International Journal of Health Sciences
Available online at www.sciencescholar.us
Vol. 7 No. 1, April 2023, pages: 1-12
e-ISSN: 2550-696X, p-ISSN: 2550-6978
https://doi.org/10.53730/ijhs.v7n1.13820

Energy Drinks Consumption Among Construction Workers in Indonesia and Associated Factors: A Cross-Sectional Study

Ira Suarilah [a], Andri Setiya Wahyudi [b], Candra Panji Asmoro [c], Chiu-Chu Lin [d]

Manuscript submitted: 26 April 2022, Manuscript revised: 20 June 2022, Accepted for publication: 04 December 2022

Corresponding Author [a]

Keywords

energy drink;
health literacy;
health risk;
kidney function;
public health;

Abstract

Younger and adults tend to consume energy drinks due to the benefit received as promoted by the manufacturer. This retrospective, cross-sectional study aimed to investigate factors associated with energy-drink consumption in a group of construction workers in Indonesia. Literate construction workers who have consumed any brand of energy drink at least once per week were recruited. Demographic data and health literacy were self-reported. The short version of the test functional health literacy for adults (S-TOFHLA) tool was used to examine health literacy. Kidney function was determined by an estimated glomerulus filtration rate (EGFR). An average EGFR of 83.76 mL/min/1.73 m^2 was retrieved from 114 participants. Health literacy (p=.016), pre-existing disease (p=.001), and intensity (p=.029) showed a significant difference with decreased kidney function. Age of the first-time experiencing energy drinks (r=-0.260) and pre-existing disease (r=-0.282) showed negative significance correlations (p=<.001) with kidney function. A family history of comorbidity (ß=-0.213), (p=.023), 95% CI (-6.697—-1.286), was a predictor of lowering kidney function among construction workers with extended ingestion of energy drinks. This study emphasizes the importance of elevating public awareness of possible dangers caused by extending the ingestion of energy drinks on the kidney.

International Journal of Health Sciences © 2023.
This is an open access article under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0/).

Contents

[a] Faculty of Nursing, Universitas Airlangga, Indonesia
[b] Faculty of Nursing, Universitas Airlangga, Indonesia
[c] Faculty of Nursing, Universitas Airlangga, Indonesia
[d] School of Nursing, Kaohsiung Medical University, Taiwan

1 Introduction

Energy drinks are trending among young people and adults due to the benefits received as promoted by the manufacturers. Till now, Asian countries including Indonesia, Thailand and India have been a market target of international energy drink brands (Bull, 2019). The impacts of ingesting energy drinks on general health have been massively discussed (Breda et al., 2014; Higgins et al., 2018) as well as a review on the dangers of energy drinks on the kidney (Ngo, 2014). Nephrotoxicity was one of the major reasons for adverse kidney function among adults with excessive ingestion of energy drinks. Concerning the growing evidence for ingesting energy drinks among adults and the nephrotoxicity effect, Indonesia with a population density ages ranging from 15 to 64-year-old (66.7%)(BPS, 2019) has been placed as a potential market for energy drinks (Bull, 2019). Therefore, the growing evidence of chronic kidney diseases (CKD) in Indonesia is high. Indonesia Renal Registry (IRR) reported a significant increase (7%) in new end-stage renal disease (ESRD) patients during the year 2007 to 2017. Half of them (52%) were between the age of 25 to 54-year-old (IRR, 2017).

Nevertheless, to date, there is a lack of studies exploring similar issues in developing countries (Gurley et al., 2017). Neither, several studies on the impacts of ingesting energy drinks for extended use on the alteration of kidney function have been published in the academic database (Kendall et al., 2014; Ragsdale et al., 2010). Previous studies investigated the impact of energy drinks on kidney function among healthy educated adults in a short time (less than a month) and reported an alteration of kidney function found in the intervention group (Kendall et al., 2014; Ragsdale et al., 2010). Another six case studies reported similar issues on the impact of ingesting energy drinks on kidney function (Al Yacoub et al., 2020; Bhatt et al., 2014; Greene et al., 2014; Iyer et al., 2016; Kelsey et al., 2019; Salanova-Villanueva et al., 2015) and emphasized that energy drinks caused kidney failure (Reissig et al., 2009). That evidence left a question on the effect of ingesting energy drinks with variation in intensity and duration on the kidney function.

Concerning ethics, exploring the impact of ingesting energy drinks on a human for extended use might never be conducted in the clinical setting. This results in a gap in the body of knowledge. Therefore, the current retrospective study aimed to investigate the association between demographics, health literacy, and kidney function among construction workers. The level of estimated glomerulus filtration rate (EGFR) referred to the kidney function and was used throughout this report. The results might inform interventions necessary to enhance public awareness of the adverse effect of energy drinks for extended use on the kidney.

2 Materials and Methods

Study design and setting

This study is a retrospective, cross-sectional study. Male worker participants were recruited from government bodies with major duties for constructing the public infrastructures in Surabaya city, Indonesia. Inclusion criteria were males with the age above 18 years old who consume any brand of energy drinks once per week at least for the current 6 months, able to write, read, and speak Bahasa Indonesia, and willing to participate in the study were included. Before collecting data, a research proposal was sent to the Head of 'Bakesbangpol' (United Nations and Political Body of Indonesia), an administrative body that issued a regulation for conducting research in the community setting. After receiving the approval letter, an administrative letter from 'Bakesbangpol' was sent to the head of three government bodies which then connected to managers of the projects. From five project managers who were separated into five different sites, the common behavior of ingesting energy drinks was retrieved. Construction workers reporting cognitive disorders were excluded.

Sample size and sampling

G-power software version 3.1.9.2 for sample size was used to calculate the sample of the study participants. Within consideration, the statistical test applied in this study was the linear multiple regression, a power analysis set with standard alpha (α) level = 0.05, medium effect size = 0.02, a standard power of 0.85, and 12 predictors. From this, an f-test was used to estimate the sample size, where the effect size would be aimed at increases in R^2 or R^2 deviation from zero (Faul et al., 2007). An appropriate estimation sample size was 108 participants. A convenient sampling of 114 construction workers participated in this study.

Data collection and measurement

Information related to any possible risks before giving spoken and written formal consent to participate in the study was delivered. Participants were informed that the result of the blood sample collected to assess the EGFR could also be used to have further health assessment related to the kidney at Public Health Center (PHC) or any primary care services.

Demographic variables

A self-report questionnaire to collect demographic data was developed in this study. Demographic variables included the information on age, level of attained education, family existence: was asked about living with/without family members, employment status, monthly income, health insurance, smoking, the age of the first time experiencing an energy drink, and the intensity of ingesting per week was measured in "*how many sachets/bottles/cans of energy drink you consume every week*?", duration of ingestion in years by " *how many months/years you have been ingesting energy drink*?", family history of comorbidity, pre-existing disease(s), and health-literacy.

Health literacy

The health literacy of participants was assessed using the short test of functional health literacy for adults (S-TOFHLA) (Baker et al., 1999). The S-TOFHLA is reading comprehension, which examines basic reading skills necessary for effective functioning in a health context (Baker et al., 1999). Each correct answer on the S-TOFHLA was scored with one point while each incorrect answer (or no answer) gets 0 points, for a total possible score of 36. Cut-off scores of the S-TOFHLA were then used to categorize participants into three levels; inadequate (total score: 0 to 16), marginal (total score: 17 to 22), and adequate (total score: 23 to 36). Inadequate and marginal levels can be merged into poor or limited health literacy (Taylor et al., 2018; Batterham et al., 2016).

Kidney function

The indicator of Kidney function was measured by an EGFR level. Kidney function was estimated using the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) creatinine equation to find the estimated EGFR (NKF, 2002). Following Indonesia Renal Registry and kidney disease improving global outcome (KDIGO) from National Kidney Foundation (NKF), in this study, the EGFR level was grouped into two categories: normal and low, where the normal value was defined by the level of EGFR ≤90 mL/min/1.73 m^2 (Ahmed et al., 2019; IRR, 2017; Schmitt et al., 2008). To measure EGFR, two phlebotomy staff from the Ministry of Health of Republic Indonesia's laboratory in Surabaya, measured the body weight and took the blood sample from the brachialis vein with vacutainer tubes containing anticoagulant. All the blood samples were directly sent to the laboratory to check creatinine and calculate the EGFR level. All data were taken in the morning starting from 06:30 AM to 8:00 AM before the participants went to the construction project sites

Ethical consideration

This study was approved by the Institutional Review Board with IRB certificate No: 1314-KEPK. All participants signed written informed consent to participate in the study.

3 Results and Discussions

Demographic and clinical characteristics of participants

Among 114 participants, the average EGFR was 83.76 mL/min/1.73 m^2 (SD= 20.64), the age was 35.83 (SD= 11.12), the age of the first-time experiencing energy drinks was 20.14 years old (SD= 7.61), the level of health literacy was poor by average 22.95 (SD= 6.77). The participant who attained 12 years of education was dominant (47.37%). Most of the participants reported having health insurance (70.18%) and living without family (70.08%) with employment status as a non-civil servant (98.24%). In the majority, participants received monthly income below 244.8 USD (88.60%). More than half reported smoking less than or equal to 10 cigarettes per day (54.38%) and had a family history of comorbidity (61.40%). More than three-quarters reported no pre-existing disease (76.32%). Above one-half reported duration of consumption of energy drinks of more than a year (58.68%) and over one-third with the intensity of consuming equal to or more than 6 sachets/cans/bottles per week (45.5%). A detailed description of demographic characteristics is provided in Table 1.

Table 1
Demographic and clinical characteristics (n=114)

Characteristics			Normal Kidney Function	Lowering Kidney Function
	Mean (SD)	N (%)	N (%)	N (%)
EGFR level	83.76(20.64)			
Age (years)	35.83(11.12)			
18-30			23(20.187)	19(16.67)
41-50			7(6.14)	29(20.14)
51-60			8(7.02)	15(10.42)
61-63			((0,00)	13(11.40)
First-time (years)*	20.14 (7.613)			
≤12			27 (23.68)	41(35.96)
13-18			4(3.51)	14(9.72)
≥19			7(6.14)	21(18.42)
Functional health literacy	22.95 (7.10)			
Low			19(16.67)	43(37.72)
High			19(16.67)	33(28.95)
Education				
Less than 6 years		1(0.88)	1(0.88)	0(0.00)
6 years		24(21.05)	8(7.02)	16(14.04)
9 years		30(26.32)	5(4.39)	25(21.93)
12 years		54(47.37)	21(18.42)	33(28.95)
College/University		5(4.38)	3(2.63)	2(1.75)
Health insurance				
No		34(29.82)	7(6.14)	27(23.68)
Yes		80(70.18)	31(27.19)	49(42.98)
Family**				
No		80(70.08)	19(16.67)	61(53.51)
Yes		34(0.88)	19(16.67)	15(13.16)
Employment statue				

Non-civil servant	112(98.24)	36(31.58)	76(66.67)
Civil servant	2(1.75)	2(1.75)	0(0.00)
Monthly income***			
≤ minimum regional payment	101(88.60)	32(28.07)	69(60.53)
≥ minimum regional payment	13(11.40)	6(5.26)	7(6.14)
Smoking			
≤10 cigarettes per day	62(54.38)	19(16.67)	43(37.72)
≥11 cigarettes per day	52(45.61)	19 (16.67)	33(28.95)
Family history of comorbidity			
No	44(38.60)	24(21.05)	20(17.54)
Yes	70(61.40)	14(12.28)	56(49.12)
Pre-existing disease(s)			
No	87(76.32)	31(27.19)	56(49.12)
Yes			
Hypertension	14(12.28)	5(4.39)	9(7.89)
Diabetes mellitus	4(3.50)	0(0.00)	4(3.51)
Hypertension and Diabetes mellitus	2(1.75)	1(0.88)	1(0.88)
COPD	5(3.39)	1(0.88)	4(3.51)
Others	2(1.75)	0(0.00)	2(1.75)
Duration of ingesting energy drink (years)			
≤ =1	45(39.47)	16(14.04)	29(25.44)
2-3	9(7.89)	3(2.63)	6(5.23)
4-5	27(23.69)	9(7.89)	18(15.79)
≥6	33(28.95)	10(8.77)	23(20.18)
The intensity of ingesting energy drinks (week)****			
1-2	29(25.44)	11(9.65)	18(15.79)
3-5	35(30.70)	11(9.65)	24(21.05)
≥6	50(43.86)	16 (14.04)	34 (29.82)

*Age at the first-time experiencing energy drink;
**Living with/without family
***Surabaya's minimum regional payment 2018= USD 244.8
****Sachet/bottle/can

The difference in kidney function and related variables

11 variables were tested to determine the difference between the two groups; normal kidney and decreased kidney function. Variable employment status was excluded since none of the participants (0%) with decreased kidney-held civil servants. Among the normal kidney function group, first-time experiencing energy drinks showed a significant correlation (p= .035) with normal kidney function while the rest remained significant. In another group, the following three variables; health literacy (p=.016), pre-existing disease (p=.001), and intensity (p=.029) were significantly different in the group with decreased kidney function (Table 2).

Table 2
The difference in kidney function and related variables (n=114)

Variable	Normal Kidney function *P* value	Lowering kidney function *P* value
1. First-time	.035[d]	.291[c]
2. Health literacy	.161[b]	.016[a]
3. Education	.172[d]	.473[c]
4. Health insurance	.685[b]	.553[a]
5. Family	.256[b]	.253[a]
6. Monthly income	.279[b]	.340[a]
7. Smoking	.624[b]	.104[a]
8. Family history of comorbidity	.128[b]	.429[a]
9. Pre-existing disease	.261[d]	.001[c]
10. Duration	.479[d]	.080[c]
11. Intensity per week	.614[c]	.029[c]

[a] T-independent Test
[b] Mann Withney U
[c] One way Anova
[d] Kruskal Wallis

Correlation between demographic characteristics, health literacy, and EGFR

Spearman's correlation shows a significant negative correlation between five inference variables with the outcome (Table 3). Variable family (r = -0.200 p =.033), employment statue (r = -0.195 p =.038), first-time experiencing energy drink (r = -0.260, p <.001), family history of comorbidity (r = -205, p =.029), pre-existing disease (r = -0.278, p < .001), with kidney function. These negative significant correlations underline the longer living separated from family, the lesser the civil servant status of employment, the younger age of experiencing drinking energy drinks, and the more disease in the family and the personal, associated with the lower EGFR level. The correlation matrix of the thirteen variables is shown in Table 3.

Table 3
Correlation between kidney function and influencing factors (n=114)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Education	1												
2. Family	0.045	1											
3. Employment status	0.238*	0.031	1										
4. Monthly income	0.273**	0.171	0.372**	1									
5. Health insurance	0.050	0.162	0.087	0.113	1								
6. Smoking	0.032	0.039	0.012	0.107	0.057	1							
7. First-time	0.135	0.220*	0.071	0.035	0.019	0.122	1						
8. Intensity per week	0.091	0.094	0.141	0.081	0.003	0.014	0.069	1					
9. Duration	0.209*	0.082	0.111	0.372**	-0.189*	0.134	0.132	-0.275**	1				
10. Family history	0.036	0.001	-0.031	0.058	-0.162	-0.070	0.029	-0.069	0.183	1			
11. Pre-existing disease	-0.173	0.326**	-0.074	0.054	0.054	-0.093	0.364**	0.133	0.025	0.133	1		
12. Health literacy	0.108	0.241**	-0.040	-0.002	0.083	0.164	0.124	0.364**	0.109	0.057	0.345*	1	
13. Kidney function	0.158	-0.200*	-0.195*	0.047	0.092	-0.043	0.260**	-0.152	0.102	-0.205*	-0.282**	-0.141	1

**. Correlation is significant at the 0.01 level (2-tailed *P* <0.01
*. Correlation is significant at the 0.05 level (2-tailed) *P*<0.05

Hierarchical regression of associated demographic characteristics and health literacy with EGFR

Table 4 shows the hierarchical multilinear regression analysis of the relationship between demographic characteristics, health literacy, and kidney function. Eleven demographic variables were entered into the first model of the hierarchical regression analysis. Demographic factors explained 24.0% of the variance in kidney function (F change = 2.922). In the second model, the health literacy factor was added and individually explained 0.4 % of the variance in kidney function (F change= 2.715). The first model (ß= -0.217), 95% CI (16.806 — -1.445), (p= .019) and the second (ß= -0.213), 95%CI (-16.697— -1.286), (p=.023) summarized a family history of comorbidity was the predictor of lowering kidney function among construction workers with extended ingestion of energy drinks.

Table 4
Predictors of lowering kidney function (n=114)

Model 1				Model 2			
Variabel	Beta	CI(95%)	P value		Beta	CI(95%)	P value
Education	0.053	(-2.319 — 6.370)	.570	Education	0.104	(-2.061 — 6.875)	.288
Family	-0.071	(-13.636 — 2.641)	.461	Family	-0.120	(-13.312 — 3.145)	.223
Employment status	0.134	(-1.847 — 58.682)	.169	Employment status	0.173	(-3.519 — 57.581)	.082
Monthly income	-0.032	(-13.403 — 12.321)	.745	Monthly income	-0.011	(-13.596 — 12.199)	.915
Health insurance	0.100	(-6.877 — 9.881)	.281	Health insurance	0.040	(-6.654 — 10.203)	.677
Smoking	-0.074	(-11,229 — 3.501)	.412	Smoking	-0.081	(-10.847 — 4.172)	.380
First time	-0.141	(-0,979 — 0.113)	.165	First time	-0.158	(-0.975 — 0.121)	.125
Intencity	-0.055	(-8.278 —1.124)	.556	Intensity	-0.126	(-8.021 — 1.594)	.188
Duration	-0.063	(-2.918 — 3.722)	.539	Duration	-0.029	(-2.863 — 3.801)	.781
Family history of comorbidity	-0.217	(-16.806 — -1.445)	.019	Family history of comorbidity	-0.213	(-16.697— -1.286)	.023
Pre-existing disease	-0.168	(-5.683 — 1.269)	.098	Pre-existing disease	-0.107	(-5.453 — 1.789)	.318
				Health-literacy	-0.075	(-7.908 — 3.547)	.452
R^2	0.240			R^2	0.244		
Adjusted R^2	0.158			Adjusted R^2	0.154		
R^2 change	0.240			R^2 change	0.244		
F change	2.922			F change	2.715		

Significance level *P*<.05.

Discussion

The prevalence of decreased kidney function in this study was shown by an average result of EGFR at the level of 83.76 mL/min/1.73 m^2 (SD= 20.64) which was categorized as lowering kidney function below the normal level (⍰90 mL/min/1.73 m^2). Following the NKF (2012), lowering EGFR below the normal level was one of the clinical parameters of early-stage CKD. This study found the actual age and the minimum age of the first-time experiencing energy drink, emphasising consuming energy drinks among the adult population started when they were very young. This phenomenon represents a rapidly expanding segment of the beverage industry and successfully created the youth drink culture. These give the fact of the power of an energy drink marketing strategies, which have reached participants from a very young age, and being loyal customers when they were adults.

The facts are that a low level of health literacy, pre-existing disease, and intensity of ingestion are likely to be more influential in lowering kidney function. Insufficient health literacy is considered a leading factor to unhealthy behaviour; ingesting energy drinks for an intense and less aware of the impact on kidney function. While this study did not investigate causality whether ingesting energy drinks causes those pre-existing diseases, the existing literature reported that extended ingestion of energy drinks among those who reported no pre-existing disease has led to massive kidney insufficiency, and end-up with acute kidney failure (Greene et al., 2014; Kelsey et al., 2019). It is then reasonable to consider that extended ingestion of energy drinks among

adults with pre-existing diseases, for example, hypertension and/or diabetes mellitus, faster the progress of decreasing kidney function.

As summarized in other studies, the issue of whether energy drinks might or might not be banned (Bhatt et al., 2014; Stordal et al., 2018), is not a crucial issue to be talked about at the level of policymakers at lower economic levels countries. The working-age populations with low formal level education (less than 12 years) tend to have an unprofessional job which is likely to be dependent on physical strength to live a productive life. However, the presence of decreasing kidney function might find itself with kidney failure earlier in life, left to live in health inequality.

Construction workers represent a society that looks for extra energy to improve their productivity. Therefore, it is reasonable to expect a parallel connection between age, education, employment status, and monthly payment received, whereas lower socioeconomic status represents lower education. Furthermore, it restricts them from gaining a professional job and from higher payment received. For those with a formal education of fewer than 12 years, a very limited job vacancy is offered. It is plausible, among construction workers, that they focus on their physical strength, having extra energy enables them to work for extra hours and earn extra money.

In Indonesia, two types of energy drinks are sold in public. The first is a powder packaged in a plastic sachet, to be poured or mixed with drinking water or another drink. The second is a water solution packaged in a glass bottle or can. Several local brands were selling in sachet packaging at affordable prices. This was a conducive environment for construction workers; sachets of energy drink powder mixed with drinking water supported their demands for instant energy. This common behaviour might then threaten kidney function. Indeed, However, there is little known about clinical studies evaluating the mechanism of CKD caused by frequent ingestion of energy drinks (Greene et al., 2014). Hence, there are shreds of evidence reporting that CKD awareness remains low among both patients and health professionals (Abraham et al., 2016; van Dipten et al., 2018).

Understanding the significant, negative association between family and kidney function, underlines the existence of how the family relates to the status of participants as migrant workers. Construction workers reported having left their families in rural areas and migrated to an urban area for a job. Less existence of the family as a caregiver resulted in less prevention of the severity associated with unhealthy behaviors (Mollica et al., 2020). This has also been alarming community nurses and public health officers to substitute the role of caregiver, to help this marginal cluster from adverse kidney function (Room et al., 2005; Freedman et al., 2009).

Of all of the twelve investigated factors, a family history of comorbidity was found as the predictor of lowering kidney function among construction workers with extended ingestion of energy drinks. Thomas et al. (2015), reported a family history of comorbidity reflects the shared genetic or environmental risk to the following generations. For example, at the first diagnosis, an individual with a family history of Diabetes mellitus identifies a slight lowering of EGFR below the normal level, later they come up with a higher risk of kidney disease. The progress of worsening kidney function among construction workers who have been ingesting energy drinks for years might have resulted from a complex process related to individual and environmental factors (Nataliia et al., 2021). Current findings add to the body of knowledge whereas the following factors, first, family history of comorbidity adds a risk factor in altering kidney function among those with extended ingestion of energy drinks. Secondly, individuals with the following characteristics (1) reported a family history of comorbidity, (2) one or more pre-existing diseases, (3) higher intensity of ingesting energy drinks, (4) low health literacy, (5) living separated from family, and (6) young age of first-time experiencing energy drinks, are on the risk of lowering kidney function (Borawski et al., 2003).

This study has several limitations. These include cross-sectional design, which limits the ability to establish a causal relationship between extended ingestion of energy drinks on the lowering of EGFR. Unfortunately, the Indonesian version of S-TOFHLA was not available to us at the time of this study. The Indonesian version was forward and backwards translated by the first author and a professional translator without piloting. Other limitations are the convenience sampling method, which limits the generalization of results, and the possibility that construction workers with low literacy levels may be less accurate when conducting the self-report. Cofounders in this current study may involve the construction workers' health literacy and its interaction with public health services. Further research with more sample sizes in different study settings is needed to be conducted and verified by the researchers to gain the generalization.

4 Conclusion

In conclusion, energy drink which has been perceived as safe to be regularly ingested needs to be redefined. Decreasing kidney function among construction workers emphasizes the urgency of elevating public awareness of possible dangers caused by extended ingestion of energy drinks on the kidney. Thus, poor health literacy and decreasing kidney function among construction workers are unspoken words asking for help. To a large extent, connecting them to health care providers, to slow the progression of the disease as well as to maintain their productivity needs to be immediately commenced.

Acknowledgements
We are grateful to Universitas Airlangga, the head of the projects and all participants for the time, and commitment to participate in this study. We also thank Dr. Tintin Sukartini, for her feedback on all statistics processes.

References

Abraham, G., Varughese, S., Thandavan, T., Iyengar, A., Fernando, E., Naqvi, S. A., ... & Kafle, R. K. (2016). Chronic kidney disease hotspots in developing countries in South Asia. *Clinical kidney journal*, *9*(1), 135-141.

Ahmed, S., Tome, J., Mourao, M., Chen, E., Harrison, S., Fagerlin, A., Nunes, J. W., & Pritchett, K. (2019). Associations between web-based resource use and patient centered outcomes in chronic kidney disease (ckd) [Conference Abstract]. *American Journal of Kidney Diseases, 73*(5), 647.

Al Yacoub, R., Luczkiewicz, D., & Kerr, C. (2020). Acute kidney injury and hepatitis associated with energy drink consumption: a case report. *Journal of medical case reports*, *14*(1), 1-4.

Baker, D. W., Williams, M. V., Parker, R. M., Gazmararian, J. A., & Nurss, J. (1999). Development of a brief test to measure functional health literacy. *Patient education and counseling*, *38*(1), 33-42. https://doi.org/10.1016/S0738-3991(98)00116-5

Batterham, R. W., Hawkins, M., Collins, P. A., Buchbinder, R., & Osborne, R. H. (2016). Health literacy: applying current concepts to improve health services and reduce health inequalities. *Public health*, *132*, 3-12. https://doi.org/10.1016/j.puhe.2016.01.001

Bhatt, A., Salberg, J., Shah, M., & Venkatesh, P. (2014). Palpitations and metabolic disturbances in a healthy young man with chronic high-caffeine energy drink consumption. In *Journal Of General Internal Medicine* (Vol. 29, pp. S404-S405). 233 SPRING ST, NEW YORK, NY 10013 USA: SPRINGER.

Borawski, E. A., Ievers-Landis, C. E., Lovegreen, L. D., & Trapl, E. S. (2003). Parental monitoring, negotiated unsupervised time, and parental trust: The role of perceived parenting practices in adolescent health risk behaviors. *Journal of adolescent health*, *33*(2), 60-70. https://doi.org/10.1016/S1054-139X(03)00100-9

Breda, J. J., Whiting, S. H., Encarnação, R., Norberg, S., Jones, R., Reinap, M., & Jewell, J. (2014). Energy drink consumption in Europe: a review of the risks, adverse health effects, and policy options to respond. *Frontiers in public health*, 134.

Bull, R. (2019). Athletes.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*, *39*(2), 175-191.

Freedman, D. A., Bess, K. D., Tucker, H. A., Boyd, D. L., Tuchman, A. M., & Wallston, K. A. (2009). Public health literacy defined. *American journal of preventive medicine*, *36*(5), 446-451. https://doi.org/10.1016/j.amepre.2009.02.001

Greene, E., Oman, K., & Lefler, M. (2014). Energy drink–induced acute kidney injury. *Annals of Pharmacotherapy*, *48*(10), 1366-1370.

Gurley, B. J., Kingston, R., & Thomas, S. L. (2017). Caffeine-Containing Energy Drinks/Shots: Safety, Efficacy, and Controversy. In *Sustained Energy for Enhanced Human Functions and Activity* (pp. 423-445). Academic Press. https://doi.org/10.1016/B978-0-12-805413-0.00026-0

Higgins, J. P., Babu, K., Deuster, P. A., & Shearer, J. (2018). Energy drinks: a contemporary issues paper. *Current sports medicine reports*, *17*(2), 65-72.

IRR. (2017). 10th Report of Indonesian Renal Registry. https://www.indonesianrenalregistry.org/data/IRR%202017%20.pdf

Iyer, P. S., Yelisetti, R., Miriyala, V., Siddiqui, W., & Kaji, A. (2016). A remarkable case of rhabdomyolysis associated with ingestion of energy drink 'neon volt'. *Journal of Community Hospital Internal Medicine Perspectives*, *6*(5), 32528.

Kelsey, D., Berry, A. J., Swain, R. A., & Lorenz, S. (2019). A case of psychosis and renal failure associated with excessive energy drink consumption. *Case reports in psychiatry*, *2019*.

Kendall, K. L., Moon, J. R., Fairman, C. M., Spradley, B. D., Tai, C. Y., Falcone, P. H., ... & Esposito, E. N. (2014). Ingesting a preworkout supplement containing caffeine, creatine, β-alanine, amino acids, and B vitamins for 28 days is both safe and efficacious in recreationally active men. *Nutrition research*, *34*(5), 442-449. https://doi.org/10.1016/j.nutres.2014.04.003

Mollica, M. A., Smith, A. W., & Kent, E. E. (2020). Caregiving tasks and unmet supportive care needs of family caregivers: A US population-based study. *Patient education and counseling*, *103*(3), 626-634. https://doi.org/10.1016/j.pec.2019.10.015

Nataliia, V., Barzylovych, A., Zabolotna, A., Boiko, M., & Rybchych, I. (2021). Healthcare facilities management in digitalization context. *International Journal of Health Sciences*, *5*(3), 429–440. https://doi.org/10.53730/ijhs.v5n3.1773

Ngo, J. (2014). Health warning as three energy drinks found to contain more caffeine than child's daily recommended dose. South China Morning Post Ltd.

NKF. (2002). DOQI guidelines 2000. Appendix V. Rationale and methods for the determination of the Protein Equivalent of Nitrogen Appearance (PNA)

Ragsdale, F. R., Gronli, T. D., Batool, N., Haight, N., Mehaffey, A., McMahon, E. C., ... & Wilson, T. (2010). Effect of Red Bull energy drink on cardiovascular and renal function. *Amino acids*, *38*(4), 1193-1200.

Reissig, C. J., Strain, E. C., & Griffiths, R. R. (2009). Caffeinated energy drinks—a growing problem. *Drug and alcohol dependence*, *99*(1-3), 1-10. https://doi.org/10.1016/j.drugalcdep.2008.08.001

Room, R., Babor, T., & Rehm, J. (2005). Alcohol and public health. *The lancet*, *365*(9458), 519-530. https://doi.org/10.1016/S0140-6736(05)17870-2

Salanova-Villanueva, L., Bernis-Carro, C., Alberto-Blazquez, L., & Sanchez-Tomero, J. A. (2015). Severe arrhythmia due to hypokalemia. Influence from diuretic substances. *Nefrología (English Edition)*, *35*(3), 334-336.

Schmitt, R., Coca, S., Kanbay, M., Tinetti, M. E., Cantley, L. G., & Parikh, C. R. (2008). Recovery of kidney function after acute kidney injury in the elderly: a systematic review and meta-analysis. *American Journal of Kidney Diseases*, *52*(2), 262-271. https://doi.org/10.1053/j.ajkd.2008.03.005

Størdal, K., Selvaag, E., & Greve-Isdahl, M. (2018). A ban on energy drinks?. *Tidsskrift for den Norske laegeforening: tidsskrift for praktisk medicin, ny raekke*, *138*(17).

Taylor, D. M., Fraser, S., Dudley, C., Oniscu, G. C., Tomson, C., Ravanan, R., ... & ATTOM investigators. (2018). Health literacy and patient outcomes in chronic kidney disease: a systematic review. *Nephrology Dialysis Transplantation*, *33*(9), 1545-1558.

Thomas, M. C., Brownlee, M., Susztak, K., Sharma, K., Jandeleit-Dahm, K. A., Zoungas, S., ... & Cooper, M. E. (2015). Diabetic kidney disease. *Nature reviews Disease primers*, *1*(1), 1-20.

Van Dipten, C., Van Berkel, S., De Grauw, W. J., Scherpbier-de Haan, N. D., Brongers, B., Van Spaendonck, K., ... & Dees, M. K. (2018). General practitioners' perspectives on management of early-stage chronic kidney disease: a focus group study. *BMC family practice*, *19*(1), 1-7.

Biography of Authors

Ira Suarilah, Ph.D, RN
Assistant Professor at Faculty of Nursing, Universitas Airlangga, Indonesia. Educational background; B.Sc. in Nursing from Universitas Padjadjaran, Indonesia; M.Sc. in Advanced Nursing from the University of Nottingham, United Kingdom (UK); and PhD in nursing from Kaohsiung Medical University, Taiwan. Research area; Chronic diseases, self-care behavior, nursing education, and health promotion.
ORCID: https://orcid.org/0000-0001-8234-949X
Email: ira.suarilah@fkp.unair.ac.id

Dr. Andri Setiya Wahyudi, RN
Assistant Professor at Faculty of Nursing, Universitas Airlangga, Indonesia. Educational background; B.Sc. in Nursing from Stikes Insan Unggul, Indonesia; M.Ns from Universitas Airlangga, Indonesia; and PhD in Medical Science from Universitas Airlangga, Indonesia. Research area; Endocrine and metabolism diseases, self-management of chronic illness; nursing education, traditional/alternative medicine and health promotion.
ORCID: andri.setiyawahyudi@fkp.unair.ac.id
Email: andri.setiyawahyudi@fkp.unair.ac.id

Candra Panji Asmoro, RN
Assistant professor at the Faculty of Nursing, Universitas Airlangga, Indonesia and Doctoral student at the Faculty of Nursing, Universitas Indonesia, Indonesia. Educational background; S.Kep.Ns. from Faculty of Nursing Universitas Airlangga, Indonesia; M.Kep. in Nursing from Universitas Airlangga, Indonesia. Research area; Fundamental of nursing, nursing management; nursing education; and HIV/AIDS.
ORCID: https://orcid.org/0000-0001-7766-2844
Email: candra.panji.a@fkp.unair.ac.id

Chiu-Chu Lin, Ph.D, RN
Professor at Nursing College, Kaohsiung Medical University, Taiwan. Researcher at the Department of Renal Care, College of Medicine, Kaohsiung Medical University and Department of Medical Research, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan. Research speciality; Nephrology Nursing; Self-Management of Chronic Illness; Theory-Based Nursing Intervention; Development and Testing of Instrument; and Health Promotion
ORCID: https://orcid.org/0000-0002-8947-467X
Email: chiuchu@kmu.edu.tw