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Review Article

Health Benefit Manifestation of Improved Sleep, Physical Exercise and Selective Diets

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ABSTRACT

The conflicting and vicarious demands of occupations schedules, stressful life situations, unrestricted dietary habits, sedentary life-styles and metabolic compromization present some of the hazards that culminate in individuals' sleep problems whether de facto experience, physiological expressions of health parameters or disorder/drug-related. Interventional therapies aimed at the avoidance of damaging insulin resistance and type II diabetes conditions extend the physical exercise benefits by their influences upon skeletal muscle tissue, with in addition exercise training inducing profound effects on adipose tissue. Regular exercise precludes nocturnal disturbance with associations to reductions in the prevalence of sleep disorders, i.e. most particularly obstructive sleep apnea and thereby improving sleep efficiency and integrity among, and across, most age-groups. In obstructive sleep apnea patients, dysregulated cardiovascular health, that may or may not counteract the elevated oxidative stress, pro-inflammatory development and sympathetic activation may alleviated through selective regimes of physical exercise. The presence of major gender difference in the quality and sufficiency of healthy sleep reinforces the requirement for selective life-styles to combat the encroachment of sleep inadequacy as a health hazard. Proper assessment of somatic and psychological health variables requires major planning and preparation.

Keywords: Sleep disturbance; Intervention; Exercise; Diet; Symptoms; Alleviation

Introduction

It has consistently been established that the disruption of circadian pattern rhythmicity as occasioned by the prolonged exposure to light stimulation, unpredictably altered sleep patterns and sleep integrity, as well as the demands of shift-work and disoriented occupations are associated to the development of obesity and related metabolic disorders, including type II diabetes, metabolic and cardiovascular diseases. Most seriously, impaired chronic sleep disturbance, loss of sleep quality and quantity are associated with future morbidity and mortality among individuals. In this context, white and brown adipose tissue activity present altered circadian rhythmicity, with daily variations in the regulation of metabolic processes such as lipolysis, glucose and lipid uptake, and adipokine secretion whereby the regulatory functioning of the 'circadian clock' controlling energy homeostasis poses implications for this type of 'clock-related' strategy for mitigating the metabolic disturbances associated with type II diabetes, involving the 'resynchronisation' of metabolism through dietary alteration or the targeting of a particular time of a day to expedite the eventual effects of a pharmacological or physiological interventions.

Literature Review

Visceral expressions of 'over-weightedness' and obesity are associated closely with obstructive sleep apnea and its putative cardio-metabolic alterations with many patients suffering from this condition presenting co-morbidity with anxiety and depression; thus life-style alterations, such as exercise-activity and restrictive diets, may constitute invigorating, even 'life-saving', adaptations. Short sleep duration is associated reliably with increased cardiovascular disease risk. Physical exercise combined with dietary stringency and regulation, and in many cases restriction, promotes various aspects of cardiovascular and metabolic health through the induction of a direct impact upon the vascular endothelium as well as other physiological factors mediating cellular homeostasis and functioning. For example, exercise may be a non-pharmacological, inexpensive, safe method to improve sleep quality in people presenting multiple sclerosis [1] with profound therapeutic effects over a variety of disorder condition and health-promoting proclivities [2-8]. Additionally, over a wide sphere of chronically-debilitating communicable and non-communicable disease states are ameliorated by physical exercise schedules, relatively independent of type, duration and intensity, especially if maintained on a chronic-regular basis [4]. Nevertheless, the problems emerging from inability to restore the brain and bodily resources constitute particular threats to health and well-being, sleep disturbances and poor sleep quality, in conjunction with detrimental psychosomatic sleep propensities, are associated with endothelial dysfunction, whereby the expressions of elevated chronic cardiovascular disease and incidences of metabolic disorders, e.g. Type I and Type II diabetes observed amongst individuals presenting as poor sleepers are increasingly evident [9,10].

The tactical necessity of non-invasive interventional means to prevent damaging insulin resistance and type II diabetes extends the exercise beneficial influences upon skeletal muscle tissue, with in addition exercise training inducing profound effects on adipose tissue. These adipose tissue-entities mediates partially those beneficial promotions of exercise upon glucose and energy homeostasis modulated by the related metabolic and endocrine functions. The interactions between 'zeitgeber time', which differs from circadian time by which the latter endogenous

rhythm of an organism which is an un-entrained accompaniment to a 'Zeitgeber' persisting even when the organism is removed from exposure to 24-hour cycles of light and dark and diet or exercise and is likely to influence the metabolic response of adipose tissue, and therefore impact the whole-body phenotype [11]. Despite the health implications of deficient sleep, the influence and consequences of sedentary life styles/physical exercise linked to poor sleep quality upon cardiovascular health demand greater elaboration, and not least consistent analysis [12]. In a systematic review of thirteen studies examining the relationship between exercise and sleep parameters it was shown that chronic resistance exercise improved all aspects of sleep, including the greatest benefit for sleep quality [13]. These perceived benefits of isolated resistance exercise were attenuated when resistance exercise was combined with aerobic exercise and/or compared to aerobic exercise alone. Nevertheless, the acute effects of resistance exercise on sleep may be construed to be only superficially examined and therewith inconsistent. Consistent with the observed the sleep benefits, resistance exercise training, which involves weights and heavy objects, improved generally symptoms of anxiety and depression. Taken together, these findings imply that applications of resistance exercise may offer useful and necessary interventions to improve sleep quality and health manifestation. Notably, even among individuals regularly exercising problems occur, in a study of elite athletes, those individuals presenting clinically-significant sleep problems and disturbances were found to be more likely to report a worsened sleep hygiene, more general health complaints, and mood disturbance than those enjoying healthy sleep [14].

Physical exercise and individual-dependent adaptive behaviors to nocturnal disturbance have been related to reductions in the prevalence of sleep disorders most particularly obstructive sleep apnea and thereby improving sleep efficiency and integrity among most age-groups [15]. For example, obstructive sleep apnea has been associated with elevated cardiovascular disease morbidity and mortality. It has been found that obstructive sleep apnea and obesity coexist commonly with the habit of sedentary behavioral conditions. The American Academy of Sleep Medicine has recommended dietary-restriction to induce weight loss and regular exercise to address lifestyle treatment management for obstructive sleep apnoea. Nevertheless, the majority of clinical trials upon adhering to this particular recommendation are based upon the necessity of establishing the efficacy of tailor-made calorie-restricted, invariably low-fat diets, despite ever-expressed qualms, for improving, or not, obstructive sleep apnea severity. Remarkably, it seems to be the case that less attention has been invested in the means through which loss of weight may be achieved, i.e. dietary restriction combined with altered dietary quality, or whether diet or exercise mediates the associations between reduced weight, improved obstructive sleep apnoea severity and the cardiovascular disease substrate. Prevailing evidence implies that the vicarious benefits of a low-carbohydrate or Mediterranean diet in overweight and obese individuals extend beyond the recognised manifestations of weight reduction. The confluence of physical exercise, nutrition, and sleep influences that mobilise both neurobiological and psychosocial systems, in a multifactorial manner, provides for medical and mental health circumstances through lifestyle domains with patients and their parents; and appropriate interventions to create optimal well-being among youths and young adults. Furthermore, associations between cardiac autonomic neuropathy point to the necessity of lifestyle interventions involving physical exercise and dietary vigilance to reverse metabolic syndrome and neuropathy through body weight loss, and sympathetic and parasympathetic heart rate variation [16].

Other analyses of exercise regimes provide for an independent perseverative effect upon cardiovascular health, that may or may not counteract the elevated oxidative stress, pro-inflammatory development and sympathetic activation that occur in obstructive sleep apnoea patients [17]. In a study of thirty-three patients were enrolled and assigned in a randomized fashion which involved certain exclusions whereby finally twenty-seven patients were included in the investigation, the obstructive sleep apnea patients were analyzed with a median age of 67 years (range 52-74 years) and median apnea-hypopnea index of 32 events/h (25–41). It was observed that the apnea-hypopnea index did not differ between groups over pre- and post-intervention measures. Despite this outcome, among intervention patients younger than 60 years (n=6) a reduction of the apnea-hypopnea index from 29.5 score (21.8-48.3) to 15.5 score (11-34) events/h were observed to have occurred. Interestingly and enigmatically, although the comprehensive multimodal program failed to alter the apnea-hypopnea index, it appears to have reduced the body weight and raised the walking distance rendered by patients presenting moderate-to-severe expressions of obstructive sleep apnea [18]. Taking into account the debilitating properties of the disorder, the observed influences of dietary stringency and exercise-investment upon obstructive sleep apnoea and associated cardiovascular and cardiorespiratory complications, are required to be both considered and appreciated in order to gage the dangers for longevity as well as the health burden among obstructive sleep apnoea patients.

Exposure to gestational diabetes mellitis in utero presents a further health hazard related to prenatal environment. In a study comparing gestational diabetes mellitis-plus and gestational diabetes mellitis-minus children aged 2 to 14 years-of-age an assessment was performed concerning whether or not a healthy lifestyle profile could be associated with lower adiposity values and health measures among these types of children [19]. Using accelerometers, physical activity and sedentary durations were measured whereas the intake of vegetables and fruit were collected by application of two 24-h dietary recalls. The gestational diabetes mellitis-plus children expressed also lower moderate-to-vigorous physical activity/exercise practices and fruit-vegetable intake practices than gestational diabetes mellitis-minus children. Additionall, among the children presenting an unhealthy lifestyle, adhering to the 0-2 lifestyle recommendations, gestational diabetes mellitis-plus children presented a greater percentage unit of fat mass together with android fat mass than the gestational diabetes mellitis-minus children. Furthermore, among the former children, those expressing healthy lifestyles, adhering to the 3-4 lifestyle recommendations, were found to present lower percentages of fat mass and android fat mass than those presenting an unhealthy lifestyle. It appears that early in life the improved life-style habit

may curtail the decrements accruing to uncontrolled adiposity. Within this context, adverse childhood experiences may induce significant 'impact-variability' for sleep duration-quality in combination with genetic factors to impact upon the variability of posttraumatic stress disorders symptoms (PTSD) among trauma-exposed individuals [20]. Among 1,865 monozygotic and 758 dizygotic twin pairs enrolled in the community-based Washington State Twin Registry (USA), high levels of PTSD severity of symptoms were associated with variations of short and long sleep duration parameters whereby increasing severity of PTSD symptoms increased the perceived variability of sleep duration to a great extent due to shared environmental factors whereas the reductions of sleep duration were linked with variability in PTSD symptoms as reflected by additive effects of genetic factors.

While there is a paucity of information pertaining to the nutritional impact on infant sleep and sleep maturation under development, particularly with regard to specific nutrients, certain nutrients, such as tryptophan and nucleotides exert an influence upon parameters of sleep at the level of brain activity, some fatty acids may affect sleep as a result of their role in supporting the maturity of the brain and central nervous system [21]. Furthermore, there appears to exist a a critical and positive relationship between infant quantity and quality within neuro-cognition and physical growth [22]. The repeated periodisation of carbohydrate intake through the application of a diet-exercise strategy called the sleep-low model can potentially induce mitochondrial biogenesis and improve endurance performance in endurance-trained individuals. Thus, during acute bouts of exercise, the average fat oxidation rate was shown to be approximately 36% times higher among sleep-low individuals compared with the sleep-high, which did not translate into sustained effects upon the maximal fat oxidation rate [23]. Time-trial performance increased equally in both these groups. The authors observed no effect on intramuscular proteins involved in lipolysis or fatty acid transport and capacity thereby concluding that the sleep-low model did not induce sustained effects on maximal fat oxidation rate, endurance performance or proteins involved in intramuscular lipid metabolism when compared to the sleep-high individuals. Certainly, diet quality and certain food consumption are related to sleep quality and consequence. In a cross-sectional study performed among urban adults derived from eight Chinese cities, with a total of 1,548 participants, sleep quality was assessed using the Chinese version of the Pittsburg Sleep Questionnaire Index. Further, diet quality was evaluated by Chinese Healthy Diet Index, and dietary intake, including food groups and nutrients, were derived from a semi-quantitative Food Intake Frequencies Questionnaire and a single 24-hr dietary recall [24]. Logistic regression analysis indicated that better diet quality, featuring greater food diversity, higher ingestion of fruits and fish, along with higher seafood consumption, lower egg consumption, and higher total energy intake, was associated significantly with lower risk of poor sleep quality. In the context of fat metabolism, maximal fat oxidation intensity reduced significantly body mass, BMI, fat mass, visceral trunk fat, and diastolic blood pressure parameters in a group receiving individualised FATmax intensity (i.e. aerobic training), over three days/week during one hour/day for a total of 12 weeks accompanied by marked elevations of high-density lipoprotein-cholesterol, predicted VO2max, left ventricular ejection fraction, and sit-and-reach performance [25].

The current prevalence of metabolic syndrome components among young adults has been found to be 17.4% of a cross-sectional study involving 694 Chinese young adults from a national survey was performed through which demographic characteristics, unhealthy lifestyle behaviors, anthropometric measurements, and blood chemistry were analysed and metabolic syndrome components were greater among males than among females (19.0% vs. 7.8%). The unhealthy lifestyle-behavior risk factors associated with metabolic syndrome components included smoking behaviour and a marked lack of physical activity among males compared to female participants, as well as greater betel-quid chewing and lesser sleep among females. The authors concluded that, in the future, health-care providers and administrators ought focus upon the reduction of metabolic syndrome components at risk by encouraging young adult males to reduce or terminate their cigarette smoking while maintaining optimum-required levels of physical exercise, on the one hand, and their efforts by which young adult females are encouraged to terminate chewing betel quid, obtain appropriate amounts of sleep and maintain/increase present levels of exercise [26]. In another study of 3659 Iranian participants (male participants = 1540), aged over 20 years-of-age and free of hypertension at baseline, it was observed that (i) there were significant between-gender differences in the relationship between obesity phenotypes and incident hypertension, (ii) generally the metabolic status, as defined by the component of metabolic syndrome components as compared to IR may be more acceptable in identifying high risk women for hypertension, and (iii) those women populations who were shown to be healthily obese metabolically using the components of metabolic syndrome definition or those individuals with either more than one component of the metabolic syndrome or the overweight/obese individuals presenting presence of insulin resistance ought to be prioritized for implementing of immediate preventive strategies against hypertension focusing on lifestyle changes, including physical exercise and dietary restriction [27].

In a small cohort of ten recently-diagnosed, male patients presenting severe obstructive sleep apnea, patients presenting diabetes/prediabetes and cardiovascular and psychiatric diseases and who are current smokers were excluded, that was evaluated using full polysomnography and a control group of four male non-apneic subjects, that were matched for age and body mass indices were assessed by abdomen adipose tissue biopsies [28]. Several measures, including psychometry, were taken: including the Epworth Sleepiness Scale, Fatigue Severity Scale, and Hospital Anxiety and Depression Scales (i.e. HADS-A and HADS-D) as well as fasting venous blood samples, collected on the day after polysomnography, between 8:00 and 9:00 a.m., after an overnight fast., fat biopsies, performed at the same time periods and adipose tissue samples of 300 mg, obtained from abdominal fat. Furthermore, fat cell size, extent of fibrosis, vascularity, leukocyte common antigen inflammatory infiltration, and tissue macrophage accumulation were all microscopically evaluated microscopically. Presenting a mean age level of 47.4 ± 13.8 years, with mean BMI of 35.8 ± 4.8 kg/m^2 and mean apnea-hypopnea index of 79.4 ± 46.1 events per

hour of sleep (severe obstructive sleep anea), markedly raised HADS-A and HADS-D scores were obtained, i.e. 5.8 ± 2.3 (3.0-8.0) and 4.7 ± 2.3 (2.0-8.0), respectively with the HADS-A score correlating positively with macrophage accumulation in the fat biopsies (r=0.82, p=0.047). The severity of fibrosis correlated negatively to a large extent with waist circumference, i.e. r=-0.66, p=0.038, and neck circumference (r=-0.790, p=0.006), and respiratory events also correlated negatively with the extent of vascularization of the adipose tissue, i.e. r=-0.614, p=0.05. This pattern of evidence prompted the conclusion that symptoms of anxiety and implied vulnerability to the metabolic manifestations of the disorder, to a lesser extent depression, contribute largely to the macrophage accumulation, an inflammatory clue in itself, whereas the increased number of respiratory events reduced the extent of vascularization in visceral fat in obstructive sleep apnea.

Women coping with the challenges of gestational demands must maintain the necessary health and well-being conditions in order fulfil the optimal term and most optimal health advantages of their newborn infants. Pregnancy has been shown to present an episodic, conditional risk period for the female gender in view of its associations with poorer health behaviours, arising from psychophysiological predilections and personal profiles that include the inadequacy nonselective diets, decreased or nonexistent physical exercise and activity and reduced sleep propensity. Consequently, the prognosis for and conditions existing for pregnant women and their unborn foetuses are threatened due to the greater risk surrounding adverse health outcomes. A systematic online search was conducted to identify Australian Government, and leading industry websites that provided information on nutrition, physical activity, or sleep during pregnancy [17]. Accordingly, the contents of each considered website was reviewed and the comparison with existing guidelines of current nutritional notions, physical exercise schemas and sleep requirements was derived. Twenty-seven governmental and primary industry websites were included in this study. Eighteen web sites were included to extract nutritional information, none of which were showing 100-percent adherence to the selected guidelines. Nine websites included physical activity information, only one of which was 100% in accordance with guidelines. Two websites included information on sleep during pregnancy, however neither were in accordance with guidelines. Women are accessing information via the internet that is not in accordance with current evidence-based guidelines. These results call to attention the need for government and leading industry websites to review and update their website information in accordance with current evidence-based guidelines. Additional to the hazards of gestation for the emerging foetus, The presence of childhood sleep disturbances that involve difficulties in initiating or maintaining trouble-free sleep, which encompasses 15-35% of children under the age of three years, several disorders or co-morbidities may affect the stability of families arising from problems controlling in emotional pressures until the insurgence psycho-pathology which if left to become malignant may persist over weeks, months and years. In a review of these existing dangers, several types of interventions have been described to present conditions under which lifestyle conditions maybe altered to ensure neuro-developmental and physiologic maturational health [29]. In a cross-sectional cum longitudinal association study between self-reported nocturnal sleep duration, blood pressure, and hypertension among European children, aged 2-9.9 years, a prospective analysis demonstrated that the presence of shorter sleep duration at baseline-level predicted, covering the 2-year follow-up period, greater increases in systolic blood pressure and diastolic blood pressure were observed, following the adjustment for age-level, gender, country of origin, body mass index z-score, parental education, physical exercise, screening time, and T0 critical value for the examined outcome variables [30].

In a projected study of 45 patients presenting high-grade glioma, after receiving neurosurgery and adjuvant radiotherapy, chemotherapy, or chemoradiotherapy, each was assigned randomly to (i) an endurance training, (ii) a resistance training or (iii) to an active control condition [31], over six consecutive weeks, that consisted of two-weekly sessions, comprising 30-45 min per session, and with measurements taken at three time-points, pertaining to the beginning of the study, which was baseline measure, at three weeks after the beginning of the baseline, and six weeks following the beginning of the baseline measure. Gliomas are typically malignant primary brain tumors and generally incurable demanding conditions whereby palliation and the maintenance or improvements of the patient's quality-of-life, assessed by using self-reported, validated questionnaires, represent areas of major importance. In clinical trials and daily clinical practice, health-related quality-of-life may be used to assess the benefits of a new treatment strategy, which should be weighed carefully against the adverse effects of that treatment. Patients presenting low-grade glioma will typically live longer, a median of six to fifteen years, than those presenting high-grade gliomas, those showing glioblastoma, most frequent and malignant, will survive upto only fifteen months. Aerobic exercise performance was registered objectively using a six-min walking test, and the handgrip test assessed the upper body strength. In addition, all the patients completed a battery of questionnaires that assessed various aspects of sociodemographic information of each, including Quality-of-life, sleep quality and sleep patterns, coping with stress, state- and trait-anxiety, depression, fatigue and symptoms of depression using the Hamilton Depression Scale rating. Forthcoming evidence ought to elucidate not only possible changes accumulating from exercise schedules but also whether or changes may be due to the active control condition.

Conclusions

The present account describing the multi-implications of interactions between sleep sufficiency, restrictive-selective diets and regular physical exercise for optimal health benefits aims at a wide variety of individuals afflicted by sleeplessness, overweight-obesity, diabetes type I or II, metabolic and cardiovascular disorders, the necessity of enhanced maximal fat oxidation, and affective syndromes among infants, adolescent, young adults and female participants through lifestyle alteration, adaptation and management compliance. The shadow of multi-morbidity and life-threatening conditions present the most common chronic health condition among children and adults and is associated with poor health outcomes, hopelessness and helplessness, and lack of 'resilience'-for-living, i.e. survival.

Optimal care for individuals with multi-morbidity, which involves the combination of sleep-diet-exercise, demands a person-centred approach that takes into account personal goals and preferences, improves quality-of-life and coordinates healthcare across the relevant services.

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