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Enhancement of Chronic Kidney Disease Health Literacy in Young Generation: Community Service in Islamic Boarding School

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Abstract

The incidence of chronic kidney disease (CKD) in younger age is concerningly increasing in developing countries, including Indonesia. Modified risk factors, namely lifestyle, smoking and diet, have more impact than genetic predisposition. The increased amount of Ultra-processed foods (UPFs) will significantly increase the risk for renal functional deterioration. The potential of risks was exacerbated by the presence of small stalls in the designated Islamic boarding school, in which they sold instant noodles and powdered drinks. In this regard, we attempted to raise awareness of CKD in the young generation of an Islamic boarding school. A community service targeted middle schoolers, high schoolers and educators by giving a health seminar regarding kidney health and booklet launching. Dietary behavior and tests to assess CKD knowledge were taken. The Wilcoxon signed-rank test was used to compare the improvement of knowledge. A total of 102 participants were included, with the majority being of adolescent age (77.4%) and the least from young adult age (>19 years old) as educators (22.5%). 35 (33.9%) participants consume more than three UPFs items daily. The most consumed were packaged snacks, instant noodles, and sweetened drinks. The knowledge level was considerably low prior to the seminar. There was a significant improvement in knowledge after receiving a seminar in which the pre-test median score was 11.5 and increased to score 20 in the post-test ($p<0.0001$). Although CKD is more prevalent in older people, bad habits include smoking, consuming high sugar intake, and UPFs will increase the risk for young people to develop CKD. Building on this, boarding schools should supervise the types of food sold in the community. A simple seminar for young generations could increase knowledge and awareness. Similar targeted efforts to raise awareness in the often-overlooked Islamic boarding school can potentially be implemented elsewhere.

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INTRODUCTION

The kidneys are vital organs responsible for regulating fluid balance, eliminating metabolic waste, and producing hormones that control blood clotting. Chronic kidney disease (CKD) is a significant global health issue and is one of the leading causes of death, particularly in conjunction with diabetes mellitus and hypertension. With ageing, kidney function declines, making CKD increasingly prevalent in individuals over 60 years (Chen et al., 2019). While CKD incidence varies between countries, a rising trend among younger age groups is evident. In low- and middle-income countries, this issue is particularly concerning, with a growing incidence of CKD observed in younger populations. For instance, data from Iran indicate a consistent increase in CKD cases

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among young and middle-aged adults (20–59 years) (Shahbazi et al., 2023). Similarly, an analysis of the 2018 Indonesian National Health Survey reported a CKD prevalence of 0.5%, with 83% of cases occurring in individuals aged 18–59 years (Hustrini et al., 2022). Risk factors for CKD include age, family history, lifestyle, obesity, and comorbid conditions such as diabetes and hypertension. Among these, lifestyle-related factors have a more significant impact than genetic predisposition. Lifestyle influences include smoking, physical inactivity, diet, and alcohol consumption (Kazancioğlu, 2013).

As the global incidence of CKD continues to rise, there has been a dramatic increase in the consumption of processed foods worldwide. In some high-income countries, ultra-processed foods (UPFs) account for over 50% of daily caloric intake, and their consumption is steadily increasing in middle-income countries. UPFs are characterized by lower nutritional quality, containing higher levels of saturated fats, added sugars, energy density, and salt, alongside elevated contaminants from processing or packaging. These components collectively harm health (Kityo & Lee, 2022). A recent cohort study using data from the Atherosclerosis Risk in Communities (ARIC) reported that individuals with high UPF consumption had a 24% higher risk of developing CKD after 24 years of follow-up (Du et al., 2022). Additionally, modern lifestyles have seen increased consumption of supplements and energy drinks. Energy drinks often contain high levels of sweeteners, caffeine, and taurine, and a 12-week administration to animal models significantly damaged the liver and kidneys (Elbendary et al., 2023).

Fig. 1. Initial observation in the boarding schools area with small stalls on the first and second floors

The Islamic boarding school, serving as the community service partner, has been in operation for nearly 100 years and is situated in a densely populated area. The boarding school never had any health seminars before, and the educators themselves found the struggle to remind the students of health promotion. Furthermore, the community showed lower health literacy, especially regarding the harm of UPFs and smoking among male students. There were several stalls within the building, yet all sell UPFs without homemade meals (Fig. 1). It reflects uncontrolled UPFs consumption. Besides that, there are CKD patients in the neighborhood.

Previous research highlights a lack of awareness regarding the health risks associated with processed foods, energy drinks, and CKD risk factors (Alobaidi, 2021). Although the relationship has been extensively studied, intervention studies among adolescents in semi-closed environments in Indonesia are still limited. This community service aimed to measure the initial knowledge of kidney disease and UPF consumption habits and subsequently, evaluated the effectiveness of educational-based interventions in improving their health literacy by employing a quantitative approach of knowledge scores and a qualitative approach through discussions in a health seminar to facilitate the integration of health information. Enhancing literacy through health promotion education focused on risk factors can foster greater awareness of health, empower individuals to adopt healthier lifestyles, and encourage the effective utilization of healthcare services.

MATERIALS AND METHODS

Materials

Infrastructure, such as student-operated canteens, was evaluated for the UPFs selling. The hall and room for health consultation in the boarding school were used for a health seminar. The community service team provided a booklet called "Kenali Ginjal Supaya Sayang Ginjal", which provided simple material regarding the kidney and processed food.

Activity design

The community service used the Rapid Rural Appraisal. Information collection began with discussions held with educators to gauge health literacy in the community, revealing concerns about instant foods, cigarettes, and processed foods. The observation found several stalls within the buildings selling UPF-only serving (Fig. 1). Community service implementation was planned into the health seminar, a simple booklet handout, and a discussion. The targeted subjects were adolescents and young adults aged 13-29 years, including students and educators at Al-Khoziny Islamic Boarding School, Sidoarjo, East Java, on August 24, 2024.

Pre and post-test assessment

Knowledge improvement was assessed by pre- and post-test. There were 102 participants included in the quantitative assessment. All data related to the

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profile and processed food consumption were collected. Participants' initial knowledge was evaluated through a pre-test related to the material. Following the health seminar, the impact on student knowledge was investigated by a post-test assessment. The CKD knowledge questionnaire was modified from a validated one (Alobaidi, 2021). It consists of multiple-choice options 'True", "False", and "I do not know". Correct responses were given a score of 1, while incorrect responses or lack of understanding of the option "I do not know" were given a score of 0 (Supplementary data 1). The questions were slightly modified to Bahasa Indonesia, incorporating the activity goal related to UPFs and risk factors associated with vitamin C and tea consumption. A pilot test was conducted on 10 random high school students to evaluate the questionnaire. This study followed the declaration of Helsinki for studies with human participants.

Data analysis

Subject profile and processed foods data were displayed in a descriptive table in percentages. Data regarding the knowledge was expressed as a median. Normality test used the Kolmogorov–Smirnov test and the paired test carried out by the Wilcoxon signed-rank test (two-tailed) or t test. Subgroup analysis between teenage and young adolescents age of the knowledge score was performed. Statistical analysis was carried out in GraphPad ver.8 software program, with $p<0.05$ considered as statistically significant.

RESULTS AND DISCUSSION

Neighborhood survey and booklet creation

The Islamic boarding school comprises several buildings designated for male and female students. The largest facility is the male dormitory, which has a mosque and a multipurpose hall. A medical room was managed by one educator who would refer students to the nearest medical facilities. Small stalls operated by students sell instant noodles, powdered beverages, and sweetened drinks; however, no stall offers homemade meals. Educators expressed concern about the students' consumption of low-nutrition foods and cigarette smoking. Following that, we developed a simple educational booklet on kidney health, titled "Mari Kenali Ginjal Supaya Sayang Ginjal". The booklet provides basic information on kidney function, ultra-processed foods, smoking, and chronic kidney disease, and includes easy-to-follow healthy recipes (Fig. 2).

Chronic kidney health seminar

The health seminar was conducted in the multipurpose hall of the Islamic boarding school. Its primary objective was to enhance the knowledge of students and educators regarding the rising incidence of CKD at a young age. Materials introduced to the kidney function for filtration, regulate blood calcium, and control blood pressure. CKD symptoms include tiredness, edema in the extremities, or loss of appetite. The risk factors associated with food additives and processed foods contain high sodium and sugar (Fig. 3). Few printed booklets were distributed to the educators to be placed in the school health room (Fig. 4). The activity also included simple health checks in the form of cholesterol, blood glucose, and uric acid for educators and local residents.

Fig. 2. Booklet design

Fig. 3. Educational activities in Islamic boarding school

Participants processed food consumption habit

A total 102 participants consist of 78 males and 24 females. In accordance with our targeted subject, the current education was mostly in junior high school (48 person) followed with senior high school (31 person) and high school graduate or barchelor (23 person). Most of the participants never see a person in their surroundings with CKD symptoms, least 11.7% have seen CKD patients but do not understand the symptomps. About 41 participants (39.8%) have heard information related to CKD and 97.5% said they received it through social media (Table 1).

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Fig. 4. Booklet handover

The majority of participants residing in a boarding school environment follow a schedule for communal meals. However, it was observed that participants consumed UPF products at least weekly, with 35 participants (33.9%) consuming more than three processed items daily (Table 1). The most consumed were packed snacks, instant noodles, and powder drinks or tapioca pearls drinks. The packed snacks include chips, sausage, or biscuits, which are preferable due to the convenience of access, affordability and the variety of tastes, smells, and colours (Askari Majabadi et al., 2016). Participants mentioned learning about CKD through social media. Given that the younger generation today is closely connected to the internet, this demographic represents an excellent target for health literacy initiatives.

Table 1. Participant's characteristics

Variables	Total (n=102,%)
Sex	
Male	78 (76.4)
Female	24 (23.5)
Age	
13-15 years old	48 (47)
16-18 years old	31 (30.3)
Above 19 years old	23 (22.5)
Education (Islamic school)	
Junior high school	48 (47)
Senior high school	31 (30.3)
High school graduate / Bachelor	23 (22.5)
Have you seen anyone in the neighbourhood with CKD symptoms?	
Yes	90 (88.2)
No	12 (11.7)
Have you received any information related to CKD?	
Yes	41 (40.1)
Social media	40
Mass media	1
No	61 (59.8)
How often do you consume processed foods and packed foods?	
1-2 products everyday	40 (39.2)
> 3 products everyday	35 (34.3
1-3 products per week	22 (21.5)
2-3 products per months	5 (4.9)
Type of processed foods that been consumed?	
Soft drinks	30 (29.4)
Chips and packaged snacks	79 (77.4)
Instant noodle	58 (56.8)
Chicken fries	18 (17.6)
Powder drinks, sugar-added drinks	53 (51.9)
Sausage and processed meats	29 (28.4)

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Table 2. Comparison of correct responses in pre-test and post-test

No	Question	Correct response (n=102, %)	
		Pre test	Post test
	Myths about chronic kidney disease		
Q1	A person can lead a normal life with one kidney	18 (17.65)	64 (62.75)
Q2	Drinking herbal can be effective in treating kidney disease condition	8 (7.84)	63 (61.76)
Q3	Certain medication can help slowing CKD progress	44 (43.14)	64 (62.75)
Q4	Dialysis is the early treatment for chronic kidney disease	8 (7.84)	35 (34.31)
Q5	Only elders can suffer from chronic kidney disease	74 (72.55)	82 (80.39)
	Kidney functions		
Q6	The kidneys clean blood	49 (48.04)	90 (88.24)
Q7	The kidneys produce urine	31 (30.39)	62 (60.78)
Q8	The kidneys help break down protein in the body	19 (18.63)	31 (30.39)
Q9	The kidneys help keep the bone healthy	41 (40.20)	53 (51.96)
Q10	The kidneys help drive the red blood production	58 (56.86)	82 (80.39)
Q11	The kidneys help regulate blood glucose	10 (9.80)	38 (37.25)
Q12	The kidney help absorb nutritients	24 (23.53)	25 (24.51)
Q13	The kidneys help regulate blood pressure	48 (47.06)	82 (80.39)
	Kidney function tests		
Q14	A urine test	38 (37.25)	71 (69.61)
Q15	A blood pressure test	63 (61.76)	85 (83.33)
Q16	A body weight measurement	35 (34.31)	20 (19.61)
Q17	A blood test	61 (59.80)	78 (76.47)
Q18	A feces test	16 (15.69)	54 (52.94)
	Risk factors		
Q19	Being male	34 (33.33)	71 969.61)
Q20	Has hypertension	58 (56.86)	89 (87.25)
Q21	Excess stress	13 (12.75)	40 (39.22)
Q22	Comsume processed foods	68 (66.67)	89 (87.25)
Q23	Has diabetes	54 (52.94)	84 (82.35)
Q24	Vitamin C infuse for whitening	18 (17.65)	31 (30.39)
Q25	Drinking tea	20 (19.61)	28 (27.45)
Q26	Excess weight	19 (18.63)	78 (76.47)
	Chronic Kidney Disease symptoms		
Q27	Nausea/vomiting	34 (33.33)	69 (67.65)
Q28	Swollen leg (water retention)	25 (24.51)	81 (79.41)
Q29	Fever	16 (15.69)	35 (34.31)
Q31	Increase fatigue (tiredness)	64 (62.75)	84 (82.35)
Q31	Loss of appetite	56 (54.90)	59 (57.84)

Improvement of participants' understanding of CKD

The questionnaire contains the comprehension of myths surrounding kidney problems, kidney function, and kidney disease symptoms. Participants had less understanding of myths surrounding CKD, such as the role of herbal drinks and dialysis role in CKD. Less than 60% of students had correct responses for kidney functions. Table 2 presents a comparison of participants' correct responses before and after an educational literacy of CKD. The questions are grouped into four categories: myths about CKD, kidney functions, kidney function tests, and CKD risk factors and symptoms for a total of 31 questions.

There was a notable gain in overall correct responses in the post-test. Regarding kidney functions, post-test responses showed higher awareness of kidneys cleaning blood (48.04% to 88.24%) and producing urine (30.39% to 60.78%). However,

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knowledge about kidney functions like absorbing nutrients showed little improvement (23.53% to 25.41%). Concerning CKD risk factors, a marked improvement was seen in understanding the role of hypertension (56.86% to 87.25%) and diabetes (52.94% % to 84.31%). Lastly, understanding CKD symptoms improved significantly, especially for recognizing nausea/vomiting (33.33% to 67.65%) and increased fatigue (62.75% to 82.35%).

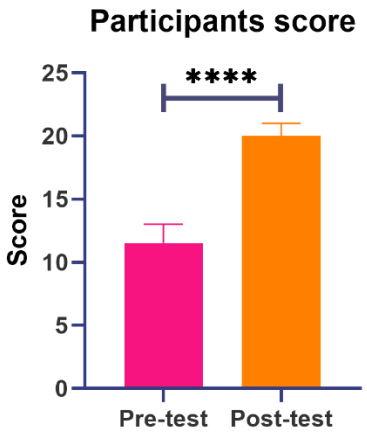

Fig. 5. Comparison of student knowledge on chronic kidney disease. **** equals to p<0.0001

The knowledge score was not normally distributed. As seen in Fig. 5, the non-parametric Wilcoxon signed rank analysis yielded a substantial difference between the pre-test and post-test scores (p<0.0001). The median pre-test score was 11.5 and increased to a post-test median score of 20. A subgroup analysis was conducted comparing students (under 19 years old) and mentors (over 19 years old) to examine the differences in health literacy. However, no notable difference (median 11 vs. 13) was seen in the initial knowledge pre-test between groups (Fig. 6). All subgroups gained similar scores in the post-test as well.

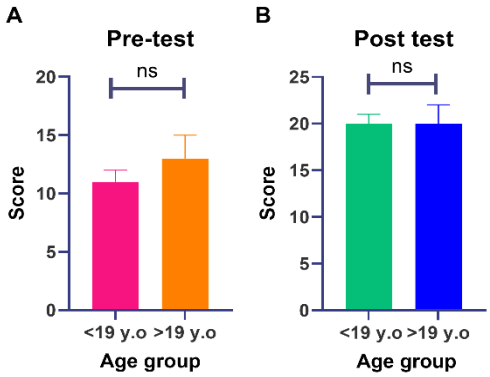

Fig. 6. Subgroup age analysis: A) Pre-test; B)Post-test. T test was performed for pre-test, Wilcoxon test for post-test

Although the output showed a significant improvement in health knowledge, we still observed a gap in participants' understanding after the explanation. A few questions, such as the kidney's role in maintaining bone health or body weight, are not needed for the kidney test. This was likely due to the need to absorb a lot of information and distractions between them. The primary focus was on lifestyle risk factors, which might have overshadowed information on kidney function or not emphasizing other important facts sufficiently.

The development of CKD is highly influenced by lifestyle. Currently, the widely accepted factors include diabetes, hypertension, obesity, dyslipidemia and environmental risk factors such as dietary salt intake and smoking. A combination of dietary factors contributes to altering corticosteroid regulation and induction of inflammation in the development of CKD (Lou Arnal et al., 2021). Abdominal obesity, where the building up visceral adipose tissue is known to secrete several biologically active substances, such as plasminogen activator inhibitor 1, leptin, adiponectin, angiotensinogen, and classical cytokines, that have the potential to cause renal damage. Moreover, adipose tissue led to insulin resistance that has an impact on endothelial vasodilatation and podocyte injury (Mallamaci & Tripepi, 2024). A high-sodium diet may increase the peripheral sympathetic tone that plays the primary role in hypertension. It also causes volume expansion and glomerular hyperfiltration in the kidney. A focus on non-communicable disease is intake restriction. The World Health Organization emphasizes limiting sodium intake to less than 5 g/day and simple sugar intake to no more than 50 g/day for adults. The intake of processed food often exceeds recommendations, assuming 72% of total sodium, 25%–35% of phosphorus, 12%–18% of potassium and contributing over 10% of daily caloric intake from simple sugars (Lou Arnal et al., 2021). These studies highly suggest carefully consider how much salt and sugar intake in our daily food.

Table 3 depicts the achievement as output of community service, which was participant awareness regarding the composition of food products. They could answer that high sodium content is not only found in salt but also in food preservatives. As an alternative to sugar, plant-based sweeteners such as stevia can be used. Many young people in Indonesia have not yet received adequate information about food composition and its connection to long-term health issues. Studies involving children with diabetes, asthma, and CKD have shown that parental literacy/education level affects child health status. Behaviors in food consumption are influenced by a combination of self-efficacy and adequate literacy skills as posited by the Social Cognitive Theory and supported by empirical studies (Anderson et al., 2007; Zhong et al.,

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2020). Low health literacy could have difficulty in maintaining healthy diets and is associated with CKD onset (Gurgel do Amaral et al., 2021). The strategy simplifies patient education materials (to the 4th-grade level) to make it more accessible to individuals with lower literacy skills. A previous study by Saraswati (2024) targeting students in the age range of 13 to 16 on kidney functions and health by presenting a simple experimental design resembling a nephron pathway function. They obtained similar significant improvements in knowledge score after education (p=0.000) (Saraswati et al., 2024). In addition, kidney disease awareness promotion by digital media has been studied and showed increased sharing and discussion of content (de Oliveira Juliana Gomes Ramalho et al., 2019; Goldstein et al., 2013).

Table 3. Problem identification and contribution of community service programs

Problem	Activity	Output
High consumption of UPFs and added additives	Distribution of a small booklet	Students and educators can examine the composition of food additives, sodium, and sugar in the products.
No information yet on kidney function and risk factors for CKD	Health seminar on CKD, ultra-proceed food, alongside a simple medical check-up.	Increase awareness and knowledge regarding CKD symptoms and disseminate the information within the community.

Another challenge in daily lifestyle was the presence of UPF products sold by the stalls. These stalls cater to students' appetite fulfillment outside of mealtimes. However, they are run by students, thus only offer easily prepared meals and do not sell homemade options. Our findings suggest that educational efforts should be accompanied by foundation management to regulate the stalls' offerings and provide healthy alternatives for students.

We acknowledge several limitations in this community service. First, a one-time seminar may not be sufficient to effectively disseminate all the necessary information for raising awareness. Activities involving both students and teachers are needed to assess the transfer of knowledge regarding nutritional composition and CKD prevention as a direct intervention. Second, conducting the seminar with a large group of participants may not be conducive, as some attendees were distracted, chatting among themselves and not fully engaging with the content. Implementation includes creating a poster together, and a video message challenge would increase the participants' awareness.

CONCLUSION

The younger generations, including students and teachers at Islamic boarding schools, have limited access to information on kidney disease awareness and food additives. A significant improvement in understanding kidney health was observed following a health education activity, as reflected in improved test scores and increased awareness of food composition. A notable 40% higher correct answer on myths and 30% on risk factors. It highlights the need for regular health promotion initiatives addressing lifestyle and environmental risk factors. The activity can be embedded in a video competition or student-led health ambassador programs to ensure continued awareness and behavior change.

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