

Library Watch on caffeine

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Winter 2008

Caffeine use by children: The quest for enhancement.

Bramstedt KA. *Substance Use & Misuse* 42(8): 1237-1251, 2007. (57 refs.)

Fair play, both in academics and sports, is a concept that is challenged by the notion of performance enhancement. Both cognitive and physical performance can be viewed as potentially enhanceable, and arguments can be made that enhancement can serve two purposes: gaining an edge or keeping up with others (who may or may not have used performance-enhancing substances). Caffeine, a central nervous system and cardiac stimulant, is frequently used by children for both academic and athletic performance enhancement. In fact, the marketplace contains a plethora of caffeinated products marketed directly to children. This article examines safety and ethical issues associated with the use of caffeine by children and explores the question: Can cognitive performance enhancement be ethically permissible if sports performance enhancement is not? Copyright 2007, Marcel Dekker, Inc.

Well-trained endurance athletes' knowledge, insight, and experience of caffeine use.

Desbrow B; Leveritt M. *International Journal of Sport Nutrition and Exercise Metabolism* 17(4): 328-339, 2007. (17 refs.)

This descriptive cross-sectional study assessed the perceptions, knowledge, and experiences of caffeine use by athletes competing at the 2005 Ironman Triathlon World Championships. Questionnaires were distributed to 140 athletes (105 men and 35 women, 40.3 +/- 10.7 y old) representing 16 countries during prerace registration. A large proportion (73%) of these endurance athletes believe that caffeine is ergogenic to their endurance performance, and 84% believe it improves their concentration. The most commonly reported positive caffeine experiences related to in-competition use of cola drinks (65%) and caffeinated gels (24%). The athletes' ability to accurately quantify the caffeine content of common food items was limited. The most popular sources of caffeine information were self-experimentation (16%), fellow athletes (15%), magazines (13%), and journal articles (12%). Over half the athletes (53%) could not identify

an amount of caffeine required to improve their triathlon performance. Mean (+/- standard deviation) suggested doses were 3.8 (+/- 3) mg/kg body weight. Few side effects associated with taking caffeine during exercise were reported. Copyright 2007, Human Kinetics Publishing.

Chlorogenic acid and caffeine contents in various commercial brewed coffees.

Fujioka K; Shibamoto T. *Food Chemistry* 106(1): 217-221, 2008. (15 refs.)

Twelve commercial brewed coffees (seven regular and five decaffeinated) were analyzed for chlorogenic acids (CGA) and caffeine by HPLC. Their pH and UV-Vis absorbances were also measured. The CGAs identified were three caffeoylquinic acids (3-CQA, 4-CQA, and 5-CQA), three feruloylquinic acids (3-FQA, 4-FQA, and 5-FQA), and three dicaffeoylquinic acids (3,4-diCQA, 3,5-diCQA, and 4,5-diCQA). The total CGAs ranged from 5.26 mg/g to 17.1 mg/g in regular coffees and from 2.10 mg/g to 16.1 mg/g in decaffeinated coffees. Among CGA, 5-CQA was present at the highest level, ranging from 2.13 mg/g to 7.06 mg/g coffee, and comprising 36-42% and 37-39% of the total CGA in the regular and decaffeinated coffees, respectively. CGA isomer contents were, in decreasing order, 5-CQA > 4-CQA > 3-CQA > 5-FQA > 4-FQA > 3-FQA > 3,4-diCQA > 4,5-diCQA, 3,5-diCQA. The caffeine content in regular and decaffeinated coffees ranged from 10.9 mg/g to 16.5 mg/g and from 0.34 mg/g to 0.47 mg/g, respectively. The pH of regular and decaffeinated coffees ranged from 4.95 to 5.99 and from 5.14 to 5.80, respectively. The relationship between the pH and the UV-Vis absorbance at 325 nm was moderately correlated ($R^2 = 0.7829$, $p < 0.001$, $n = 12$). Copyright 2008, Elsevier Science.

Personality traits associated with caffeine intake and smoking. (review).

Gurpegui M; Jurado D; Luna JD; Fernandez-Molina C; Moreno-Abril O; Galvez R. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* 31(5): 997-1005, 2007. (64 refs.)

Objectives: Some studies find a relationship between certain personality traits, as impulsivity or sensation seeking, and caffeine consumption, but these studies

do not consider the potential confounding effect of smoking on caffeine intake, a co-occurrence that has been well demonstrated in epidemiological and clinical studies. The main objective of this cross-sectional study was to analyze the association of personality with caffeine intake controlling for the effects of smoking; a secondary objective was to explore the effect of caffeine intake on the previously known relationship between personality and smoking. **Methods:** A sample of 498 adults answered a self-questionnaire including socio-demographic variables, and items regarding consumption of tobacco and caffeine. Personality was measured by the Temperament and Character Inventory (TCI-125). We analyzed the association of personality traits with both caffeine intake and smoking, controlling the possible confounding effects of sex, age and each substance with the other one. **Results:** Logistic regression analyses showed that the temperamental dimension of novelty seeking was associated with heavy caffeine consumption (> 200 mg/day) (adjusted OR=2.0; 95% CI: 1.1-3.9), controlling for the effect of smoking. Moreover, novelty seeking was associated with both smoking (adjusted OR=1.8; 95% CI: 1.1-2.9) and heavy smoking (> 20 cigarettes/day) (adjusted OR=1.8; 95% CI: 1.0-3.7), after controlling for the effect of caffeine intake. **Conclusion:** Our study offers an epidemiological evidence of the relationship of novelty seeking, considered to be associated with low basal dopaminergic activity, with both nicotine consumption and heavy caffeine intake, two substances that enhance dopaminergic neurotransmission. Copyright 2007, Elsevier Science.

Effects of repeated doses of caffeine on performance and alertness: New data and secondary analyses.

Hewlett P; Smith A. *Human Psychopharmacology: Clinical and Experimental* 22(6): 339-350, 2007. (23 refs.)

Rationale The effects of caffeine on mood and performance are well established. Some authors suggest that caffeine merely reverses effects of caffeine withdrawal rather than having direct behavioural effects. It has also been suggested that withdrawal may be removed by a first dose of caffeine and further doses have little subsequent effect. These issues are examined here. **Objectives** The present study aimed to determine whether caffeine withdrawal influenced mood and performance by comparing regular consumers who had been withdrawn from caffeine overnight with non-consumers. Following this repeated caffeine doses were administered to test the claim that repeated dosing has no extra effect on mood

or performance. Secondary analyses of data collected after a day of normal caffeine consumption were also carried out to examine some alternative explanations of their results which showed effects of caffeine after a day of normal caffeine consumption. **Methods** One hundred and twenty volunteers participated in the study. Regular caffeine consumption was assessed by questionnaire and this showed that 36 of the volunteers did not regularly consume caffeinated beverages. Volunteers were instructed to abstain from caffeine overnight and then completed a baseline session measuring mood and a range of cognitive functions at 08.00 the next day. Following this volunteers were given 0, or 1 mg/kg caffeine in a milkshake, glucose solution or water (at 09:00), followed by a second 0 or 1 mg/kg caffeine dose (at 09:40) and the test battery repeated at 10:00. **Results** The baseline data showed no effect of overnight caffeine withdrawal on mood or performance. In contrast, caffeine challenge improved vigilance performance and prevented decreases in alertness induced by completion of the task battery. The magnitude of these effects increased as a function of the number of doses of caffeine given. Secondary analyses of data from Christopher et al. (2003) also confirmed that effects of caffeine did not depend on length of withdrawal. **Conclusions** The present findings show no effect of overnight caffeine withdrawal on mood and performance. Caffeine challenge did have the predicted effect on alertness and vigilance, with the size of the effects increasing with caffeine dose. These findings suggest that the effects of caffeine are not due to reversal of effects of withdrawal, a view confirmed by secondary analyses of data collected after a day of normal caffeine consumption. Copyright 2007, John Wiley & Sons.

Relationship between tea drinking and bone mineral density in Iranian population.

Hosseini-Nezhad A; Maghbooli Z; Shafaei AR; Javadi E; Larijani B. *Iranian Journal of Public Health Supplement S*: 57-62, 2007. (17 refs.)

Background: Tea is the most commonly consumed beverage by Iranian adults after water, and while previous studies have examined the negative effects of coffee-based caffeine on Bone Mineral Density (BMD), the relationship between the consumption of tea and BMD has not been clearly explored. The aim of this study was to investigate the relationship between habitual tea drinking and BMD in the adult Iranian population. **Methods:** BMD was measured at the lumbar spine and hip, in 830 men and women living in Tehran, all aged between 20 and 76 yr old. The degree of tea consumption was assessed by questionnaire, and subjects were categorized as either

tea drinkers (more than 5 cups of tea per day) or non-tea drinkers (equal or less than 5 cups of tea per day). Results: After adjusting for age and body mass index, it was found that female tea drinkers had a small (4.2%), but significantly higher BMD in the hip ($P=0.01$). Conclusions: This may suggest a potentially positive effect for habitual tea drinking on the BMD of those women with an inadequate consumption of calcium and vitamin D. Copyright 2007, Tehran University of Medical Sciences.

Caffeine's influence on nicotine's effects in nonsmokers.

Blank MD; Kleykamp BA; Jennings JM; Eissenberg T. *American Journal of Health Behavior* 31(5): 473-483, 2007. (50 refs.)

Objective: To determine if nicotine's effects are influenced by caffeine in nonsmoking, moderate-caffeine consuming individuals ($N=20$). Methods: The first 3 sessions included one of 3 randomly ordered, double-blind caffeine doses (0, 75, or 150 mg, oral [po]) and 2 single-blind nicotine gum doses (2 and 4 mg) in ascending order. The fourth session (single blind) repeated the 0 mg caffeine condition. Results: Nicotine increased heart rate and subjective ratings indicative of aversive effects, and decreased reaction times. These effects were independent of caffeine dose and reliable across sessions. Conclusions: In nonsmokers, nicotine effects are not influenced by moderate caffeine doses. Copyright 2007, PNG Publications.

The neuroprotective effects of caffeine : A prospective population study (the Three City Study).

Ritchie K; Carriere I; de Mendonca A; Portet F; Dartigues JF; Rouaud O. *Neurology* 69(6): 536-545, 2007. (29 refs.)

Objective: To examine the association between caffeine intake, cognitive decline, and incident dementia in a community-based sample of subjects aged 65 years and over. Methods: Participants were 4,197 women and 2,820 men from a population-based cohort recruited from three French cities. Cognitive performance, clinical diagnosis of dementia, and caffeine consumption were evaluated at baseline and at 2 and 4 year follow-up. Results: Caffeine consumption is associated with a wide range of sociodemographic, lifestyle, and clinical variables which may also affect cognitive decline. Multivariate mixed models and multivariate adjusted logistic regression indicated that women with high rates of caffeine consumption (over three cups per day) showed less decline in verbal retrieval ($OR = 0.67$, $CI = 0.53, 0.85$), and to a lesser extent in visuospatial

memory ($OR = 0.82$, $CI = 0.65, 1.03$) over 4 years than women consuming one cup or less. The protective effect of caffeine was observed to increase with age ($OR = 0.73$, $CI = 0.53, 1.02$ in the age range 65 to 74; $OR = 0.3$, $CI = 0.14, 0.63$ in the range 80+). No relation was found between caffeine intake and cognitive decline in men. Caffeine consumption did not reduce dementia risk over 4 years. Conclusions: The psychostimulant properties of caffeine appear to reduce cognitive decline in women without dementia, especially at higher ages. Although no impact is observed on dementia incidence, further studies are required to ascertain whether caffeine may nonetheless be of potential use in prolonging the period of mild cognitive impairment in women prior to a diagnosis of dementia. Copyright 2007, Lippincott, Williams & Wilkins.

Caffeine effects on risky decision making after 75 hours of sleep deprivation.

Killgore WDS; Lipizzi EL; Kamimori GH; Balkin TJ. *Aviation, Space, and Environmental Medicine* 78(10): 957-962, 2007. (41 refs.)

Introduction: Recent research indicates that sleep deprivation impairs decision making. However, it is unknown to what extent such deficits are exacerbated in a dose-response manner by increasing levels of sleepiness, and the extent to which such sleep-loss-induced deficits can be reversed by caffeine. Methods: At three time points, 26 healthy subjects completed alternate forms of the Iowa Gambling Task (IGT): rested baseline, 51 h awake, and 75 h awake. Every 2 h each night, 12 volunteers also received 4 200-mg doses of caffeine, with the last dose occurring 3 h prior to the IGT. Results: At baseline, volunteers readily learned to avoid disadvantageous high-risk card decks while progressively choosing more frequently from advantageous low-risk card decks. When sleep deprived, however, these same subjects showed impaired performance, choosing more frequently from the disadvantageous high-risk card decks, particularly during the latter half of the game. Contrary to expectations, the severity of performance impairment did not increase significantly from 51 to 75 h of wakefulness, and caffeine had no significant effects on IGT performance during sleep deprivation. Discussion and Conclusions: As a provisional extension of our previous study, these preliminary findings further suggest that the ability to integrate emotion with cognition to guide decision making, a capacity believed to be mediated by the ventromedial prefrontal cortex, may be particularly vulnerable to sleep loss. Moreover, these capacities may not be significantly improved by moderate doses of caffeine, suggesting that they may function separately from simple arousal

and alertness systems. Copyright 2007, Aerospace Medical Association.

Maternal caffeine consumption and risk of cardiovascular malformations.

Browne ML; Bell EM; Druschel CM; Gensburg LJ; Mitchell AA; Lin AE et al. *Birth Defects Research. Part A: Clinical and Molecular Teratology* 79(7): 533-543, 2007. (36 refs.)

Background: The physiologic effects and common use of caffeine during pregnancy call for examination of maternal caffeine consumption and risk of birth defects. Epidemiologic studies have yielded mixed results, but such studies have grouped etiologically different defects and have not evaluated effect modification. Methods: The large sample size and precise case classification of the National Birth Defects Prevention Study allowed us to examine caffeine consumption and specific cardiovascular malformation (CVM) case groups. We studied consumption of caffeinated coffee, tea, soda, and chocolate to estimate total caffeine intake and separately examined exposure to each caffeinated beverage. Smoking, alcohol, vasoactive medications, folic acid supplement use, and infant gender were evaluated for effect modification. Maternal interview reports for 4,196 CVM case infants overall and 3,957 control infants were analyzed. Results: We did not identify any significant positive associations between maternal caffeine consumption and CVMs. For tetralogy of Fallot, nonsignificant elevations in risk were observed for moderate (but not high) caffeine intake overall and among nonsmokers (ORs of 1.3 to 1.5). Risk estimates for both smoking and consuming caffeine were less than the sum of the excess risks for each exposure. We observed an inverse trend between coffee intake and risk of atrial septal defect; however, this single significant pattern of association might have been a chance finding. Conclusions: Our study found no evidence for an appreciable teratogenic effect of caffeine with regard to CVMs. Copyright 2007, Wiley-Liss.

Effect of caffeine on simulator flight performance in sleep-deprived military pilot student.

Lohi JJ; Huttunen KH; Lahtinen TVM; Kilpelainen AA; Muhli AA; Leino TK. *Military Medicine* 172(9): 982-987, 2007. (24 refs.)

Caffeine has been suggested to act as a countermeasure against fatigue in military operations. In this randomized, double-blind, placebo-controlled study, the effect of caffeine on simulator flight performance was examined in 13 military pilots during 37 hours of sleep deprivation. Each subject performed

a flight mission in simulator four times. The subjects received either a placebo (six subjects) or 200 mg of caffeine (seven subjects) 1 hour before the simulated flights. A moderate 200 mg intake of caffeine was associated with higher axillary temperatures, but it did not affect subjectively assessed sleepiness. Flight performance was similar in both groups during the four rounds flown under sleep deprivation. However, subjective evaluation of overall flight performance in the caffeine group tended to be too optimistic, indicating a potential flight safety problem. Based on our results, we do not recommend using caffeine pills in military flight operations. Copyright 2007, Association of Military Surgeons.

Coffee consumption and the incidence of anti-hypertensive drug treatment in Finnish men and women.

Hu G; Jousilahti P; Nissinen A; Bidel S; Antikainen R; Tuomilehto J. *American Journal of Clinical Nutrition* 86(2): 457-464, 2007. (40 refs.)

Background: Only 2 prospective studies have previously investigated the association between coffee consumption and incident hypertension, and the findings are equivocal. Objective: The objective was to determine the relation between coffee consumption and the incidence of antihypertensive drug treatment. Design: We prospectively followed 24 710 Finnish subjects aged 25-64 y without a history of antihypertensive drug treatment, coronary heart disease, or stroke at baseline. Daily coffee consumption was assessed by questionnaires. Results: During a mean follow-up period of 13.2 y, 2505 participants started antihypertensive drug treatment. The multivariate-adjusted (age, sex, study year, education, leisure-time physical activity, smoking, body mass index, high total cholesterol, history of diabetes, and alcohol, tea, fruit, vegetable, sausage, and bread consumption) hazard ratios for antihypertensive drug treatment associated with the amount of coffee consumed daily (0-1, 2-3, 4-5, 6-7, or \geq 8 cups) were 1.00, 1.29 (95% CI: 1.09, 1.54), 1.26 (95% CI: 1.06, 1.49), 1.24 (95% CI: 1.04, 1.48), and 1.14 (95% CI: 0.94, 1.37) (P for trend = 0.024), respectively. This trend became marginally significant after additional adjustment for baseline systolic blood pressure (P for trend = 0.077). Conclusions: The results indicate that coffee drinking seems to increase the risk of antihypertensive drug treatment, and this risk was higher in subjects with low-to-moderate coffee intakes; however, there was no significantly increased trend in drinkers of approximate to 1 cup (100 mL)/d or \geq 8 cups/d. Copyright 2007, American Society of Clinical Nutrition.

"No thanks, it keeps me awake": The genetics of coffee-attributed sleep disturbance.

Luciano M; Zhu G; Kirk KM; Gordon SD; Heath AC; Montgomery GW; Martin NG. *Sleep* 30(10): 1378-1386, 2007. (35 refs.)

Study Objectives: Previous genetic investigations of sleep disturbance have shown various measures of sleep quality and sleep pattern to be heritable. But none of these studies have investigated the genetic predisposition to sleep disturbance attributed to caffeine. In this study, the heritability of coffee-attributed sleep disturbance and its relationship with other sleep measures were estimated, and chromosomal regions influencing this trait were identified. **Design:** A classical twin design was used to estimate the heritability of coffee-attributed sleep disturbance and its genetic covariance with other measures of sleep disturbance (e.g., due to anxiety, depression) and sleep quality (e.g., variability in sleep quality). To locate quantitative trait loci influencing coffee-attributed sleep disturbance, a genome-wide linkage screen of 1395 microsatellite markers was performed. **Participants:** The study included 3808 Australian adult twin pairs (n = 1799 monozygous pairs; n = 2009 dizygous pairs). A subsample of 1989 individuals from 1175 families was used for the linkage analysis. **Measurements and Results:** The heritability of coffee-attributed sleep disturbance (measured by self report) was approximately 0.40, with three fourths of this genetic variance explained by genes unrelated to the general sleep disturbance factor. One region of significant linkage to coffee-attributed sleep disturbance was identified on chromosome 2q (LOD score of 2.9). **Conclusions:** Although no candidate genes known to be related to caffeine metabolism or sleep disorder were identified in the significant linkage region, 2 candidates were found under a smaller peak on chromosome 17q. Copyright 2007, American Academy of Sleep Medicine.

Coffee drinking and hepatocellular carcinoma risk: A meta-analysis.

Bravi F; Bosetti C; Tavani A; Bagnardi V; Gallus S; Negri E et al. *Hepatology* 46(2): 430-435, 2007. (40 refs.)

Several studies suggest an inverse relation between coffee drinking and risk of hepatocellular carcinoma (HCC). We conducted a meta-analysis of published studies on HCC that included quantitative information on coffee consumption. Ten studies were retrieved (2,260 HCC cases), including 6 case-control studies from southern Europe and Japan (1551 cases) and 4 cohort studies from Japan (709 cases). The summary relative risk (RR) for coffee drinkers versus non-

drinkers was 0.54 (95% confidence interval [CI] 0.38-0.76) for case-control studies and 0.64 (95% CI 0.56-0.74) for cohort studies. The overall RR was 0.59 (95% CI 0.49-0.72), with significant heterogeneity between studies. The overall summary RR for low or moderate coffee drinkers was 0.70 (95% CI 0.57-0.85), and that for high drinkers was 0.45 (95% CI 0.38-0.53). The summary RR for an increase of 1 cup of coffee per day was 0.77 (95% CI 0.72-0.83) from case-control studies, 0.75 (95% CI 0.65-0.85) from cohort studies, and 0.77 (95% CI 0.72-0.82) overall. The consistency of an inverse relation between coffee drinking and HCC across study design and geographic areas weighs against a major role of bias or confounding. Coffee drinking has also been related to reduced risk of other liver diseases, thus suggesting a continuum of the favorable effect of coffee on liver function. However, subjects with liver conditions may selectively reduce their coffee consumption. **Conclusion:** The present analysis provides evidence that the inverse relation between coffee and HCC is real, though inference on causality remains Copyright 2007, John Wiley & Sons.

Effect of a thermogenic beverage on 24-hour energy metabolism in humans.

Rudelle S; Ferruzzi MG; Cristiani I; Moulin J; Mace K; Acheson KJ et al. *Obesity* 15(2): 349-355, 2007. (36 refs.)

Objective: To test whether consumption of a beverage containing active ingredients will increase 24-hour energy metabolism in healthy, young, lean individuals. **Research Method and Procedures:** Thirty-one male and female subjects consumed 3 X 250-mL servings of a beverage containing green tea catechins, caffeine, and calcium for 3 days in a single-center, double-blind, placebo-controlled, cross-over design study. On the 3rd day, 23-hour energy metabolism, extrapolated to 24-hour, was measured in a calorimeter chamber. Blood pressure and heart rate were measured, and total day and night urines were analyzed for urea and catecholamine excretion. **Results:** Twenty-four-hour energy expenditure (EE) and 24-hour fat oxidation were lower in women than in men (p < 0.0001 and p < 0.015, respectively). Although there were no treatment or treatment/gender effects on substrate oxidation, treatment increased 24-hour EE by 106 +/- 31 kcal/24 hours (p = 0.002), equivalent to 4.7 +/- 1.6 kcal/h (day; p = 0.005) and 3.3 +/- 1.5 kcal/h (night; p = 0.04). No significant differences were observed in hemodynamic parameters. **Discussion:** The present study provides evidence that consumption of a beverage containing green tea catechins, caffeine, and calcium increases 24-hour EE by 4.6%, but the contribution of the

individual ingredients cannot be distinguished. Although this increase is modest, the results are discussed in relation to proposed public health goals, indicating that such modifications are sufficient to prevent weight gain. When consumed regularly as part of a healthy diet and exercise regime, such a beverage may provide benefits for weight control. Copyright 2007, North American Association for the Study of Obesity.

Intake of coffee and tea and risk of ovarian cancer: A prospective cohort study.

Silvera SAN; Jain M; Howe GR; Miller AB; Rohan TE. *Nutrition and Cancer* 58(1): 22-27, 2007. (47 refs.)

There is some evidence from case-control studies that coffee consumption might be positively associated with ovarian cancer risk, whereas the epidemiologic evidence regarding tea consumption and ovarian cancer is inconsistent. To date, there have been few prospective studies of these associations. Therefore, we examined ovarian cancer risk in association with both coffee and tea intake in a prospective cohort study of 49,613 Canadian women enrolled in the National Breast Screening Study (NBSS) who completed a self-administered food frequency questionnaire between 1980 and 1985. Linkages to national mortality and cancer databases yielded data on deaths and cancer incidence, with follow-up ending between 1998 and 2000. Data from the food frequency questionnaire were used to estimate daily intake of coffee and tea. Cox proportional hazards models were used to estimate hazard ratios (HR) and 95% confidence intervals (CI) for the association between categories of coffee and tea intake and ovarian cancer risk. During a mean 16.4 years of follow-up, we

observed 264 incident ovarian cancer cases. Tea intake was not associated with ovarian cancer risk in our study population. In contrast, a borderline positive association was observed among women who drank >4 cups coffee/day compared to women who did not drink coffee (HR = 1.62, 95% CI = 0.95-2.75, P-trend = 0.06). Given the pervasive use of these beverages, the associations between coffee and tea consumption and ovarian cancer risk warrant investigation in further prospective studies. Copyright 2007, Lawrence Erlbaum Assoc.

Prevention and treatment of sleep deprivation among emergency physicians. (review).

Nelson D. *Pediatric Emergency Care* 23(7): 498-503, 2007. (54 refs.)

Emergency physicians commonly experience sleep deprivation because of the need to work shifts during evening and late night hours. The negative effects of this problem are compounded by job stress and traditional methods of scheduling work shifts. Sleep deprivation may be reduced by schedules designed to lessen interference with normal sleep patterns and circadian rhythms. Pharmacological treatments for sleep deprivation exist in the form of alertness-enhancing agents, caffeine and modafinil. Sleep-promoting agents may also help treat the problem by helping physicians to sleep during daytime hours. Minimizing sleep deprivation may help prevent job burnout and prolong the length of an emergency physician's career. Copyright 2007, Lippincott, Williams & Wilkins.
