Community Research

Health, nutrition and hydration status of Indonesian workers: a preliminary study in two different environmental settings

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Abstrak

Latar belakang: *Status hidrasi di lingkungan kerja suhu tinggi maupun suhu sejuk dapat mempengaruhi status kesehatan pekerja. Penelitian ini bertujuan untuk mengetahui status kesehatan, status gizi dan status hidrasi pekerja di dua lingkungan kerja yang berbeda.*

Metode: *Studi potong lintang komparatif dipilih dengan melibatkan dua kelompok pekerja pabrik, masing-masing terdiri dari 39 orang laki-laki sehat berusia 25-45 tahun dari dua lingkungan kerja yang berbeda, yaitu yang terpapar langsung dengan suhu tinggi dan yang bekerja di ruangan bersuhu sejuk. Data yang diperoleh meliputi data hasil pemeriksaan fisik, berat, tinggi badan, lingkar pinggang dan komposisi lemak tubuh serta data laboratorium. Data disajikan secara deskriptif sebagai nilai tengah dan proporsi; analisa statistik dengan uji-t tidak berpasangan (Mann-Whitney) dan* chi-square *digunakan untuk membandingkan data kedua kelompok subjek.*

Hasil: *Subjek yang terpapar panas berisiko lebih mengalami dehidrasi dibanding yang tidak terpapar panas, terlihat dari lebih tingginya beberapa penanda status hidrasi secara bermakna, yaitu kadar hemoglobin (15,6 vs 14,8 mg/dL, p = 0,017), hematokrit (46 vs 44%, p = 0,040), viskositas darah (23 vs 12 mEq/L, p < 0,001), dan kadar natrium darah (140 vs 138 mEq/L, p < 0,001). Sebaliknya, subjek yang tidak terpapar panas dan hanya duduk mengerjakan tugas administrasi mempunyai kadar kolesterol HDL yang lebih rendah secara bermakna (43 vs 52,1 mg/dL, p = 0,005), dan mempunyai persentase komposisi lemak tubuh dan lemak viseral yang lebih tinggi secara bermakna dibanding subjek terpapar panas yang hampir selalu berdiri dan bergerak melaksanakan pekerjaannya (21,6% vs 17,6%, p = 0,008 dan 10% vs 8%, p = 0,015).*

Kesimpulan: *Pekerja di dua lingkungan kerja berbeda (panas dan sejuk) berisiko terhadap masalah kesehatan, masalah gizi dan masalah dehidrasi sehingga perlu perhatian khusus terhadap asupan cairan serta aktivitas fisik yang memadai.*

Abstract

Background: Hydration status in the working environment of hot and conveniently cool may influence the health status of workers, including their hydration status. This study aimed to determine the health, nutrition and hydration status of workers in two different working environment, i.e. hot and conveniently cool environment.

Methods: A cross-sectional comparative study was done on apparently healthy male subjects, age 25-45 years. Two groups of factory workers consisted of 39 subjects working in environment exposed directly to heat and the other doing administrative work in cool environment. Data on their health status (physical examination), weight, height, waist circumference, fat body composition, laboratory result, were collected. The data was presented as average value and proportion; statistical analysis with unpaired-t (Mann-Whitney test) and chi-square test was used.

Results: Subjects working in a hot environment were more prone to dehydration in comparison to their counterparts, as was shown by significantly higher values of several hydration status biomarkers: hemoglobin (15.6 vs 14.8 g/dL, p = 0.017), hematocrit (46 vs 44.5%, p = 0.040), blood viscosity (23 vs 12 mEq/L, p < 0.001), and blood sodium concentration (140 vs 138 mEq/L, p < 0.001). In contrast, subjects working in a conveniently cool environment who did more administrative tasks were physically less active, had significantly lower HDL-cholesterol level (43 vs 52.1 mg/dL, p = 0.005), higher body and visceral fat compositions (21.6 vs 17.6%, p = 0.008, and 10 vs 8%, p = 0.015, respectively) compared to their counterparts.

Conclusion: Workers in hot and cool working environment are prone to nutrition- and health problems as well as dehydration, suggesting special attention to the provision of timely drinking water, and physical activity during working time.

Keywords: health, hydration, nutrition, working environment

pISSN: 0853-1773 • eISSN: 2252-8083 • http://dx.doi.org/10.13181/mji.v23i2.993 • Med J Indones. 2014;23:112-6
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Health and nutritional status of workers is certainly affecting their performance and productivity.[1,2] Acute and chronic diseases, as well as under- and overweight/obesity, are common problems among workers which are preventable. Special attention should be drawn to health-screening and timely monitoring, including health education to workers, especially those working at higher risk, e.g. in hot environment.[3]

In Indonesia, the workers undergo at least yearly medical check-up. However, the follow-up is merely providing medicine or supplements. Health and nutritional promotion and education is the least important in the work place. Hypertension and dyslipidemia are amongst health problems found during the medical check-up that needs health and nutrition counseling.[4] Furthermore, hydration status is considered not important in the work place.[5,6] There are several diseases related to chronic systemic mild dehydration, namely urolithiasis, urinary tract infection, bladder and colon cancer, constipation, hypertension and other cardiovascular diseases.[7]

Workings in hot environment such as in industrial setting, cause dehydration because of high sweat rate, 1 L per hour, especially if body fluids are not adequately replenished during and after the period of heat exposure. This is the reason why dehydration should be included in health and safety concerns as it will reduce the work performance.[5] This study was performed to identify the health, nutrition and hydration status among male Indonesian workers in hot and cool working environments.

METHODS

Design study

A cross-sectional comparative study design was applied to compare the health-, nutrition- and hydration status of Indonesian workers in two factories in Cibitung, West-Java, i.e. the hot and conveniently cool working environments.

Subjects

Subjects were recruited from two selected factories, 39 subjects per group for each working environment, following the study criteria: apparently healthy males aged 25-45 year, working approximately for 8 hours/day, not having renal disease and diabetes mellitus based on their latest general check-up, willing to participate in the study and gave informed consent. Ethical clearance was obtained from the Ethical Committee Faculty of Medicine Universitas Indonesia (No. 30/PT02/FK/ETIK/2012, January 18, 2012).

Sample size

In conducting a preliminary study, this study recruited 39 subjects per group for each environmental condition or 78 subjects for the total sample. The selected subjects were classified according to their environmental temperature by using total population sampling technique.

Study procedure

Interview

Subjects were interviewed about their socio-demographic characteristics, employment duration, and medical history.

Anthropometric measurement

Anthropometric measurements including weight, height, waist circumference, and body compositions were done using standard instruments. All measurements were done in the morning before the blood withdrawn, using type 571 Tanita weighing scale for weight and body composition, Seca 206 and Seca 201 for height and waist circumference, respectively.

Vital sign measurement

Blood pressure was measured using Reister Anova sphygmomanometer in a sitting position, and heart rate was taken by counting the pulse of Radialis artery per-minute manually.

Laboratory measurements

Blood and urine were taken in the morning before the subjects started to work by Prodia Laboratory. Blood tests consisted of hemoglobin, hematocrit, blood viscosity, lipid profile, blood electrolytes and urine test were urine color, pH, specific gravity, and electrolytes.

Data management and analysis

Data were recorded using special forms and collected between 6th of January and 3rd of February 2012.

Data were edited, coded, and submitted into working sheets in the computer using SPSS version 20. Statistical analyses were performed and data were presented into descriptive and analytical approaches to confirm the hypothesis using unpaired-t test and/or Mann-Whitney test.

RESULTS

A total sample of 39 subjects per working environment was eligible in this study. During study observation, it was found that those working in hot environment are mostly in standing position and keeps moving to process the production materials. In contrast, those working in the conveniently cool environment, mostly did administrative work, sitting most of the time, rarely moved their bodies, unless they went to other places for a meeting or having breaks.

Table 1 shows that the subjects had similar age and duration of working time in the factory however had different working hours. Subjects working in the cool environment had significantly less working hours than those in the hot environment, consequently the latter was exposed more to heat. There were no significant differences in blood pressure, heart rate, triglyceride, total and LDL-cholesterol levels, however those working in the conveniently cool environment had significantly lower HDL-cholesterol levels.

Table 2 shows analysis of the nutritional status between the two groups. It revealed that workers in hot working environment had significantly lower body and visceral fat contents than those in the cool working environment. The body mass index (BMI) and waist circumference were also less however the difference was not statistically significant. More than 50% of workers in both working environments were overweight and obese (BMI ≥ 23.0 kg/m^2) where 23% of those working in the hot environment and 41% in the cool environment had abdominal obesity (waist circumference ≥ 90 cm).

Analysis of hydration status of the two groups showed that the water content was significantly higher among workers in the hot environment than those in the conveniently cool environment. This consistently related to the inversed correlation between percentages of body fat to body water suggesting that the higher percentage of body fat will be followed by the lower body water content.[8]

Although the workers in hot working environment had significantly higher body water content, 79.5%

Table 1. The health status of the subjects in hot and cool working environments

Variables	Hot environment (n = 39)	Cool environment (n = 39)	p
Age (year)	29 (25-44)§	30 (25-45)§	0.086*
Duration of working (years)	8 (1-22)§	8 (1-30)§	0.695*
Working hours/day (hours)	12 (8-12)	8 (7-12)	< 0.001*
Blood pressure (mmHg):			
Systolic	110 (90-160)§	120 (80-150)§	0.243*
High risk (> 139 mmHg), n (%)	3 (7.7)	3 (7.7)	1.000†
Diastolic	80 (60-100)§	80 (60-100)§	0.949*
High risk (> 89 mmHg), n (%)	0	0	-
Heart rate (times/minute)	68 (60-88)§	72 (60-88)§	0.426*
Total-cholesterol (mg/dL)	189.2 (31.8)ǀ	194.6 (29.9)ǀ	0.444‡
High risk (> 239 mg/dL), n (%)	11 (28.2)	19 (48.7)	0.063†
Triglycerides (mg/dL)	91 (34-263)§	103 (37-341)§	0.054*
High risk (> 200 mg/dL)	8 (20.5)	12 (30.8)	0.300†
LDL-cholesterol (mg/dL), n (%)	126.6 (32.4)ǀ	126.8 (25.2)ǀ	0.972‡
High risk (> 130 mg/dLk)	35 (89.7)	32 (82.1)	0.329†
HDL-cholesterol (mg/dL), n (%)	52.1 (12.6)ǀ	43 (27-96)§	0.005*
High risk (< 45 mg/dL)	7 (17.9)	14 (35.9)	0.074†

*Mann-Whitney U test; †chi-square-test; ‡unpaired-t test; §median (minimum-maximum); ǀmean (SD) of them had high blood viscosity versus 25.6% working in conveniently cool environment. This finding was supported by other hydration biomarkers such as hemoglobin concentration, hematocrit, blood viscosity and blood sodium concentration which were significantly higher among workers in hot environment (Table 3).

DISCUSSION

This study aimed to assess the health, nutrition and hydration status of workers in hot and conveniently cool working environment. It was conducted in two factories with room temperature of 36-38°C and 20-22°C.

Table 2. Nutritional status of the subjects in hot and cool working environments

Variables	Hot environment (n = 39)	Cool environment (n = 39)	p
Body weight in kg, mean (SD)	64.81 (11.93)	68.97 (11.99)	0.129*
Fat in %, mean (SD)	17.61 (6.71)	21.65 (6.31)	0.008*
Water in %, median (min-max)	60.1 (25.4-68.2)	57.0 (48.7-66.9)	0.022†
Visceral fat in %, median (min-max)	8 (1-19)	10 (1-16)	0.015†
Muscle mass in %, mean (SD)	50.01 (6.12)	50.86 (5.64)	0.526*
Bone mass in %, mean (SD)	2.74 (0.33)	2.77 (0.28)	0.631*
Basal metabolic rate in kcal, mean (SD)	1484.38 (196.65)	1503.46 (181.19)	0.657*
Height in m, median (min-max)	1.67 (1.55-1.87)	1.66 (1.57-1.83)	0.682†
Body mass index in kg/m2, mean (SD)	23.58 (4.82)	24.83 (4.24)	0.227*
Thin (< 18.5), n (%)	4 (10.3)	3 (7.7)	
Normal (18.5 - 22.9), n (%)	14 (35.9)	8 (20.5)	
Overweight (23.0 - 24.9), n (%)	9 (23.1)	9 (23.1)	
Obese (≥ 25.0), n (%)	12 (30.8)	19 (48.7)	0.556‡
Waist-circumference in cm, mean (SD)	82.75 (10.44)	87.47 (11.10)	0.057*
Abdominal obesity (≥ 90 cm), n (%)	9 (23.1)	16 (41.0)	0.089§

*independent-t test; †Mann-Whitney U test; ‡Kolmogorov-Smirnov test; §chi-square-test

Table 3. Hydration status of workers in hot and cool working environments

Variables	Hot environment (n = 39)	Cool environment (n = 39)	p
Hemoglobin in g/dL, median (min-max)	15.6 (12.3-18.0)	14.8 (12.6-17.2)	0.017*
Anemia, n (%)	3 (7.7)	1 (2.6)	0.615†
Hematocrit in %, median (min-max)	46 (39-49)	44 (40-49)	0.040*
Less than normal, n (%)	1 (2.6)	-	1.000†
Blood viscosity, mean (SD)	22.99 (8.21)	11.99 (2.18)	< 0.001‡
High blood viscosity, n (%)	31 (79.5)	10 (25.6)	< 0.001§
Blood Na, median (min-max)	140 (136-145)	138 (135-141)	< 0.001*
Hyponatremia, n (%)	-	1 (2,6)	1.000§
Urine color, n (%)			
Pale yellow	3 (7.7)	6 (15.4)	1.000§
Yellow	25 (64.1)	23 (59)	1.000§
Dark yellow	-	1 (2.6)	1.000§
Amber	11 (28.2)	9 (23.1)	1.000§
Urine pH, median (min-max)	6 (5-7)	6 (5-8)	0.233*
Urine pH status, n (%)	All normal	All normal	
Urine specific gravity (USG), mean (SD)	1.0178 (0.0076)	1.0187 (0.0077)	0.626‡
USG status, n (%)	All normal	All normal	

*Mann-Whitney U test; †chi-square test; ‡independent-t test; §Kolmogorov-Smirnov test

There were no significant differences in the blood pressure, heart rate, triglyceride, total and LDL-cholesterol levels between the two groups of workers except that those working in the conveniently cool environment had significantly lower HDL-cholesterol level. This was possibly due to longer working hours and more physical activities happened among the workers in hot environment. It is well known that higher physical activity will decrease the risk factors for CVD, including the plasma lipids and lipoproteins. Evidence showed that increasing physical activity was associated with the increase level of HDL and decrease of triglycerides.[9]

The overall health status of the workers in this study suggested they were at high risk of dyslipidemia, which is potentially related to coronary heart disease (CHD). Several studies revealed that CHD risk correlates to HDL-cholesterol level than to other blood lipid parameters since HDL plays a role in transferring circulating cholesterol to the liver; thus lowering the blood cholesterol level. Lower HDL-cholesterol level is evidently showing inverse association with the risk for coronary heart disease (CHD); while HDL-cholesterol level is much related to daily life style, i.e. mostly is aerobic exercise and diet.[10]

Nutritional status of the workers in both working environment showed that overweight, obesity and abdominal obesity, as determined by BMI and waist circumference, were highly prevalent among them. Instead of BMI, abdominal obesity has been reported to be a good indicator for the risk of developing cardio-vascular diseases (CVD).[11] Individuals with low BMI but having excess waist circumference, representing intra-abdominal (visceral) adiposity, may not be detected on the basis of BMI alone.

Blood viscosity is one physiological marker to determine both acute and chronic dehydration status, whereas urine specific gravity relates more to chronic dehydration.[12] Our study showed that individuals working in hot environment were at higher risk to develop both acute and chronic dehydration. While acute dehydration can be reversed by providing sufficient fluid intakes, chronic dehydration may lead to organ damage such as deposits of the blood vessels and kidney stone.

In conclusion, this preliminary study shows that workers in hot and cool working environment are prone to metabolic health problems as well as dehydration, suggesting special attention to the provision of timely drinking water, and physical activity during working time are required.

Conflict of interest

Dr. Bardosono reports grants from PT Amerta Indah Otsuka, during the conduct of the study.

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