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RESEARCH ARTICLE

REVIEW OF HEALTH IMPLICATIONS OF HOT HUMID ENVIRONMENT ON INDOOR AND OUTDOOR WORKERS

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ABSTRACT

The workers working in hot humid summer environment outdoor as well as those working indoor in various industrial, governments, private or domestic establishments have increase risk of suffering with heat related illness. Those working indoor also experience equal adverse effects as they have frequent change in exposure to hot outdoor climate and hot and humid indoor temperatures while reporting on duty, during lunch breaks and at end of the shift. These indoor workers may be affected with heat stroke related illness. Our earlier study on hydration status in indoor workers of an academic institution revealed hypo-hydrated status of majority of the working staff both pre and post shift. Proper hydration status of workers, well ventilated indoor premises, adequate cooling zones indoor as well as rest zones for food and relaxation of workers during shift breaks and adequate safe drinking water will help to reduce the adverse effect of heat illness. The above fact gave us an impetus to review the literature and ascertain the effects s of hot environment on indoor and outdoor work employees.

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INTRODUCTION

The environmental temperature during hot summer environment is debilitating for outdoor workers working in construction companies, shipping corporation, agricultural laborers, industrial labors and armed forces (army, navy and air force) and para-armed forces (Border Security Forces) personnel's working in open air environment. As the working labor manpower is generally unaware of the importance of hydration and drinking of adequate water and moreover they face the brunt of the heated atmosphere and suffer from heat exhaustion, heat stroke and other heat related illness (Jardine, 2007; Sawka *et al.,* 2007; Brake *et al.,* 2003; Donoghue and Bates, 2000). The ill effects of this heat exposure also affects the indoor work force working in various industries, and all other kind of establishment such as those working in academic institutes, business centers, recreational centers, government offices etc since many of these working establishments lack air conditioning facilities, proper ventilation and inadequate drinking water sources (Gopinathan *et al.,* 1988; Belding and Hatch, 1955). Though many studies are done to study physiological effects of hot environment in indoor workers but studies evaluating the hot environmental effect in indoor workers are scarce (Brake *et al.,* 2003; Gopinathan *et al.,* 1988; Armstrong *et al.,* 2007). As our earlier work regarding hydration status and altered homeostatic response of heart rate and fluid intake in indoor office workers during hot summer environment had revealed hypo hydrated state of indoor office workers throughout the shift due to lack of awareness regarding water intake and physiological homeostatic response of our body, inadequate safe water supply at working site, inadequate ventilation, lack of cooling facilities such as air conditioners and water coolers and lack of adequate cross ventilation affecting the productivity and work outcome of these workers (Armstrong *et al.,* 2007). When the environmental temperature and humidity increases above 30 C heat burden increases and the individuals may suffer from

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health problems such as increased irritability, loss of concentration and ability to perform skilled or unskilled work, detiorating psychomotor functions and thus affecting performance and optimum work productivity (Nitin Ashok John *et al.,* 2015; Miller, 2010; Kavouras, 2002). The above facts gave us an impetus to verify the effect of hot and humid environment of indoor and outdoor workers on human health.

DISCUSSION

Environmental effects of hot humid environment in outdoor workers

Long working hours in hot humid environment leads to heat related illness like heat stroke, heat cramps and heat exhaustion. The hypo-hydrated workers may manifest with heat exhaustion symptoms of fatigue, dizziness, excessive sweating, headache and signs of dry lips and parched skin. Heat stroke generally occurs because of either long exposure to hot environment as seen in outdoor workers or also in those workers working both in office and field due to varied exposure to hot and cool environment. There is no sweating in heat stroke and the individuals may report with rapid weak pulse, tachycardia, high body temperature, delirium and unconsciousness. Heat cramps result due to depletion of electrolytes as a result of heavy sweating and consuming plain water without any water supplementation. Physiological and behavioral alteration with delirium, confusion, irritability and lack of concentration, high body temperature results from heat strain and heat hyperpyrexia (Brake *et al.,* 2003; Donoghue and Bates, 2000; Belding and Hatch, 1955; Montain *et al.,* 1999; Kavouras, 2002).

A study was conducted to formulate *a* dehydration and heat illness protocol. It was found that industrial workers reported for duty in hypo-hydrated states. The voluntary and involuntary dehydration was monitored in the workers. Voluntary dehydration was due to physiological effect of heat producing heat stress and unavoidable dehydration while voluntary dehydration was due to non consumption of water due unavailability of safe drinking water, work culture practices in establishment or being unaware of the health implications of non consumption of water. It was found that most of the workers reported hypo-hydrated state at rend of the shift. The euhydrated state of the workers with constant sweating at the rate of 0.5 and 1.1 liters per hour and loss of electrolytes from body and non replacement of water and electrolyte in paced manner sets early fatigue in these workers with symptoms of uneasiness, headache, confusion, lack of concentration and thus may affect work outcome and productivity at the end of the shift. The study recommended education of working employees for the physiological effects of heat stress and preventives measures thereof (Kavouras, 2002; Adolph *et al.,* 1954; Cross *et al.,* 1989). The chronic effects of acute heat illness are chronic heat exhaustion, reduced tolerance to heat, muscle soreness, headache, insomnia and the workers may develop hypertension, myocardial damage, psychoneurosis and hypochromemia. Many of the research work have recommended interventions to ensure that workers working in hot humid environment maintain adequate levels of hydration (Armstrong *et al.,* 2010; Kavouras, 2002; Adolph *et al.,* 1954; Cheung and McLellan, 1998).

Environmental effects of hot humid environment in indoor workers

In our observational analytical study carried out in sixty office staff workers working indoor during hot summer environment; the urine specific gravity, fluid intake and heart rate were evaluated during the hot summer days. The average outdoor temperature was 44 °C and indoor room temperature of 36 °C. Randomly selected sixty health male office staff in the age group of 30 to 40 years were divided into two groups [Group I included 30 participants who were given planned protocol of fluid (electrolyte drink) and water over the work shift, and Group II included 30 participants who were observed for the fluid intake voluntarily if they desired]. The urine specific gravity and heart rate was measured on three occasions at 9 am (pre-day), 1 pm (mid day) and at 5 pm (end of the day). Their fluid intake was noted. The fluid intake ranged from 0.3 to 1.5 L (mean fluid intake of 1.2 ± 0.8 L) in Group II participants. The fluid intake in Group I participants was of 450 ml / hour (Average 3l per 8-h shift). The fluid intake in-take in Group I participants ranged from 0.3 to 1.5 L, with a mean fluid intake of 1.2 ± 0.8 L (Armstrong *et al.,* 2010).

The highly significant increase in the prevalence of dehydration across the eight hour duties in office workers signified ineffective fluid intake during the day by the Group II participants. Most of the office staff arrived dehydrated to job at 9am (Around 100% in Group I and 83.33% in Group II). All participants of Group I were given water and electrolyte as fluid throughout the day and to prevent hyper-hydration. The indoor office staff workers of Group I remained in hydrated states at end of the shift because of adequate fluid intake while those in Group II remained in hypo-hydrated state due to lack of inadequate intake of water and fluids. Fluid intake during the day did not compensate for poor hydration status after the day in Group II.

The factors which were observed for low intake of water in Group II was heavy work load in office and were busy in time management, lack of availability of purified water supply at working place, unclean water purifiers and filters and most of them did not carry water bottles from home. Moreover they also had to sit in hot humid rooms having open access to outdoor temperature. None of the staff had air conditioners in the rooms they worked at. Similarly we found in our study that the heart rate was significantly high in Group II as compared to Group I participant (Armstrong *et al.,* 2010). Increased internal body temperature leads to sweating and thereby fatigability, disturbed concentration, uneasiness, compromised physical and mental function affecting work at work place. Decreased work output affects the optimal productivity. Hypo-hydrated state further hampers the thinking capability and increased viscosity of blood and this will increase peripheral resistance and blood pressure. The above physiological alterations affect their physical and mental capacity to work safely and productivity is compromised (Armstrong *et al.,* 2010; Cheung and McLellan, 1998; Lu and Zhu, 2007)

Humid Environment and Health Effects

As a protective response to humid environment the human body by aid of evaporation of perspiration cools the body. Humid and hot environmental conditions have more deleterious effect on health as compared to hot environment itself. In summer the air contains more moisture and this decreases the body's ability to lose heat by evaporation perspiration and may lead to heat stress and general discomfort. The low relative humidity of air produce nasal discomfort with signs of dryness of nose, throat and trachea and the moisture is extracted over of the nasal passages and upper respiratory tract producing dehydration of these organs. The increase in viscosity of bronchial mucous makes it susceptible to bacterial and viral invasion producing respiratory tract infections. Increased humidity promotes fungal growth in the house hold and these fungal spores may precipitate bronchial asthma attacks in humans (Cheung and McLellan, 1998; Lu and Zhu, 2007).

Conclusion

Heat-Related Illnesses can be prevented in indoor and outdoor workers by drinking adequate water and electrolyte supplementation during the working shift, having adequate water in morning so that they report for duties in hydrated states, drinking water as and when feeling thirsty during the shift, those working outdoor should rest in cool zone area during shift breaks, those working indoor should avoid going out in noon time in the break hours of lunch and visit for any outdoor assignments in morning or evening hours, wear comfortable and loose clothing so that there is free circulation of air and stay in cooler indoor environment if facilities are available.

Future research should be aimed towards recognizing hydration status both in indoor and outdoor workers of all levels from Supervisors to laborers and investigate there health profile regularly for the cardio-respiratory functions, autonomic status, renal functions and overall health and fitness status. Strategies for effective occupational health education and preventive measures implementation, statutory bye laws and regulations for safe environmental health work practices under supervision of government regulatory body needs to be explored and worked upon. More studies targeting environmental monitoring, occupational hygiene practices, health education awareness of workers, and health profile evaluation amongst various working force exposed to heat stress such as in refinery, thermal power station, nuclear power station, construction work, bakeries, metallurgy units, mines, various industrial units and other all indoor working places needs to be carried at larger scales. Health profile in coastal humid environment amongst indoor and outdoor workers has not yet been explored much scientifically, hence ill effects of hot and humid environment on human health is warranted as need of the hour today for current research. The researcher's attention is also being drawn to area which needs further exploration for advanced environmental monitoring and adaptation strategies especially in the defence personnel's of our country.

Armed Forces personnel's working in field areas in army, navy and air force worked in varied environment from too hot in a desert area posting to too cold area in hilly and mountainous region. As the armed forces personnel's defend the safety and security of the country so is the duty of fellow doctor citizens to conduct a detailed evaluation of changes in health profile in varied temperatures and further develop new modalities and protocols for easy and faster rehabilitation in extreme weather conditions. Thus this raw area of research for resolving solutions for effective human adaptation to hot and humid environments should be worked over me

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