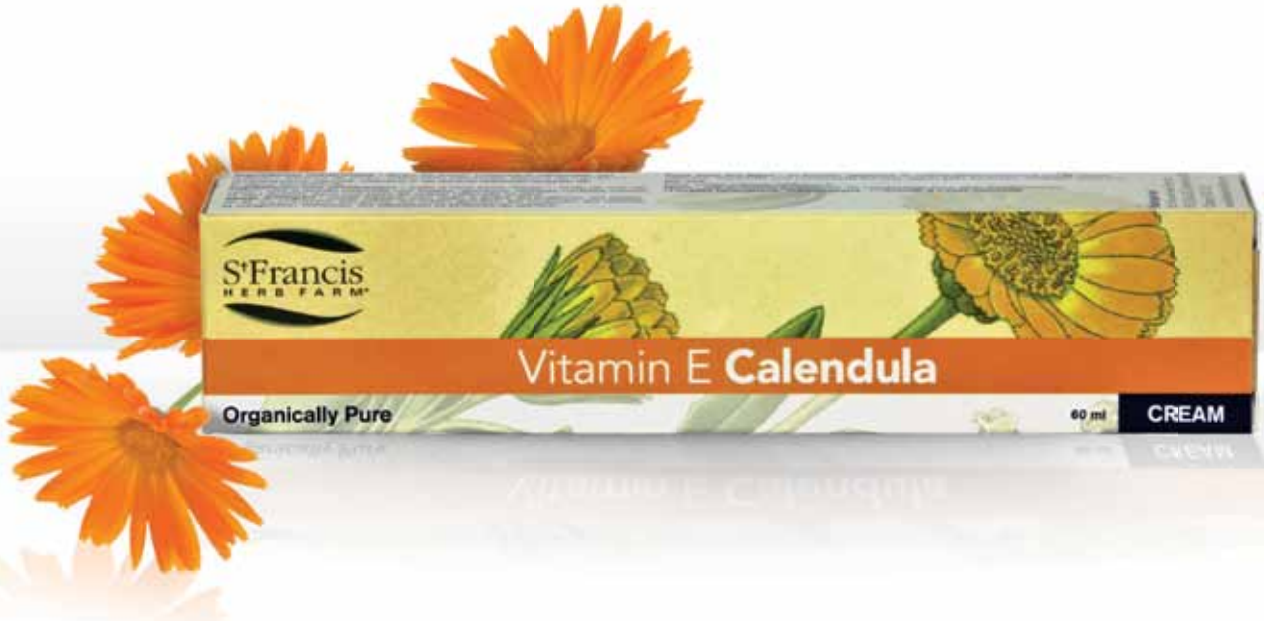

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In the authoritative expanded edition of the Commission E monographs, herbal researcher Mark Blumenthal and his fellow editors point out that, "In both contemporary and historic times, Calendula tinctures, ointments, and washes have been used to notably speed the healing of burns, bruises, cuts, and the minor infections that they cause."

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are at an increased risk for developing metabolic syndrome. In fact, first responders with high PTSD are at triple the risk for developing metabolic syndrome.[11]

Thus, this further emphasizes the need for proper lifestyle modification with regards to diet and exercise, in order to improve the health parameters relating to the management of weight, glucose control, blood pressure, and cholesterol levels. In turn, this will help combat the metabolic conditions first responders are prone to experience.

KEY POINT

First responders are at an increased risk for developing obesity and diabetes. Consequently, they are prone to suffer from metabolic syndrome. Therefore, it is essential to manage and reduce the risk factors associated with developing these metabolic concerns by ensuring appropriate lifestyle measures are encouraged in order to maintain healthy weight, nutritious dietary intake, adequate physical activity, and sufficient rest.[11, 15, 16]

Conclusion

Thus, as a result of the inherent occupational demands associated with the role of first responders, they experience an increased risk for developing certain health conditions. The various health considerations our first responders face include potential exposure to substances and/or pathogens that may detrimentally affect health, depression, anxiety, critical incident stress, post-traumatic stress disorder, hypertension, cardiovascular disease, obesity, and diabetes. In order to appropriately address the health and welfare of our first responders, naturopathic doctors must understand and assess these inherent occupational risk factors and provide workable options to help them flourish and maintain good health in this highly demanding profession. Furthermore, by ensuring a holistic assessment and treatment protocol which addresses the physical, psychological, and emotional aspects of first responders, naturopathic doctors can help significantly reduce and/or prevent the potential occupational health concerns encountered by these professionals. By doing this, we will ensure that the appropriate help is given to respond to the needs of our first responders.

About the Author

Jonathan J. Tokiwa, BScN, RN, ND, LAc completed his Bachelor of Science degree in Nursing at the University of Toronto and obtained his Doctor of Naturopathic Medicine at the Canadian College of Naturopathic Medicine. Prior to starting a career in naturopathic medicine, his previous experience includes emergency medicine and paramedical service. Currently, Dr. Tokiwa is a professor of Clinical Medicine and Emergency Medicine at the Canadian College of Naturopathic Medicine and a clinical supervisor at the Robert Schad Naturopathic Clinic. As well, he maintains a private practice at CuraMedics Multidisciplinary Health Care in Toronto, in which he uses lifestyle modification, nutrition, acupuncture, Chinese medicine, and homeopathy to address concerns relating to women's health, digestive complaints, immune support, pain management, and the mental/emotional aspects of illness. In addition, Jonathan is a certified instructor for the Heart and Stroke Foundation of Ontario and Toronto Emergency Medical Services First Aid program. Dr. Tokiwa is a member of the Ontario Association of Naturopathic Doctors and the Canadian Association of Naturopathic Doctors. Furthermore, he is a member in good standing with the Board of Directors of Drugless Therapy-Naturopathy and College of Nurses of Ontario.

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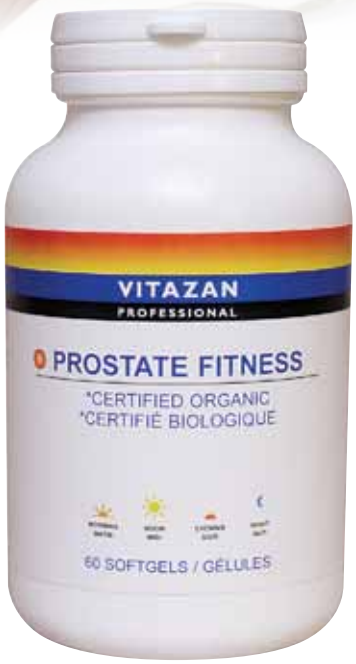

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Aircrew Health Risks and Regulating Melatonin Synthesis

Dr. Taryn Deane, ND

In 2011, there were a total of 113.1 million air passengers in Canada. In the last 10 years, this number has increased by over 30 million people.[1] The invention of airplanes has made countries on the other side of the globe accessible in less than a day of travel. Similar to healthcare, public safety and other modes of transportation, the aviation industry requires flight crew to be on the job around the clock.[2] The advancing demand for this industry is not without consequences – namely health risks for those who make a living working on airplanes.

Numerous studies have associated shift work, stress, jet lag and irregular schedules with circadian rhythm disturbance/disruption, sleep difficulties and ensuing health problems, including cognitive impairment.[3-6] Additionally, flight crews are at risk of being exposed to a variety of toxic substances and potentially harmful cosmic and/or electromagnetic radiation. The culmination of these factors leads to an increased potential for in-flight staff errors and accidents due to ill physical and cognitive health that could endanger passengers aboard the plane. Naturopathic doctors can work to prevent these accidents and improve the health of airline crew through education and treatment, particularly with the natural hormone melatonin, which has diverse beneficial effects in the body.

Health risks

Stress

The demands of being an aircraft pilot can be likened to those of anesthesiologist. Both require the operation of complex devices, exceptional skills, alertness in assessing rapidly evolving situations and quick decision making ability. Individuals in each of these professions must work systematically while allowing for adaptation and rapid problem solving in the face of extreme danger and high stress. Simulation training is used in aviation to practice appropriate reactions to circumstances of increased stress, knowing that thought processes and attention span are compromised when an individual is under pressure.[8]

Naturopathic doctors are well versed in identifying and treating the effects of chronic elevated stress in the short and long term. Hypothalamic-Pituitary-Adrenal axis dysfunction has the potential to impair growth, development, behavior and metabolism, which may lead to a multitude of acute and chronic conditions listed in Table 1, below.[9]

TABLE 1
Adaptive responses to evolutionary stressors and related diseases in modern human societies[10]

Response to Survival Threat	Selective Advantage	Contemporary Disease
Combat starvation	Energy conservation	Obesity
Combat dehydration	Fluid and electrolyte conservation	Hypertension
Combat infectious diseases	Potent immune reaction	Autoimmunity/ allergy
Anticipate adversaries	Arousal/fear	Anxiety/insomnia
Minimize exposure to danger	Withdrawal from danger	Depression
Prevent tissue strain/injury	Retain tissue integrity and reserve	Pain and fatigue syndrome

Irregular schedule

The disorders/diseases associated with stress response adaptations are compounded by the physiological consequences of an unpredictable work schedule with long hours, early report times, overnight shifts and time zone transitions. Each of these plays a role in disrupting the internal 24-hour clock (the circadian rhythm). The consequences of a career in flight pose significant challenges to basic biological necessities – sleeping, eating, and physical activity.[11, 12]

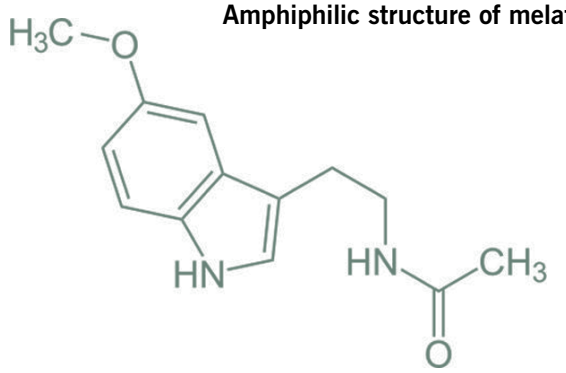
Mammalian circadian rhythm is controlled by the suprachiasmatic nuclei (SCN), which is located in the hypothalamus of the brain. The SCN drives the complex molecular mechanisms responsible for the production of melatonin at night and the regulation of the sleep/wake cycle, body temperature, food consumption and metabolism. The goal of this circadian timing system is to facilitate

an organism's adaptation to changes in the environment, including seasonal variation (and mating season for many animals). This internal organization of time converges with the environment's 24-hour clock through light signals, which alter the pineal gland's production of melatonin.[13]

Environmental light detected by the retina controls the production of melatonin by inhibiting N-acetyl transferase, an enzyme which converts the precursor serotonin into melatonin.[14] Melatonin is secreted into the blood primarily by the pineal gland, but is also synthesized in, and appears to have a local action on the retina, gastrointestinal tract, bone marrow, skin, blood platelets and circulating lymphocytes.[13] After entering the bloodstream, it has the unique ability to cross all physiologic membranes, allowing it to act on any cell and tissue in the body.[15]

Aircrew fatigue, particularly in pilots, has been studied extensively. Shift work, jet leg and the result of sleeping at inappropriate times of the day for insufficient hours, all share the same

Amphiphilic structure of melatonin



pathophysiologic mechanism. The consequence is an incongruence between the endogenous circadian rhythm and the imposed schedule for waking and sleeping, where melatonin is one of the key factors for regulation.[2,4,6] Misalignment of the circadian phase, combined with sleep loss, contributes to increased rates of gastrointestinal conditions, cardiovascular disease, metabolic disturbances,[12] and certain cancers (breast and prostate) in shift workers. Not surprisingly, this population also has a higher incidence of workplace accidents and a general decline in work performance.[2,5]

Toxic Exposure

While in flight, commercial airline crews are exposed to many harmful substances including cosmic ionizing radiation (from solar proximity), electromagnetic fields (EMFs) from cockpit instruments, jet fuel and other noxious chemicals.[16] Additionally, when the cabin is flown at high altitude there are hazards associated with decreased amounts of circulating oxygen.[17,18]

Hypoxia is a serious concern in aviation because it impairs vision, judgment, motor control and can result in incapacitation, or in severe cases, death. Although fatalities are rare, incidents of hypoxia in flight are common.[18] Aircrafts are specially designed with pressurization systems to protect the operators and passengers when flying at high altitude. However, loss of cabin pressure is possible if equipment failures take place. Signs and symptoms of low oxygen circulating in the blood include: rapid breathing, headache, drowsiness, nausea, euphoria, irritability, slurred speech, and diminished thinking capacity.[17] It is essential for flight crews to understand what hypoxia looks like and how to respond in an emergency situation, which is why altitude training is mandatory in this profession.[19]

For flight personnel, EMFs come from two ends of the spectrum: non-ionizing radiation from radio waves and weather transmitters, and cosmic ionizing radiation from heat emitted directly from the sun. High levels of exposure to cosmic radiation on long distance flights is believed to be responsible for the increased incidence of certain cancers (melanoma, acute leukemia, breast and prostate cancer) seen in epidemiological studies of pilots and flight attendants.[16] This is consistent with the physiological findings that ionizing radiation is a known carcinogen – it causes double stranded DNA deletions and genomic instability.[20] Certain factors must be accounted for when estimating the dose of radiation while in flight: altitude and latitude, phase of the solar cycle, and flight duration. Other potential cancer causing risk factors must also be acknowledged, particularly sun exposure in southern destinations (melanoma) and circadian rhythm disturbance (hormonal cancers). Although we cannot ascertain exactly to what extent, evidence continues to surface supporting the idea that flight personnel are at a higher risk of developing cancer.[21]

Studies done on the proposed health effects of non-ionizing radiation from EMFs are as equally inconclusive as those exploring cosmic radiation. Carcinogenic, reproductive and neurological effects have been researched in an attempt to find evidence of causality due to EMF exposure, particularly in an occupational setting.[20] Although recent studies have found an association between mobile phone use, occupational or residential exposure and brain tumors or leukemia, no relation has been consistently demonstrated. The biological mechanism of damage is unclear and studies are confounded by weakness in classifying and communicating evidence of health risks with regards to EMF exposure. Missing information on crude exposure amounts (in and out of the occupational setting), small study numbers and the lack of control for confounding variables are limiting these studies.[22] Despite the fact that there are still many unknowns, these forces present important pollution in the occupational environment and adverse health effects cannot be ignored.[20] Of note is that EMFs have been shown to suppress melatonin production from the pineal gland, which may play a major part in depressing the immune response and potentially increasing the risk of developing cancer.[23,24]

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Furthermore, flight crews are occupationally exposed to various hazardous chemicals (jet fuel, de-icing fluids, engine oil, hydraulic fluids and cleaning materials), subjecting them to toxic substances including carbon monoxide, aldehydes, aromatic hydrocarbons, chlorinated, fluorinated and methylated phosphate and nitrogen compounds. Contamination resulting from contact can occur due to leaks or improperly controlled maintenance procedures for managing ventilation. This is a concern for the health and safety of the aircrew as exposure can cause a range of symptoms from chronic headaches to multiple chemical sensitivity.[25] Systems are in place to account for these risks, but it is prudent for physicians to assess patients who work in the airline industry for signs and symptoms of increased toxic load, order diagnostic labs to evaluate level of exposure and treat accordingly. Prevention with the use of antioxidants may also be considered appropriate in these cases.

General Lifestyle Factors

Traveling away from home, staying in hotels, eating out and socializing with crewmembers can make it difficult for airline staff to have a clean, balanced diet, exercise regularly and limit alcohol and caffeine consumption. These factors can greatly impact immune function, making the crew more susceptible to contracting airborne infections on the plane, as well as food borne illnesses while traveling.

The culmination of these factors ultimately leads to physical discomfort, an increased risk of developing life-threatening chronic conditions and the potential for impaired cognition, which directly affects work performance and safety.

TABLE 2
Summary of health effects in aviation

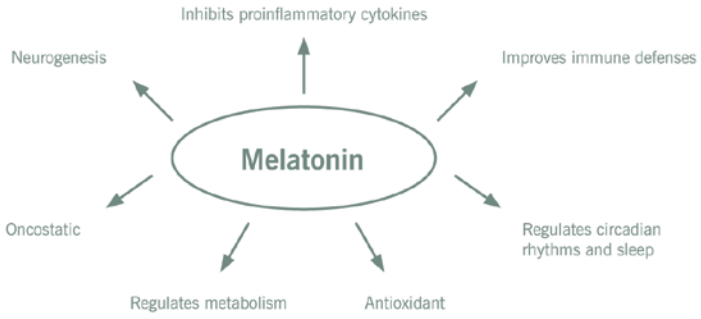
INHERENT JOB RISKS	PHYSIOLOGICAL IMPACT
On-the-job stress	Fatigue, insomnia, digestive disturbance, anxiety, depression, weight gain, cardiovascular disease, relationship stress
Irregular schedule: circadian rhythm disturbance, odd hours, long shifts	Fatigue, insomnia, digestive disturbance, impaired CNS function, relationship stress, ↑ risk of cancer, metabolic consequences
Toxic exposure: EMF, radiation, fumes, hypoxic environment	↑ risk of cancer (leukemia, melanoma, carcinoma of the breast), aerotoxic syndrome
Lifestyle factors: alcohol and caffeine consumption, lack of movement and exercise	Weight gain, cardiovascular disease, deep vein thrombosis, GI concerns
Diet: poor nutrition, irregular eating times, dehydration, caffeine dependence	Weight gain, cardiovascular disease, blood sugar dysregulation, insomnia, ↓ immune function, gastrointestinal discomfort and disease

Therapeutic Considerations - Melatonin

Naturopathic medicine has an important role to play in benefiting the health of airline personnel. Most NDs would have no trouble drawing up an extensive list of treatment options to help with the individual's symptoms and the risk factors listed above. However, the unfortunate reality is that frequent travel, security checkpoints, and absence of routine reduce compliance and make it difficult for flight personnel to follow complicated protocols. Carting around multiple bottles of liquids, tablets and teas is not a realistic option for many of these patients and irregular timing of medications and supplements can exacerbate certain conditions.[12] Therefore, simplicity is key for this population. Education focused on promoting appropriate natural melatonin production as well as supplementation when necessary may be the easiest treatment strategy with the greatest advantage for the airline patient.

Melatonin is the body's all natural "night cap" - a neuroendocrine hormone secreted in a daily rhythm from the pineal gland, in accordance with the dark phase of the day.[26] Reduced concentrations of melatonin have been seen in many pathologies including: coronary artery disease, orthostatic hypotension, schizophrenia, Alzheimer's disease and chronic pain.[14] The correlation between deficiency and disease has prompted a search to understand the mechanism by which melatonin exerts its effects and its applicability for use in the prevention and treatment of numerous other conditions. This is best understood by analyzing the hormone's actions in its natural form in the body.

TABLE 3
Schematic representation of the main effects exerted by melatonin[26]



As detailed above, it is well known that melatonin has a crucial role in the synchronization of the internal circadian rhythms with external environment cues (i.e., light). It is not surprising then, that studies have proven its effective application in the treatment of jet lag disorders through the hormone's capacity to adjust to the environment when traveling to different time zones. Melatonin blunts the effect of light, thereby accelerating adaptation to the destination's environment.[4] This is the same mechanism by which it induces sleep in patients with insomnia.

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Other actions in the body

- **Antioxidant**: One melatonin molecule has the potential to scavenge up to four or more molecules of reactive oxygen species – making it a multifaceted, broad-spectrum antioxidant. It stimulates several intracellular and extracellular free radical scavenging enzymes including glutathione peroxidase, glutathione reductase, glucose-6-phosphate dehydrogenase and superoxide dismutase and catalase, while inhibiting nitric oxide synthase – a prooxidative enzyme.[14]

- **Immunomodulator:** It upregulates the immune response by binding to melatonin receptors in T helper cells and monocytes, stimulating the production of IFN-gamma and IL-1, 2 and 12.[27] Evidence supports that it modifies inflammatory parameters at least partly through nuclear binding sites for melatonin within the cell, as well as membrane receptors on the outside of cells. It also possesses the ability to perform non-receptor mediated actions throughout the body, including the immune system.[15]

- **Oncostatic:** Melatonin inhibits cancer cell proliferation and the growth of solid tumors, tumor angiogenesis and metastasis, thereby alleviating cancer symptoms including pain, cachexia, fatigue, and nausea.[14] It also reduces many of the adverse effects of chemo and radiotherapy, and is not only safe to use in conjunction with many chemotherapeutic drugs, but increases their effectiveness as well.[28]

- **Endocrine modulator:** It inhibits corticotrophin-releasing factor, thereby reducing cortisol levels,[13] alters the synthesis and secretion of sex hormones by promoting the release of gonadotropin releasing hormone,[28] controls energy metabolism and fatty acid transport, affects synthesis of prolactin and growth hormone,[14] and may be involved in the regulation of calcium and phosphorus metabolism via inhibition of calcitonin release and prostaglandin synthesis.[14]

The examples above are a brief summary of the many diverse actions that melatonin exhibits. Ongoing research will likely continue to discover ways to use this hormone in the treatment of various other conditions.

Suggested use

Understanding the physiology of melatonin synthesis and its mechanism of action, it is not surprising that the aircrew's work environment could potentially alter the production of this important hormone. A melatonin deficiency in flight personnel may further predispose these individuals to health conditions that they may already be at risk of developing. Promoting the body's own natural production of melatonin through sleep regulation and optimization is recommended for this population. This can be accomplished through scheduled exposure to light and darkness and the use of eye masks, black-out blinds and a phototherapy lamp upon waking. In some circumstances (ie. insomnia, jet lag due to travel across time zones), occasional melatonin supplementation may be required to initiate sleep and increase endogenous levels of the hormone. This would allow maximal benefit of melatonin's crucial role in immune regulation, protection from damaging oxidative stress and prevention of numerous conditions.

Melatonin has a short half-life of approximately 30-60 minutes[32] and it crosses all barriers, enabling it to enter any cell in the body. Its pharmacology and pharmacodynamics have prompted the development of various formulations and delivery methods to address different concerns with relation to insomnia. Sublingual tablets are useful for sleep onset insomnia, while rapid absorption and prolonged-released delivery methods aim to resemble physiological secretions more closely, requiring a slightly higher dose and assisting primarily with sleep maintenance issues. Liquid formulations are also available, which can be conveniently added to tea or other beverages and have similar onset of action as sublingual tablets.

Dosing for melatonin ranges from 0.3mg (physiological dose) to 40mg (pharmacological dose), and it is best absorbed on an empty stomach.[32] Due to individual biochemical variability, each person may require a different amount of melatonin to achieve the desired result, therefore it is recommended to start with the lowest dose and work up until the appropriate clinical effect is achieved.[28] Dosage timing is of the utmost importance with this nutraceutical hormone since it is naturally synthesized at a specific time of the day. Depending on the chosen delivery method and the desired outcome, melatonin should be administered anywhere from 3 hours to 20 minutes before required onset of sleep.[32] The patient should experiment with timing of doses to see what works best for them. It is generally well tolerated when using the appropriate dose at the right time, although higher doses are associated with vivid dreams or nightmares and drowsiness on waking for some patients.[28]

No long-term studies have been done to assess the safety of melatonin; however, it is important to note that it has no known toxic dose level. It is suggested that patients try periodically to discontinue treatment and evaluate effects, as evidence of tolerance has been shown. It is contraindicated in pregnancy and autoimmune conditions because of its endocrine and immune modulating actions.[32] Caution should be taken when prescribing melatonin to patients on medications, especially other hypnotics, sedative medications and substances (including alcohol), anticoagulants, anticonvulsants (may lower seizure threshold, particularly in children), antihypertensives, antidiabetic agents and immunosuppressants, as doses may need to be adjusted, usually due to an additive effect.[30, 31, 32]

This once a day treatment would be optimized if prescribed alongside an individualized treatment program including education regarding proper diet recommendations, routine detoxification, stress management (meditation, exercise, deep breathing), regular sleep patterns (anxiolytic and sedating herbs) and lifestyle choices (limit alcohol and use of stimulants).

Conclusion

As advances in aviation technology progress – larger planes, flown at higher altitudes, for longer periods of time – the health risks associated with the aviation industry will only become more apparent. The consequences of these risks lead to cognitive function impairment and aviation errors, meaning the safety of the aircrew, aircraft and passengers is compromised. Recognizing the physiological demands and impacts of this profession and educating flight personnel about preventative strategies, including the potential use of melatonin, will ensure that the population at large is safe when travelling.

About the Author

Dr. Taryn Deane, ND practices in South Surrey, BC where she treats a number of conditions, focused primarily on hormonal imbalances and mental/emotional concerns. In addition to this, she lectures at BINM, her alma mater. You can follow Dr. Deane on twitter at @drtaryndeane or explore the clinic's website at www.agencyhealth.ca

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Chronic Pesticide Exposure in Farming: Risks and Solutions

Dr. Brian Casteels, ND, **Dr. Aisling Lanigan,** ND, and **Jessa Haldane,** ND (cand.)

During the 1950s and 1960s a major trend towards replacing traditional methods of pest control with chemical pesticides occurred.[1] This development enabled increased crop yields.[2] However, it soon became apparent that pesticides were causing toxic effects to not only the targeted organisms, but to other organisms and the environment.[3]

Farmers are individuals who work with the direct application of pesticides and as a result, have the potential for chronic exposure. However, it is important to note that pesticide exposures are not limited to farmers and may also occur in the general population, as well as those working with lawns, golf courses, and right of ways.[4] Although, one study found that individuals exposed to pesticides were 14 times more likely to report farming as their occupation.[5]

As naturopathic doctors, this is an important consideration when treating farmers. Understanding what the risks of chronic exposure are and how these risks may be prevented or mitigated is an essential component of treatment. Similarly, it is important to know which tests may be used to help guide diagnosis, as well as possible treatment strategies.

Health Implications of Pesticide Exposure

There are a number of potential health problems associated with chronic pesticide exposure and numerous studies have been published. The following is a review of some common health outcomes, with many of the studies coming from the Agriculture Health Study (AHS). The AHS is an ongoing project involving over 89,000 commercial and private pesticide applicators and their spouses, mainly from North Carolina and Iowa.[6]

Respiratory Effects

Farmers may be exposed to a variety of pesticides, many of which may be inhaled. Therefore, the impact of pesticides on respiratory health is important to address. Studies have been conducted to determine the prevalence of chronic rhinitis, bronchitis and asthma among pesticide users. For the majority of pesticides analyzed, there was no clear association between their use and risk of developing chronic rhinitis. However, six insecticides did show a significant correlation, including organophosphates.[7] A significant association between pesticide exposure and the prevalence of chronic bronchitis has also been shown to occur. In one study, the prevalence of chronic bronchitis increased with age and years living on a farm.[8] Another study found that high pesticide exposure doubles the risk of developing asthma, but generalized use does not.[9] However, other studies have found a link between asthma and generalized use of pesticides.[10] It is possible that pesticide exposure negates the potentially protective effects of living on a farm. Studies looking at traditional dairy farms have found that exposure to increased microbial diversity as a result of living on these farms may have protective effects against asthma and allergies.[11] Further studies are required to determine if these benefits occur on other farms, including more modern factory farms.

Neurological Symptoms

The nervous system is another area of concern for farmers exposed to pesticides. One study that used questionnaires to capture lifetime exposure, found six organophosphate pesticides to be significantly associated with abnormal toe proprioception and four organophosphates significantly associated with postural tremor abnormality. The researchers concluded that there was a risk of developing peripheral nervous system abnormalities after long-term use of organophosphate pesticides.[12]

Similarly, Parkinson's disease is strongly linked to a history of pesticide use. The pesticides rotenone and paraquat act as complex I mitochondrial inhibitors or oxidative stressors which are thought to play a role in the disease.[13] In a prospective cohort study of more than 140,000 people, the risk of Parkinson's disease was found to be 70% higher (adjusted relative risk, 1.7; 95% confidence interval, 1.2–2.3; $p = 0.002$) for those who were exposed to pesticides.[5]

Unfortunately, there are also a number of other nervous system disorders associated with pesticide use, including, but not limited to Alzheimer's disease, Amyotrophic Lateral Sclerosis, cognitive and psychiatric disorders.[14]

In Utero and Early-Life Exposure

Pesticide exposure during pregnancy and early childhood is a concern. Studies indicate a link between Attention Deficit

Hyperactivity Disorder, Autism, neonatal reflexes, as well as mental and psychomotor developmental implications with perinatal and early childhood exposure.[15,16] A number of animal studies indicate problems as well. Animal studies have found that when methoxychlor, a synthetic organochlorine, is given to rodents in early pregnancy, as well as neonatal or perinatal periods, that abnormalities may occur when adulthood is reached.[17] High-dose exposure of methylchlor during fetal and neonatal ovarian development in rats affected female offspring by accelerating the onset of puberty and first estrus, decreasing fertility and litter size, increasing cycle irregularity and leading to premature reproductive aging.[18] A lower dose, considered more environmentally relevant, induced non-significant cyclical irregularities as well as significantly affecting serum estradiol (E_2) and ovarian Anti-Mullerian Hormone (AMH) levels.[18] Preimplantation exposure may cause reproductive abnormalities in adult male mice by decreasing sexual arousal and altering seminal vesicle weights.[19] These studies indicate that pesticide exposure *in utero* or early in life may have adverse health consequences later in life. However, not all human trials found adverse affects *in utero*. One study conducted in Salinas Valley California found only shortened gestation with exposure to organophosphate pesticides.[20] Whereas, another study conducted in New York found decreased length and birth weight associated with blood levels of chlorpyrifos in pregnant women.[21] The differences may in part be attributed to fluctuating exposure levels as well as geographic variables; for example, the New York study consisted of inner city minority populations which are considered high risk groups for adverse birth outcomes;[21] whereas the California study was based on an agricultural population.

Infertility

Reproductive health is another area of concern. One study found that 28% of the couples were infertile when both partners were involved in applying pesticides,[22] compared to 10-15% couple infertility in the general United States population.[23] Studies on male infertility have suggested that pesticides contribute to poor semen quality and altered semen parameters.[24] Similarly, a higher rate of miscarriages was found in females exposed to pesticides.[25]

Epigenetics

A number of animal studies indicate that transgenerational changes in gene function may occur when exposed to pesticides. For example, the fungicide vinclozolin, and the pesticide methoxychlor, may cause subsequent generations to have spermatogenic defects.[26] Similarly, the pesticide permethrin may induce epigenetic inheritance of ovarian disease.[27] One study with rats found that females preferentially chose males where vinclozolin exposure three generations previous did not occur.[28] It is important to note that while we can't extrapolate results from rodents to humans directly, the same pesticides that affect animals may have epigenetic effects in humans as well.

Cancer

The overall incidence of cancer is lower among agricultural populations when compared to the general population. Despite the significant association between pesticide use and certain respiratory ailments, such as asthma, bronchitis, and rhinitis, the rates of lung cancer are lower in farmers versus the non-farming population. Similarly, the rates of lung cancer are lower in farmers who smoke compared to smokers in the general population.[29] However, there are certain types of cancer that seem to be over-represented among farmers. These include: prostate, lymphohematopoietic cancer, and melanoma.[30] Farmers exposed to high levels of pesticides had a two-fold risk of prostate cancer compared to unexposed farmers.[31] A questionnaire based study on British Columbia farmers found a significant risk of prostate cancer with exposure to DDT, simazine, lindane, dichlone, dinoseb amine, malathion, endosulfan, 2,4-D, 2,4-DB and carbaryl.[32]

Farmers also have an increased incidence of ovarian cancer, lip cancer, diffuse large B-cell lymphoma, multiple myeloma, chronic lymphocytic leukemia, small lymphocytic lymphoma and mantle cell lymphoma.[33, 34] Whether this is attributable to pesticide use or not is uncertain, as farmers may be exposed to a number of potentially dangerous agents, such as welding fumes, solvents, engine fuels and exhausts, organic and inorganic dusts, mycotoxins, and viruses.

Lab Testing

When considering lab testing it should be recognized that all individuals are exposed to pesticides and carry some level of these toxins in their bodies.[35] Farmers are generally exposed to higher than average pesticide levels. Often chronological history of specific pesticides used, such as a good case history, can direct the physician as to which lab tests will provide the most information. The Center of Disease Control (CDC) has questionnaires for acute pesticide poisoning,[36] and the U.S. Department of Health and Human Services has a questionnaire for exposure history.[36, 37] A common pattern of neurotoxicity and immunotoxicity, possibly followed by endocrine toxicity has been proposed to suggest a toxic burden on the body.[35] If pesticide exposure is suspected, as is in the agricultural community, testing may be warranted. Unless otherwise indicated, the following lab tests may be ordered by an ND in Canada, and may be used for exposure or poisoning from chemicals found in pesticides:

Cholinesterase Tests: Acetylcholinesterase, RBC Cholinesterase, Butyrylcholinesterase, Plasma cholinesterase, Pseudocholinesterase

> Measures organophosphate exposure, a common component of agricultural insecticides. High organophosphate exposure can inhibit cholinesterase and pseudocholinesterase activity causing overstimulation of nerves within body tissues and organs and disruptions in the processing and metabolizing of certain medications.[38] (not available to NDs)

Hepatic Function Panel (Liver Function Tests): Alanine Aminotransferase, Alkaline Phosphatase, Aspartate Aminotransferase, Bilirubin, Albumin

> The liver is responsible for metabolizing and detoxifying drugs and other substances that are harmful to the body, such as pesticides. The Hepatic Function Panel is a group of tests that are performed together to detect, evaluate, and monitor liver damage.[38]

Kidney Function tests

> Creatinine may be decreased with pesticide exposure.[39]

Autoantibody testing

> Gold immunochromatography assay strip test for detecting organophosphorous pesticides based on monoclonal antibodies.[40] (not available to NDs)

Complete Blood Count

> To assess for signs of immunotoxicity; such as but not limited to, low red blood cell count, thrombocytopenia, leukopenia or neutropenia.[41]

Heavy Metals Panel: Arsenic

> Arsenic is used in certain pesticides and may be formed from exposure to pesticides and solvents.[41]

A number of individual pesticides can also be tested in clinical laboratories through the following biological matrices: blood, serum, plasma, urine, and fat.[42] However, many of these tests are not available to NDs.

Prevention and Mitigating Factors

The first step in managing a patient with potential pesticide toxicity is the prevention of further exposure. This may pose a problem when treating the farming population. For the general population, prevention can include avoiding living in or travelling through agricultural areas during spraying seasons, avoidance of areas where known pesticide spraying has taken place and finding out when neighbours or government agencies are planning to spray an area.[43] Washing and peeling fruits and vegetables, as well as eating organic foods or foods produced using integrated pest management (IPM) practices is also recommended.[44]

However, for the agricultural community who farm for a living, and who rely on pesticide use, it is difficult to avoid environmental pesticide exposure. Therefore, it is important for farmers to wear protective clothing; such as, coveralls, apron, broad-rimmed waterproof hat, boots, rubber gloves, goggles or face shields, and respirators.[43] The fabric of these materials is important for adequate protection. Studies have shown that fluorocarbon finished fabric, or a coated nonwoven fabric such as Gore-Tex may provide increased protection against pesticides.[45] Health Canada states that all pesticides used in Canada must have a label which states the specific type of personal protective equipment that should be worn with each pesticide and it is imperative to follow the instructions.[46] It is also important for farmers not to eat, drink or smoke around pesticides, and to wash hands before undertaking these or other activities, which may increase the risk of ingestion or inhalation. When preparing pesticides, farmers should ensure there is adequate ventilation and that all livestock and people leave the area, especially those at higher risk; such as, pregnant mothers, children, elderly and the immunocompromised.[43] Pesticide users should also be aware of restricted entry intervals after pesticides have been applied and pre-harvest intervals, meaning the time between the last application and harvest. Finally, it is also important to store and dispose of pesticides properly to prevent contamination.[43] All private pesticide applicators in Canada are required to undergo specialized training and be certified in the proper use of pesticides.[47] It is important that these safety procedures be followed to protect farmers from the adverse health effects of pesticide use.

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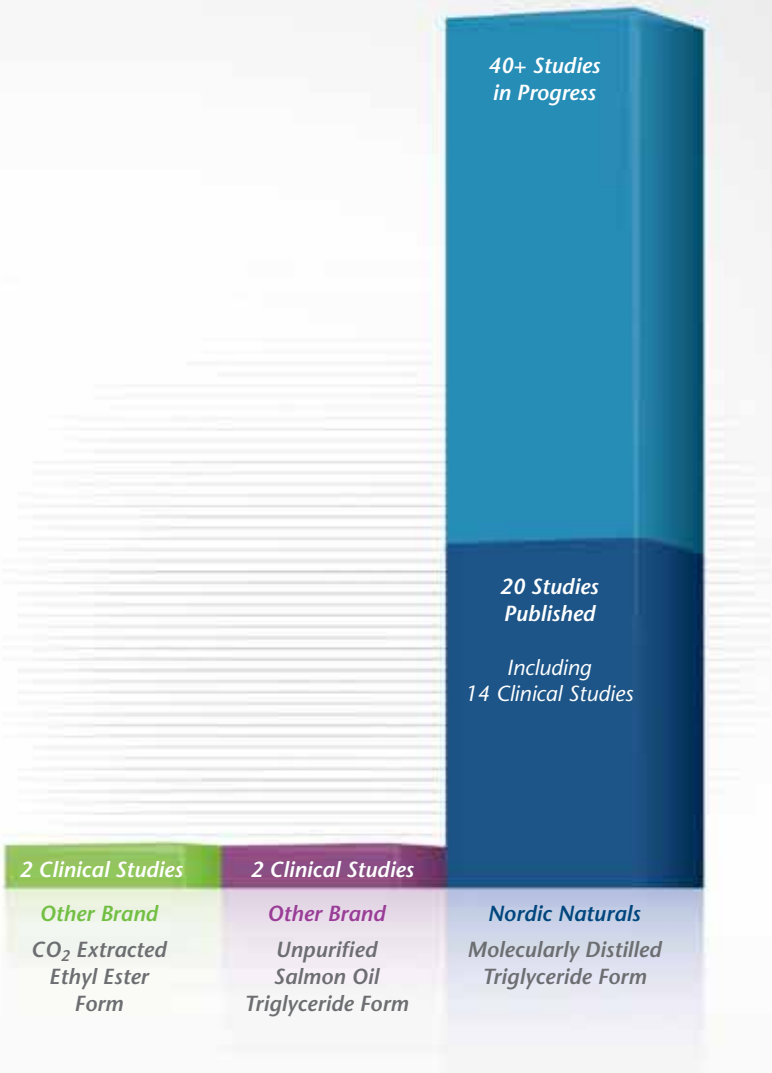

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Supplementation

Secondly, supplementation of certain nutrients is indicated in cases of pesticide exposure or toxicity. This is essential to support the body's detoxification system and it aids to promote pesticide clearance from the body. Currently, there are limited clinical trials available that study the effects of Natural Health Products on humans with pesticide exposure. However, animal studies suggest efficacy of supplement treatment in humans.[48] Nonetheless, there is a need for more research using human subjects to definitely prove the efficacy of supplements in treating farmers with potential pesticide toxicity. Studies with rats have shown that the combined effect of selenium and vitamin E was effective in mitigating the oxidative damage of various pesticides, especially organophosphates, and at decreasing their levels in the body.[48] Similarly, studies on rats have also shown elevated plasma transaminases, lactate dehydrogenase activity and bilirubin levels were found in those exposed to pesticides and the co-administration of selenium and vitamin E improved these biochemical parameters and decreased liver damage associated with pesticide exposure.[49]

Ascorbic acid or vitamin C supplementation, has also shown beneficial effects at promoting the detoxification of oxidative species in the body and may be most effective against organochlorine insecticides.[50] Likewise, when combined with garlic extract, vitamin C supplementation to male rats preconception or pregnant female rats, dampen the reproductive toxicity and teratogenicity caused by certain pyrethroid insecticides.[51]

Glutathione is another powerful defence that helps protect the cell against xenobiotics, intracellular oxidants and is necessary for lymphocyte function.[52] However, under normal physiologic conditions glutathione is produced intra-cellularly and is poorly absorbed into the cell.[53] Therefore, means of raising glutathione other than direct supplementation, are of interest.[52] Supplementation with N-Acetyl cysteine (NAC) has been shown to increase glutathione levels in the body.[45] The research also suggests that the supplementation of vitamins E, C and selenium increase glutathione levels in the body which aids to decrease the toxin burden in the body.[52, 55, 56, 57]

Other studies show that zinc citrate supplementation decreases reactive oxygen species and lipid perioxidation in those exposed to high levels of organophosphate pesticides and increases glutathione levels to promote detoxification.[58] This results in an improvement in neurological and physical functioning in those with organophosphate pesticide toxicity.[58] Similarly, Docosahexaenoic acid (DHA), has been shown to protect against neurological and retinal damage due to organophosphate exposure. This is accomplished by preventing apoptosis in retinal and other neurons.[59]

Liver detoxifying botanicals should also be included as part of a treatment plan for an individual with significant pesticide exposure. Of these, the most widely used and researched is Milk Thistle or Silymarin. A systematic review found that Milk Thistle supplementation clearly demonstrated antifibrotic, antioxidant and metabolic hepatic effects. All of which would benefit those exposed to pesticides.[60]

It is also important to restore common pesticide-induced deficiencies and prevent tissue damage from these compounds. Decreased hepatic stores of vitamin A were found in rats exposed to organochlorine pesticides. These rats also experienced growth retardation, endocrine organ deformities and had elevated levels of liver enzymes indicating toxicity. Restoring vitamin A levels through supplementation resulted in significant protection against toxicity, a decrease in physical abnormalities and an increase in the hepatic xenobiotic metabolizing enzymes, that promote pesticide clearance.[61] Various studies demonstrate a beneficial effect of thiamine supplementation for thiamine deficiency due to organochlorine pesticide exposure. This was evidenced in a decrease in early mortality syndrome in salmontids in the Great Lakes of North America as well as alligator embryo survival in southern United States.[62, 63]

From a dietary perspective, adequate protein and reduced sugar intake improves liver clearance of toxins from the body. Specifically, whey protein increases glutathione and provides a complete protein to the body. Therefore, whey protein can enhance liver function to promote detoxification.[35]

Physical Therapy

Naturopathic physical therapy treatments that may be beneficial for decreasing pesticide levels in the agricultural population include infrared saunas, hydrotherapy, dry skin brushing and castor oil packs.[64] Infrared saunas act to mobilize toxins and increase circulation. This increases the elimination of toxins through perspiration.[64]

Contrast hydrotherapy improves circulation and immune system function to remove toxins.[65] Dry skin brushing encourages waste removal and increases blood and lymph flow to promote detoxification.[65] Finally, castor oil is a powerful anti-inflammatory. When castor oil is absorbed through the skin, it promotes increased circulation, elimination of toxins, and healing of organs. In cases of pesticide toxicity, castor oil packs should be placed over the liver to maximize the detoxification effect.[53]

Conclusion

Farmers are at risk of developing a number of diseases from chronic pesticide exposure. Of the risks reviewed in this paper, it was found that respiratory ailments, neurological ailments, cancers and reproductive consequences exist. The research is largely observational and not without limitations, but the experimental evidence from animals confirms certain findings. Further research is needed to better understand how pesticides affect humans and how great the risk is for certain diseases associated with exposure. This research is needed to develop improved treatment strategies and safety protocols. Regardless, as there is an association between pesticide use and a variety of ailments, it is importat that current precautionary measures are adhered to.

If exposure to pesticides is suspected, a number of lab tests are available that may help to direct treatment. Choosing a lab test will depend on which pesticides a patient has potentially been exposed to, as well as which organs have likely been affected.

Through supplementation and physical therapies, naturopathic doctors can support farmers who may be chronically exposed to pesticides. Research supports the use of selenium, vitamin E, vitamin C, garlic extract, NAC, zinc, DHA, vitamin A, and thiamine. However, it should be noted that the majority of research on supplementation involves animal studies and human research is lacking. More research is needed to better understand how and when to use particular supplements in humans. Nonetheless, healthy diet and lifestyle practices in combination with naturopathic physical therapies are likely to be beneficial.

In conclusion, it is clear that farmers have an increased risk of developing several adverse health effects from using pesticides. As naturopathic doctors, it is our responsibility to be aware of these risks and to utilize effective treatment protocols to improve the health of the farming population and others exposed to high levels of pesticides.

QUICK KEY:

SUPPLEMENTS INDICATED FOR PESTICIDE EXPOSURE

Selenium + Vitamin E mitigates oxidative damage.

Vitamin C promotes detoxification of oxidative species.

Vitamin C + garlic extract may decrease reproductive toxicity.

Glutathione (i.e increasing levels via supplementation of vitamins E, C, selenium and NAC) promotes detoxification of pesticides.

Zinc Citrate may improve neurological and physical function by reducing oxidative damage associated with pesticide exposure.

Docosahexanoic acid (DHA) protects against neurological and retinal damage.

Silymarin is protective via antifibrotic, antioxidant and metabolic hepatic effects.

Vitamin A and Thiamine supplementation if deficient, protects against the toxic effects of pesticides.

Whey protein in general may enhance detoxification by promoting glutathione production.

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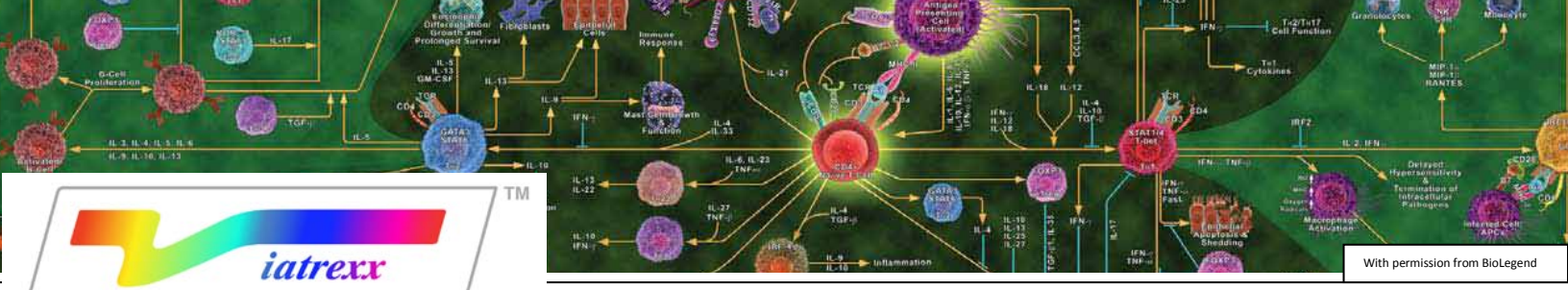

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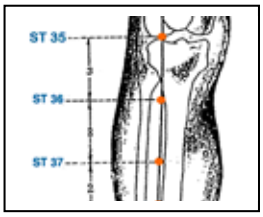
{Thereafter continue appropriate protocol.}		

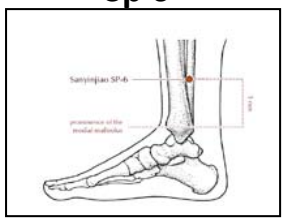
Key immune Ac points:

Consider Immunexx for immune compromised systems.

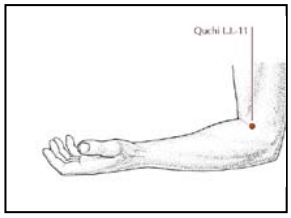
St 36



Sp 6



L.I. 11



Lv 3

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↓ (Allinase, activated by heat or cutting)

Allicin (garlic odour)

↓

Daily trisulfide (DATS)
Diallyl disulfide (DADS)
Methylallyl trisulfide (MATS)

↓

Diallysulfides
Ajoenes
Vinyldithiines

Garlic Active Principles is a unique composition using Garlic Supercritical Extract. It is an original garlic oil-macerate extract, from organic raw garlic, with standardized quantities of vinyldithiins and sulfides.

Each capsule contains:

Garlic (Organic) Supercritical extract	*280 mg*
Providing: Vinyldithiines	*0.0855 mg*
Sulfides	*0.0210 mg*
Ajoenes	*0.006 (traces)*
Natural Vitamin E (D-α-tocopherol) Non GMO	*2 mg*

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