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Energy Conservation Practices among Undergraduate Students of King Faisal University

Hussain A. Alradhi*[1], Ahmed M. Al abbas[2], Mohammed H. Alabadi[3], Edric D. Estrella[4]

Department of Public Health, College of Applied Medical Sciences,

King Faisal University, Al Ahsa, Eastern region, Saudi Arabia.

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Abstract: **Background: Energy is very crucial component in the entire process of growth, development, and survival for any country. However, there has been a wide gap between its demand and supply. With the problem of scarcity, conservation efforts should be undertaken by every citizen of every nation.**

Objective: The study is conducted with the aim of assessing the knowledge, attitudes, and practices related to energy conservation among undergraduate students at King Faisal University.

Methods: This analytical, cross-sectional study utilized data from 806 students selected through two-stage sampling procedures. Data was collected using online, self-administered questionnaire consisting of 25 items related to knowledge, attitudes, and practices on energy conservation. The proportions of students possessing high level of knowledge, exhibiting positive attitude towards energy conservation, and consistently practicing energy conservation measures were estimated using the Stata MP version 13. The crude association between the level of the knowledge and consistency of practice of energy conservation measures was determined using binary logistic regression.

Results: About 59.30% of the students (95% CI: 55.87, 62.65) had high level of knowledge related to energy conservation. Roughly 57% of the students (95% CI: 53.99, 60.80) possessed positive attitude toward energy conservation while 47.14% of them were consistently practicing energy conservation measures. Students who had high level of knowledge related to energy conservation were 1.38 times more likely to consistently practice energy conservation measures compared with those who possessed low level of knowledge.

Conclusion: The level of knowledge of King Faisal University students was significantly associated with their practices related to energy conservation. However, a large proportion of King Faisal University students were not consistent in practicing energy conservation measures.

Keywords: **Energy conservation, practices, knowledge, attitudes, logistic regression.**

I. INTRODUCTION

Burning of fossil fuels produces energy needed to support human existence. However, the process emits harmful gases that causes air pollution and eventually destroys the environment. Energy conservation limits the waste released into the atmosphere like the undesirable carbon dioxide emissions, thus plays a major role in protecting our environment. [1],[10]

Over the last decades, the attention toward the sustainability of environment as well as the earth resources has been given a high priority. [2] Concerns on the growing populations worldwide, and the impact of social structures, economic recession, as well environmental changes, have influenced the globe awareness toward sustainability practices. [14]

Energy is very crucial component in the entire process of growth, development, and survival for any country. However, there has been a wide gap between its demand and supply. With the problem of scarcity, conservation efforts should be undertaken by every citizen of every nation. [3]

According to IPCC, since the mid-20th century, the increase in anthropogenic greenhouse-gas concentrations is likely to be the cause of the worldwide averaged temperature increase, which led to the warming of the Earth's surface. Global warning also causes glaciers to melt which resulted into the raising of the seas level. Furthermore, it has increased the incidence of various communicable diseases including malaria, dengue fever and Japanese encephalitis. [4],[5]

The emissions of the gases to the atmosphere causes ozone layer depletion. Ozone layer is the defense line between earth and the ultraviolet rays emitted by the sun. People who have more exposed to ultraviolet radiation may have some health problems such as DNA damage, skin cancer, aging, photokeratitis, photo conjunctivitis and other health problems related to skin. [6]

Meeting existing and future energy demands in a sustainable way is a crucial challenge for every nation. Sustainable energy consumption entails the use of clean, renewable, and alternative sources of energy that emits less pollutants. Wind turbines and solar panels has now been utilized to provide alternative sources of energy that pose minimal environmental hazards. Reduction in the use of fossil fuels like coal, petroleum, and natural gases has been advocated by shifting to these clean energy sources. [7],[11]

The lack of information on the knowledge, attitude and practices related to energy conservation has prompted the researchers to purse the topic. It has been noted that there has been no study conducted in Al Ahsa, Saudi Arabia that focused on exploring the knowledge, attitude, and practices of energy conservation measures. Furthermore, the said topic is aligned with the research agenda of King Faisal University which anchor on environmental sustainability and food security. It is also responds to the objectives of the Saudi Arabian Vision 2030 - Quality of Life Program.

The study was conducted with the goal of assessing the knowledge, attitude and practices related to energy conservation among students at King Faisal University. Specifically, this study aimed to 1. determine the level of knowledge of the students regarding energy conservation; 2. describe the attitudes of the students related to energy conservation in terms of frequency and type; 3. determine the energy conservation practices of the students; and 4. determine whether KFU students' practices related to energy conservation are affected by their level of knowledge.

II. METHOD

This analytical cross-sectional study was conducted among students at King Faisal University. Students in the Preparatory Year Department, Graduate Studies Programs, and those registered in the distance learning mode were excluded. The minimum sample size of 760 was calculated using Epi Info® version 7 based on the following parameters: undergraduate student population for academic year 2020-2021 of 36,643, anticipated frequency of 50%, margin of error of 5%, and a design effect of 2.

Two stage sampling design was utilized to select the participants. Three health and three non-health colleges were randomly selected at first stage of sampling. Within each of the selected colleges, class sections identified through the Course Reference Number (CRN) were randomly selected which then served as clusters in the second stage of sampling. All the students registered in each of the selected CRN were invited to participate.

A researcher-developed questionnaire was utilized as the data collection instrument which was made accessible to the potential participants electronically via Google Forms. The said instrument contained four sections: 1. demographic variables such as college, year level, and gender; 2. knowledge section with eight questions on the knowledge on energy conservation; 3. nine questions on the practices related to energy conservation; and 4. a section consisting of eight questions about the attitudes toward energy conservation.

Collected data were exported to MS Excel for processing and was then analyzed using STATA MP version 13 software. Descriptive statistics were generated for the demographic variables. The sum of the correct responses on the 8-item inventory of knowledge on energy conservation were computed for each participant. A participant who obtained a score

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equal or higher than 6 points was classified as "high level of knowledge' otherwise, was considered as "low level of knowledge". Similarly, the responses to the 8 attitudinal statements were dichotomized such that "strongly agree" and "agree" were assigned a value of "1" while responses "disagree" and "neutral" were assigned a value of "0". The scores were added and a participant whose score was equal or higher than 7 was classified as possessing "positive attitude" otherwise, was considered as "negative attitude".

The responses in the various questions related to energy conservation practices were dichotomized. A response of "never", "once a week", "twice a week', or "thrice a week" was assigned the value "0" while a response of "most days of the week" or "always" was assigned a value "1". The sum of the recoded value on all the nine questions were computed per participant which later was categorized as "consistent" if equal or greater than 4 otherwise, was labelled as "non-consistent".

The proportion of students who possess high level of knowledge on energy conservation as well as the proportion of those who possess positive attitude towards energy conservation were estimated and the 95% logit-transformed confidence intervals were calculated. Likewise, the proportion of students who consistently practice the various energy conservation measures was estimated and the corresponding 95% logit-transformed confidence interval was determined. Finally, binary logistic regression was performed to determine magnitude of the crude association between the level of knowledge on energy conservation of the students and their consistency of practices the various energy conservation measures. The odds ratio and the corresponding 95% confidence interval were derived.

Data collection took place in main campus of King Faisal University which is located in Hofuf, Al Ahsa from January 19, 2022, until February 6, 2022. Participation in the study was voluntary and the participants were assured that their anonymity and the confidentiality of their responses were preserved.

III. RESULTS

A. Demographic characteristics of King Faisal University students

Table I shows that a total of 806 students participated in the study of which 61.91% were male and 38.09% were female. Students from health colleges comprised 55.45% of the respondents, and the remaining 44.55% students from non-health colleges. First to third year students comprised 77.05% of all the respondents.

Table I. Depicts the distribution of respondents based on different demographic characteristics.

Variable	Frequency (n= 806)	Percentage %
Gender		
Male	499	61.91%
Female	307	38.09%
College		
Applied Medical Science	215	26.67%
Medicine	143	17.74%
Business Administration	52	6.45%
Engineering	176	21.84%
Veterinary medicine	89	11.04%
Agriculture and food science	131	16.25%
Year level		
First year	196	24.32%
Second year	236	29.28%
Third year	189	23.45%
Fourth year	89	11.04%
Fifth year	62	7.69%
Sixth year	34	4.22%

B. Level of the knowledge of King Faisal University students related to energy conservation.

The mean score in the eight-item inventory of knowledge related to energy conservation among King Faisal University students was equal to 5.7 with standard deviation of 1.43 and median of 6. The lowest score of knowledge was equal to 1 while the highest score was equal to 8.

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The proportions of students with high and low levels knowledge related to energy conservation is depicted in **Table II**. Among the 806 participants, 40.69% (95% CI: 37.34, 44.13) had a low level of knowledge related to energy conservation while, 59.30% (95% CI: 55.87, 62.65) had a high level of knowledge.

Table II. Estimated proportion of King Faisal University students who possessed high- and low-level of knowledge related to energy conservation.

Variable	Proportion %	95% confidence interval
Level of knowledge		
Low knowledge	40.69%	37.34 %- 44.13%
High knowledge	59.30%	55.87 %- 62.65%

C. Comparison of the level of knowledge related to energy conservation across various demographics groups.

There was a higher proportion of male students who possessed a high level of knowledge related to energy conservation compared to the female, while the proportion of those students who possessed high level of knowledge was almost the same for the health and non-health colleges students. **Table III** depicted the distribution of the level of knowledge related to energy conservation across various demographic groups.

Table III. Distribution of the King Faisal University students based on the level of knowledge related to energy conservation.

	Low level of knowledge		High level of knowledge	
Variable	**Count**	**%**	**Count**	**%**
Gender				
Male	195	39.08%	304	60.92%
Female	133	43.32%	174	56.67%
College type				
Health colleges	183	40.94%	264	59.06%
Non-Health colleges	145	40.39%	214	59.61%

D. Attitudes of King Faisal University students related to energy conservation.

The mean score in eight-item inventory of attitudes related to energy conservation was equal to 6.33 with stranded deviation of 1.63 and median of 7. The lowest score was 0 while the highest score was equal to 8. The students were asked to indicate their level of agreement to each of the eight attitudinal statements presented in **Table IV**. The distribution of respondents based on their agreement to the attitudinal statements is presented in **Figure 1.**

Table IV. Presents the 8 attitudinal statements

	Statement
A1	I would do more to save energy if I knew how.
A2	Saving energy is important.
A3	The way I personally use energy does not really make a difference to the energy problems that face globe.
A4	I don't need to worry about turning the lights or computers off in the classroom, because the university pays for the electricity.
A5	We don't have to worry about conserving energy, because new technologies will be developed to solve the energy problems for future generations.
A6	I believe that I can contribute to solving the energy problems by making appropriate energy-related choices and actions.
A7	I believe that I can contribute to solving energy problems by working with others.
A8	I am too busy to be concerned about saving energy.

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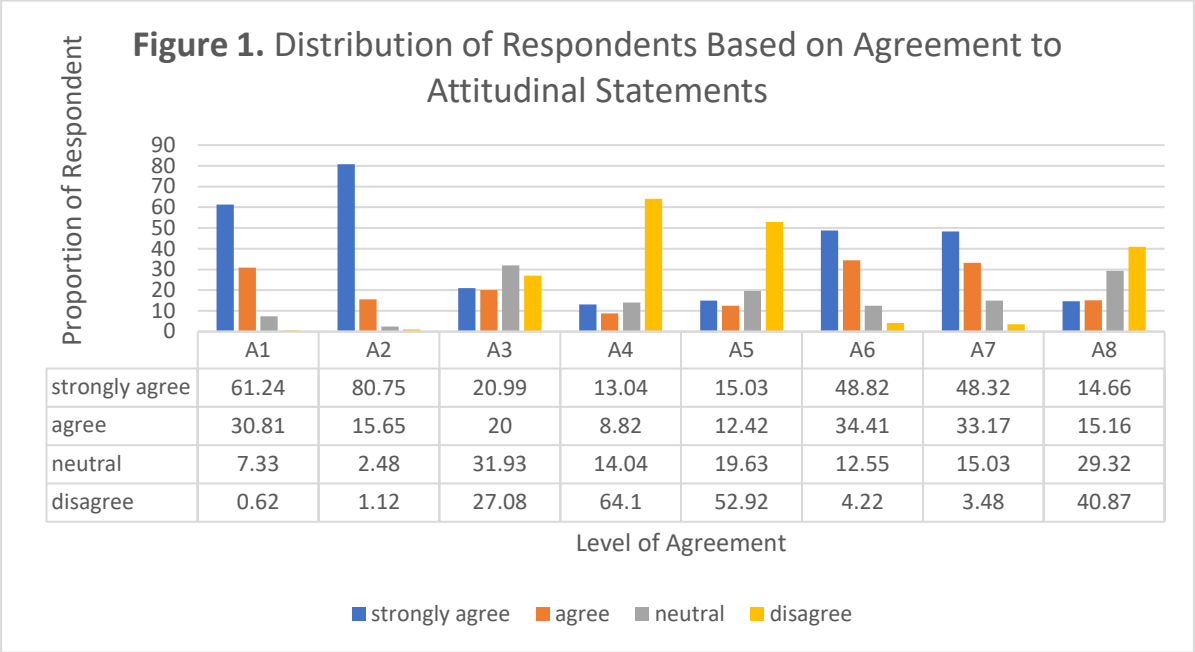

Table V shows that almost six for every ten students had positive attitude toward energy conservation, while the remaining of the students 42.55% had negative attitudes toward energy conservation. When stratified by gender, a higher proportion of the female students had positive attitude toward energy conservation compared to male students. Moreover, a higher proportion of the students from health colleges students had positive attitude toward energy conservation compared with those students from non-health colleges. **Table V** depicts the distribution of the attitude type related to energy conservation across various demographic groups.

Table V. Estimated proportion of king Faisal university students who had positive and negative attitudes related to energy conservation.

Variable	Proportion %	95% confidence interval
Attitude type		
Positive	57.45%	53.99 %- 60.82%
Negative	42.55%	39.17 %- 46.00%

Table VI. Distribution of King Faisal University students who had a positive and negative attitude toward energy conservation.

	Negative attitudes		Positive attitudes	
Variable	**Count**	**%**	**Count**	**%**
Gender				
Male	270	54.11%	229	45.89%
Female	73	23.78%	234	76.22%
College type				
Health colleges	162	36.24%	285	63.76%
Non health colleges	181	50.42%	178	49.58%

E. Energy conservation practices among King Faisal University students.

The mean score of practices was equal to 3.5 with standard deviation of 1.77 and median of 4. The lowest score was 0 while the highest score was equal to 8. **Table VII** shows that among the 806 study participants, 52.85% (95% CI: 49.39, 56.28) were not consistent in practicing energy conservation measures while the remaining students were practicing the energy conservation measures consistently.

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Table VII. Estimated proportion of King Faisal University students who were consistent and non-consistent of their practices related to energy conservation.

Practices related to energy conservation	Count	Proportion	95% confidence Interval
Consistent	380	47.14 %	43.71% - 50.60%
Non consistent	426	52.85%	49.39% - 56.28%

F. Comparison of level of practices related to energy conservation across various demographic groups.

There was a higher proportion of the female students who were consistent with their practices of energy conservation compared to male students. Additionally, there was a higher proportion of students from health colleges who were consistent in practicing energy conservation compared to those students from non-health colleges as shown in **Table VIII.**

Table VIII. Distribution of King Faisal University students according to their level of practices related energy conservation.

	Non-Consistent practices		Consistent practices	
Variable	Count	**%**	Count	**%**
Gender				
Male	296	59.32 %	203	40.68%
Female	130	42.35 %	177	57.65 %
College type				
Health colleges	227	50.78%	220	49.22%
Non health colleges	199	55.43%	160	44.57%

G. Association between the level of knowledge and practices related to energy conservation among King Faisal University students.

Those students who had high level of knowledge related to energy conservation are 1.38 times more likely to be consistent in practicing energy conservation compared with those students who had a low level of knowledge. **Table IX** shows the crude association between the level of knowledge and practices related to energy conservation.

Table IX. Crude association between the level of the knowledge of King Faisal University students and practices related to energy conservation.

Variable	Odds ratio	P-value	95% C. I
Level of knowledge			
High knowledge	1.38	0.025	1.131408 - 2.016216
Low knowledge	1		

IV. DISCUSSION

The study investigated the knowledge, attitude, and practices related to energy conservation among King Faisal University students, the proportion of the students who were consistently practicing the energy conservation measures differs to a slight extent between gender groups and college type . While more than half of the students had high level of knowledge related to energy conservation ,a lower proportion of the participants were consistent in practicing the energy conservation measures. The knowledge, attitude, and practices related to energy conservation is most likely to be due to nature of their education as well as the quality of their courses. Moreover, there are many influential factors on the knowledge, attitudes and practices of the students related to energy conservation such as social media, culture, and socioeconomic status. Additionally, among the colleges included in the study the highest proportion of students who were consistent of practicing energy conservation measures was from the health colleges, and this is due the fact that courses that discuss the environmental sustainability and environmental health are part of their curriculum.

In the current study, it was shown that 59.30% of the participants had a high level of knowledge related to energy conservation. A study conducted among university students in Malaysia has shown a low knowledge related to energy saving. [8]

In the current study, it was shown that, a higher proportion of the female students who had a positive attitude toward energy conservation compared with male's students. A study conducted among energy consumers in the state of Himachal Pradesh, showed that urban consumers have a very high positive attitude toward energy conservation as compared to the rural household. [4]

In the current study 57.45% of the students had a positive attitude toward energy conservation, a study conducted in UAE among university students showed that students generally have positive attitudes toward sustainability. [12]

In the current study, it was shown that, more than half of the students were not consistent in practicing energy conservation measures. In a study conducted in Saudi Arabia to assess the sustainability of higher education institutions showed that, Saudi universities are relatively less committed to common energy-saving practices such as energy-efficient lightning and air-conditioning systems, and day light saving practices. [9]

The findings of this study also showed that, almost 81.38 % of the students were not consistent in using public transportation, a study conducted in Greece among primary School students showed that 91.4% of the students never used public transport to go to school. [13]

This study has several limitations, due to the fact that the study utilized an analytical cross-sectional design, the main interest variable of study which is energy conservation practice is a time varying variable, therefore the collected energy conservation practices of the respondents may not truly reflect their actual practices. Additionally, there is a possibility of misclassification on the energy conservation practices since the self-reported level of practice were not verified through actual observation. Furthermore, there are other variables which might affect the energy conservation practices which have not been investigated in the study.

V. CONCLUSION

This study has shown that roughly six for every ten students of King Faisal University had high level of knowledge related to energy conservation. Fifty seven percent of the students had a positive attitude toward energy conservation. More than half of the students were not consistent of practicing energy conservation. The level of knowledge of King Faisal University students was significantly associated with their practices related to energy conservation. However, a large proportion of King Faisal University students were not consistent in practicing energy conservation measures.

VI. RECOMMENDATION

The researchers believe that more public health interventions and programs are needed. More intensive courses or at least topics for the students related to energy conservation should be integrated in their curriculum. The importance of energy conservation should be emphasized in relation to both environment as well as the economy of the country. Lastly, the researchers recommend that this study should be expanded to the community as well as to assess the other variables which might influence energy conservation practices.

VII. ETHICAL APPROVAL

The ethical clearance was obtained from the Deanship of Scientific Research in King Faisal University (KFU-REC-2021-DEC -EA000291).

VIII. ACKNOWLEDGMENT

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IX. CONFLICT OF INTEREST

The authors have no conflict of interest associated with the materials presented in this paper.

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