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HEAT RELATED ILLNESSES;
ITS ADAPTIVE STRATEGIES IN HEALTHY YOUNG MEDICAL STUDENTS

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ABSTRACT…Objective: To study the adaptive strategies from harmful effect of heat wave on an urban, educated, well to do subjects for a period of May to July 2014.**Data Source**: 250 selected young students of RIHS. **Design of Study**: Descriptive Study. **Setting**: Rawal Institute of Health Sciences, Islamabad. **Period**: March – July 2014. **Method:** A questionnaire was circulated among the students of Rawal Institute of Health Sciences Islamabad regarding effects of heat and measures taken to combat its effects. **Results:** A total of 250 urban students with mean age of 19.77±1.10 years were inducted in the study, having resources to face the extreme heat. A significant number of female non boarder students (p=0.000), wearing cotton clothes (p=0.000) having fair skin (p=0.000) and using air condition at homes (p=0.000) were not acclimatized to heat waves still have headache and anxiety. A great percent of students did not complaint of headache, heat exhaustion, heat cramp or syncope, except mild sweating, effect on studies. A great percentage (>65%) of students complained of malaise, nausea vomiting. Male students showed increase thirst than female, while anxiety state was noticed more in female than male students. **Conclusion:** The use of cotton clothing, daily bathing, increased water intake and use of air conditioner minimized the severe adverse effects like heat exhaustion, heat syncope, and heat stroke, although the minor effects like skin tanning, disturbed sleep, anxiety and adverse effects on studies cannot be avoided in heat wave season.

Key words: Heat waves, Heat stress, Heat exhaustion, Heat strokes

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INTRODUCTION

It has been known that climate changes affects extreme weather and impacts on health. The National Academy of Sciences reports that the hottest days are now hotter and the global warming has been identified behind this change.[1,2] Increasing knowledge regarding climate changes has increased interest to assess the potential mechanisms that influence the health. The adverse effects of heat waves on health are negatively balanced and people with low socio-economics are likely to be vulnerable. Climate changes will be experienced against a background of other global changes like population growth, urbanization, land use change and depletion of fresh water resources that themselves have implications for health and that could, in some way interact with climate changes to magnify the impact.[3]

The climate change has wide range to impact on health through various pathways like increased frequency and intensity of heat waves, reduction in cold related deaths, increased floods and droughts and risk of disasters and malnutrition.[3]

Effects of heat illness are preventable and thorough knowledge can be helped to reduce mortality and morbidity.[4] The classic heat stroke is predominant in very young or elderly persons and in those who have no access to air conditioning.[5] It is relatively common among persons with chronic mental disorder, cardiopulmonary disease and who receiving anticholinergic and tranquilizers. The young population at risk includes manual laborers, young soldiers, football players, marathon racers and those who use cocaine and amphatamines.[6]

Heat induced illnesses result from inability to maintain homeostasis at an elevated ambient temperature situation. A rise in body temperature may produce heat edema, heat rash, heat cramps,

heat tetany, heat syncope, heat exhaustion or heat stroke. The environmental risk factors include high humidity, high temperature and without air conditioning breaks.[7]

OPERATIONAL DEFINITIONS

Heat wave is air temperature more than 32.2°C for three or more consecutive days.

Heat stress is discomfort and physiological strain associated with exposure to a hot environment especially during physical work.

Heat exhaustion is un-ability to continue activity because of environmental conditions, associated with water or salt depletion caused by central mechanism that protects the body at time of overexertion.

Heat stroke is characterized by an elevated core temperature more than 40°C (104° F) with central nervous system disturbances. It predominantly occurs in older persons and those with chronic illness.[3,5] Exertional heat stroke has a more rapid onset and is associated with higher core temperatures. It generally occurs in young, healthy persons and is characterized by hot skin with or without sweating and central nervous system alterations.

Milder forms of heat-related illness are associated with a core temperature less than 104°F (40°C) without central nervous system symptoms.[6]

The study is an attempt to see the effect of heat on young educated subjects during the heat wave of May to July 2014.

MATERIAL AND METHODS

A questionnaire was circulated among 2nd and 3rd year MBBS students of Rawal Institute of Health Sciences Islamabad, which included age, sex, skin complexion, boarding status, acclimatization and use of air condition at home and at college premises. The effects of heat exhaustion nitration, like headache, nausea/vomiting, malaise/fatigue, thirst, lack of concentration, anxiety and muscle cramps. The questions regarding heat stroke were also included in the questionnaire like convulsion or coma. In order to highlight the salient features of heat illness and in priority heat stress the importance of ensuring that students appreciate need for water, proper clothing, bath taking, air conditioning and the need to be able to recognize early signs of distress cannot be over emphasized. The choice of diagnostic criteria was made on the basis of plausible physiological mechanisms, and published literature on heat wave impacts.

Variable	n = 250 (%)		OR	95% CI		p value
Residence						
Boarder	69	27.6%	5.188	2.691	10.00	0.000
Non boarder	181	72.4%				
Acclimatized						
Yes	55	22.0%	2.619	1.373	4.997	0.003
No	195	78.0%				
Ac college						
use	207	82.2%	0.171	.0.073	0.403	0.000
Not used	43	17.2%				
AC Home						
Used	225	90.0%	1.508	0.656	3.464	0.400
Not used	25	10.0%				
Bath						
Daily	104	41.6%	1.364	0.822	2.263	0249
Twice daily	146	58.4%				
Cloths						
Cotton	215	86.0%	8.828	3.269	23.642	0.000
Synthetic	35	14.0%				
Sleep						
Normal	152	60.8%	1.513	0.908	2.521	0.121
Disturbed	98	39.2%				

Sweat						
Mild –Moderate	175	70.0%	11764	5.867	23.588	0.000
Severe	75	30.0%				
Skin						
Rash	174	69.6%	0.822	0.478	1.414	0.494
Tanned	76	30.4%				
Heat Cramp						
Present	114	45.6%	1.615	.0.976	2.671	0.040
Absent	136	54.4%				
Heat Exhaustion						
Present	50	20.0%	0.569	0.304	1.065	0.083
Absent	200	80.0%				
Nausea/Vomiting						
Present	174	69.6%	0.652	0.377	1.128	0.132
Absent	76	30.4%				
Headache						
Yes	97	38.8%	0.557	0.333	0.932	0.028
No	153	61.2%				
Malaise						
Yes	192	79.2%	0.476	0.250	0.905	0.028
No	52	20.8%				
Thirst						
Yes	236	94.4%	0.435	0.133	1.427	0.180
No	14	5.6%				
Study Concentration						
Normal	211	84.4%	3.025	1.454	6.294	0.002
Disturbed	39	15.6%				
Anxiety						
Yes	107	42.8%	0.259	.0.152	0.439	0.000
No	143	57.2%				
Effect on Study						
Yes	218	87.2%	1.003	0.477	2.111	1.000
No	32	12.8%				
Heat Syncope						
Yes	25	10.0%	0.142	0.047	0.426	0.000
No	225	90.0%				
Skin Complexion						
Fair	169	67.6%	0.071	0.033	0.151	0.000
Dark	81	32.4%				

Table-I. Effect of heat waves on heat illness variables and compensatory mechanisms

Variables	Male		Odds Ratio	95% CI		p value	
Residence							
Boarder	55	41.4%	14	5.188	2.691	10.000	0.000
Non-boarder	78	58.6%	103				
Skin complexion							
Fair	61	45.9%	108	0.071	0.033	0.151	0.000
Dark	72	54.1%	09				
Acclimatization							
Yes	64	48.1%	40	1.786	1.071	2.978	0.026
No	69	51.9%	77				
AC in College							
Used	1	0.8%	48	0.011	.001	.081	0.000
Not used	132	99.2%	69				
AC at home							
Used	122	91.7%	103	1.508	.656	3.464	0.331
Not used	11	8.3%	14				
Bath							
Daily	69	51.9%	96	0.236	.132	.422	0.000
Twice daily	64	48.1%	21				

Cloths							
Cotton	128	96.2%	87	8,828	3.296	23.642	0.000
Synthetic	05	3.8%	30				
Sleep							
Normal	87	65.4%	65	1.513	.908	2.521	0.111
Disturbed	46	34.6%	52				
Sweat							
Mild – moderate	121	91.0%	54	11.764	5.867	23.588	0.000
Severe		129.0%	63				
Skin							
Tanned	90	67.7%	84	.822	.478	1.414	0.494
Rash	43	32.3%	33				
Heat Cramp							
Present	68	51.5%	46	1.615	.976	2.671	0.075
Absent	65	48.9%	71				
Heat Exhaustion							
Present	211	5.8%	29	0.569	.304	1.065	0.083
Absent	112	84.2%	88				
Nausea / vomiting							
Yes	87	65.4%	87	.652	.377	1.128	0.081
No	46	34.6%	30				
Headache							
Yes	43	32.3%	54	0.557	0.333	0.932	0.025
No	90	67.7%	63				
Malaise							
Yes	98	73.7%	91	0.800	.447	1.432	0.452
No	36	26.3%	26				
Thirst							
Yes	123	92.5%	113	0.435	.133	1.427	0.159
No	10	7.5%	04				
Concentration							
Yes	121	91%	90	3.025	1.454	6.294	0.002
No	12	09%	27				
Anxiety							
Yes	66	49.6%	70	0.661	.400	1.093	0.106
No	67	50.4%	47				
Effect on Studies							
Yes	116	87.2%	92	1.854	.945	3.639	0.070
No	17	12.8%	25				
Heat Syncope							
Yes	04	3%	21	0.142	0.047	0.426	0.000
No	129	97%	96				

Table-II. Effect of heat illness and compensatory mechanism on sex

RESULTS

A total of 250 students of MBBS and BDS class from 1st to 3rd year were inducted having a mean age of 17.1±1.25 years (range 18-22 years); 117 students (46.8%) were females while 133 (53.2%) were males; with female to male ratio of 1:1.14.

Table-I showed that a significant difference (p=0.000) was noticed between boarder and non-boarder, fair and dark skinners, taking daily versus twice daily bath, and between students who wear cotton and synthetic clothes.

A significant number (p=0.000) of students were non-boarder than boarder, have fair skin (p=0.000) compared to dark skin and took daily bath (p=0.000) than those who took bath twice daily. A similar significant difference was also noticed in students who wear cotton clothes (p=0.000) than who wear synthetic made and in those using air condition in the college premises (p=0.000) than not users. A significant number of students were complaining of headache (p=0.000) and heat cramps (p=0.032) and were not acclimatized. A great percentage of non-significant students were complaining of perfused sweating (61.6%,

Variables	Ac. College	Ac. home	Bath	Cloth	Sleep	Sweat	Skin	Heat cramp	Heat exhaustion	Headache	Water intake	Effect on study	Heat syncope
Ac. college	1	.095	-.239**	-.031	-.084	.002	.021	-.136*	.175**	-.007	-.065	.047	-.095
p value		.133	.000	.624	.187	.971	.737	.032	.00	.914	.307	.455	.133
Ac.home	.095	1	.146*	.058	-.022	.015	-.133*	.011	-.100	.074	-.023	-.048	-.244**
p value	.133		.021	.364	.731	.819	.035	.866	.115	.244	.715	.415	.000
Bath	-.239**	.146*	1	-.314**	.312**	.004	-.042	-.219**	.024	-.072	-.077	-.114	-.173**
p value	.000	.021		.000	.000	.956	.508	.000	.702	.254	.226	.072	.006
Cloth	-.031	-.058	-.314**	1	-.324**	.189**	-.116	.231**	-.144*	-.034	-.048	-.018	-.096
p value	.624	.364	.000		.000	.003	.066	.000	.023	.597	.449	.778	.130
Sweat	.002	.015	.004	.189**	-.222*	1	-.072	.214**	-.218**	-.020	-.084	.089	-.393**
p value	.971	.819	.956	.003	.000		.925	.001	.001	.757	.188	.161	.000
Skin Tanning	.021	-.133*	-.042	-.116	.200**	-.072	1	-.006	.178**	.080	.066	.111	.046
p value	.737	.035	.508	.066	.002	.256		.925	.005	.207	.299	.079	.465
Heat. cramp	-.136**	.011	-.219**	.231**	-.285**	.214**	-.006	1	-.036	-.210**	-.022	.110	-.064
p value	.032	.866	.000	.000	.000	.001	.925		.570	.001	.735	.082	.312
Heat exhaustion	.175**	-.100	.024	-.144*	.094	-.218**	.178**	-.036	1	-.029	.035	.012	.000
p value	.006	.115	.702	.023	.137	.001	.005	.570		.651	.584	.851	1.000
Headache	-.007	.074	-.072	-.034	.068	.020	.080	.210**	-.029	1	.123	.084	.200**
p value	.914	.244	.254	.597	.287	.757	.207	.001	.651		.053	.186	.002
Water intake	-.065	-.023	-.077	-.048	.090	-.084	.066	-.022	.035	.123	1	.011	.081
p value	.307	.715	.226	.449	.158	.188	.299	.735	.584	.053		.865	.201
Effect-study	.047	-.048	-.114	.018	-.013	.089	.111	.110	.012	.084	.011	1	.048
p value	.455	.451	.072	.778	.834	.161	.079	.082	.851	.186	.865		.451
H. syncope	-.095	-.244**	-.173**	.096	-.033	-.393**	.046	-.064	.000	.200**	.081	.048	1
p value	.133	.000	.006	.130	.606	.000	.465	.312	1.000	.002	.201	.451	

Table-III. Correlation between variables of heat illness and compensatory mechanisms stimulated by heat waves

p=0.362), malaise (75.6%, p=0.452), nausea vomiting (69.6%, p=0.081) and heat exhaustion (94.8%, p=0.096). Same trend was noticed for students who were complaining of increased thirst (94.4%, p=0.159), anxiety state (54.4%, p=0.106) have effects on their studies (94.4%, p=0.159), skin tanning (67.7%, p=0.285) while very few had heat syncope (3%, p=0.503).

Table-II shows effects of heat waves on male and female students. A significant number of female non boarder students (p=0.000) have fair skin (p=0.000) using air condition at their homes (p=0.000) were not acclimatized o heat waves as compared to males. A great percentage of male students (65.4%, p=0.111) had normal sleep as compared to female with disturbed sleep. More than 80% of the male and female students showed non-significant difference in severe sweating (p=0.861). A significant number of male (p=0.000) wearing cotton clothes still have skin tanning and rashes in a greater percentage compared to female (p=0.494).

A similar trend of significant difference (p=0.000) was noticed in female students when heat waves resulting heat exhaustion was compared with their male collogues. A great number of male and female students complained of heat cramps (>85%, p=0.580), malaise (>70%, p=0.452) and nausea and vomiting (>65%, p=0.081). Male students complained of headache (p=0.000) with effect on their studies (p=0.070) compared to female. A slightly increased number of male students showed increased thirst (p=0.159) than female collogues, while anxiety state was non-significantly (p=0.106) more noticed in female as compared to male students.

The use of air conditioner (college premises and

or home) showed a negative correlation with headache (r= -0.007, p=0.914), thirst (r= -0.065, p=0.307), heat cramps (r= -0.136, p=0.032), heat exhaustion (r= -0.100, p=0.115) and heat syncope (r= -0,244, p=0.000). Same trend of negative correlation was noticed between taking bath and skin tanning (r= -0.042, p=0.508), headache (r= -0.072, p=0.245), thirst (r= -0.077, p=0.226), heat cramps (r= -0.219, p=0.000), heat exhaustion (r= -0.024, p=0.702), and heat syncope (r= -0.173, p=0.006).

Wearing cotton clothes has negative correlation with thirst (r= -0.048, p=0.449), headache (r= -0.034, p=0.597), and heat exhaustion (r= -0.144, p=0.023); while increased water intake showed negative correlation with taking daily bath(r= -0.077, p=0.226), sweating (r= -0.084, p=0.188), and heat cramps (r= -0.022, p=0.735). The studies were more effected and showed a positive correlation with sweating (r=0.089, p=0.161), headache (r=0.084, p=0.186), heat cramps (r=0110, p=0.082), heat exhaustion (r=0.012, p=0.854) and heat syncope (r=0.048, p=0.451).

DISCUSSION

Our results are in consistent with Kirk R, et al.[8]and Hayat S, et al.[9]who showed increased heat wave is associated with perfused sweating, increased thirst, and stimulates wearing of cotton clothes as well as use of air conditioner at home or work place.

Body temperature is regulated through a dynamic balance between heat production and absorption and heat loss. Heat is a byproduct of cellular metabolism and the mechanical work of skeletal muscles[10].The body heat is lost by conduction, convection, radiation and evaporation. Convection and evaporations are more important than other methods of losing heat and are regulated by the body itself. Anterior hypothalamus is responsible for heat loss, receives afferent information from cutaneous (surface) receptors and internal (core) temperature and gives efferent signals to dilate skin vessels through sympathetic nerves and results sweating[11]. So to maintain the appropriate body temperature three issues work, (a) the metabolic heat produced must be transferred to the skin via the circulation for dissipation (b) the sweat glands must be able to produce the necessary amount of sweat (c) the sweat must be able to evaporate.[12]

Cutaneous vasodilatation increases convective heat loss. Sweating increases dissipation because of cooling the skin through evaporation. A number of changes in the cutaneous architecture are induced. Skin blood flow is increased from a loose line of approximately 250ml/min to approximately 6 to 8 L/minute through increased cardiac output and concomitant vasoconstriction of the renal and splanchnic circulation. Cardiac output may increase nearly 3 L/minute for each 1°C of temperature elevation.[13]

Our results showed that students exposed to increased heat waves were complaining of headache, malaise, nausea vomiting and state of anxiety heat cramps, and exhaustion due to increased heat are in consistent with Kilbourne EM et al.[5]and Bouchana A et al.[7]Heat cramps are painful, involuntary and self-limited muscle spasm; especially involved are large muscle groups such as the calves, thighs and shoulders. In heat syncope there is brief loss of consciousness or orthostatic dizziness due to volume depletion, peripheral vasodilation, pooling of blood and decreased vasomotor tone. [14, 15]Why a mild illness develops in response to heat (as in heat exhaustion) in some people, where as in others the condition progresses to heat stroke is unknown. Genetic factors may determine the susceptibility to heat stroke. Susceptible genes include those that encode cytokines, coagulation proteins and heat shock proteins induced in the adaptation to heat stress. Usually, heat causes damage to the body by three mechanisms. First heat is directly damaging to cell causing protein denaturation and interrupts critical cellular responses; second heat induces release of inflammatory cytokines including tumor necrosis factor-9, interleukin-10 and interferon 8 along with anti-inflammatory cytokines 1L-6, 1L-10 and TNF receptor p55 and p75.[16,17]

Our also showed that urban students who were non boarder, taking regular bath and using air conditioner were not acclimatized to heat waves. People without access to air conditioning are vulnerable population. The urban poor are particularly vulnerable due to the 'urban heat island" phenomenon. City environment holds more heat and routinely experiences ambient air temperature from 2-10°F more than the surrounding rural and suburban areas.[18]

The human body response at hot climate to increase efficacy of heat loss is well known as acclimatization, providing maximal heat loosing under the physiologic and biochemical adjustments.

Acclimatization is adjustment of an individual organism to a gradual change in its environment as change in temperature, humidity, or pH. Acclimatization occurs in short period of days to weeks. A change in temperature can change the biochemistry of cell membranes making them more fluid in cold and less fluid in warm temperatures by increasing the number of membrane proteins.[19] The heat shock proteins maintain cell function in extreme stress. It is shown that organisms which are acclimated to high or low temperatures have relatively high resting levels of heat shock proteins. Expression of heat shock proteins and regulation of membrane fluidity are important methods use to acclimatize organism to novel environments.[20] A recent WHO publication encourages public–health decision makers to act now to address climate hazards as well as address strategies in the longer term.[21]

CONCLUSION

It was concluded that young people bear the adverse effects of heat well being educated measures taken to combat heat like cotton clothing, daily bathing, increased water intake and use of air conditioner minimizes the severe adverse effects like heat exhaustion, heat syncope, and heat stroke, though the minor effects like sun tanning, disturbed sleep, anxiety and adverse effects of heat on studies cannot be avoided in heat wave season.

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"To love beauty is to see light."

Victor Hugo

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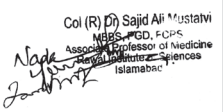
1	Dr. Sajid Ali Mustafvi	Author	
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