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Influence of Socio-demographic Variables on Electrical Energy Management Practices among Residents of Niger State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author TMS designed the study, wrote the protocol and wrote the first draft of the manuscript. Author JT managed the literature searches and editing of the work. Author TMS administered questionnaire and analyses. Author ER checked analyses of the study and author BB managed the interpretation and discussion. All authors read and approved the final manuscript.

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ABSTRACT

The study investigated the influence of socio-demographic variables on electrical energy management practices among residents of Niger State, Nigeria. The study adopted Cross Sectional Survey Research Design. The population of the study was made up of 191,416 heads of households in residential buildings. The sample for the study consisted of 1,290 heads of households in residential buildings, three null hypotheses were formulated and tested at 0.05 level of significance. The instrument used for data collection was a structured questionnaire. Statistical Package for Social Sciences (SPSS version 19) was used for data analysis. Levene's test Statistic, one–way analysis of variance (ANOVA), post-hoc (Tukey Honest Significant Different (HSD) test) was used to test hypotheses at ($P < 0.05$). The finding of the study shows that, low and high income

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residents in Niger State wasted more of electricity, young aged (18 to 39 years) wasted more electricity compare to other aged groups and residents with low education contributed significantly to energy wastage. Based on these findings, the following recommendations were made: The electricity management board in collaboration with energy commission should intensify effort to organize enlightenment campaigns on electrical energy management practices targeting low and high income earners, the enlightenment campaigns on electrical energy management should focus on young adult (18 to 39 years) as they wasted more of electricity and residents with low educational qualification should be well informed on implications of electrical energy management.

Keywords: Socio-demographic variables; electrical energy management practices and residents.

1. INTRODUCTION

Electrical energy is derived from the flow of electrical charges, and is commonly referred to as electricity. Electricity is used for several applications such as lighting, heating, cooling and operation of electrical machines. It is generally accepted as an essential commodity for biological lives, as it improves the standards of living and facilitates economic development and poverty reduction [1,2]. Nigeria generates an average of 3,500MW of electricity, while Abuja Electricity Distribution Company (AEDC) who is saddled with the responsibility of distributing electricity to FCT, Kogi, Nassarawa and Niger States received an average allocation of 300 MW and Niger State on an average receives 30.84 MW despite three hydropower sited in the state. It is sad to observe that, about 30 to 40% of electricity generated is being lost from point of generation to utilization in Nigeria [1,3,4]. Observed that, even the available electricity capacity is insufficient to meet existing power needs of the less than 40% who have access to the national grid [5]. Reported that, the then Minister of Power, Prof. Chinedu Nebo, said Nigerians have being wasting over 1,000 Megawatts of electricity generated which amounts to N400bn, these amount of electrical energy can be used for other useful purposes. The inability of Nigeria to meet its energy needs over a long period of time is a source of worry to the entire citizenry, especially artisans and those operating in real sector of the economy, ditto for household electricity consumers, who spend thousands of naira to power their respective generators [6,7].

Policy makers, scientists and neo-classical economists considered the electrical energy consumers as rational human beings, who make consumption choices based on their own preferences [7]. They are variables which influence electrical energy usage; this means that changes in electrical energy usage may also be dependent on social-demographic variables [8,9]. Said structural variables like socio–demographic influence behaviour and intention. Socio-demographic factors such as income, age and education level affect behavioural choices, because they determine to the extent individuals are able to engage in energy-saving behaviour. The extent to which occupants of a household save electrical energy may likely depend on variables that serve as opportunities or hindrances for conserving electrical energy, such variables are; income, age and education [9,10,11]. Argued that the uses of efficient technologies are likely to be imbibed by respondents that have a high income and with behavioural measures which may be the least acceptable for high income earners. The low income earners may not be stable financially and may lack the money to invest in residential electrical energy efficient improvement technologies. Age is generally referred as a predictor variable for electrical energy conservation [12]. made a serious classification on the issue of age as a predictor variable. They emphasized that young and elderly household occupants may take less action on electrical energy conservation than those in middle age. Although the number of domestic appliances owned by consumers has been directly linked to the level of education of head of household, this trend may likely be as a result of the positive correlation between income and education. It also believes that the level of education of consumers may certainly have a significant effect on the behaviour they exhibited in electrical energy usage in residential buildings [10].

Researches carried out in the area of electrical energy consumption shows that socio-demographic variables can be greatly related to residential energy usage. There are some contention factors within the literature about the influence of socio-demographic variables on electrical energy consumption, as there is no significant debate over the fact that socio-

demographic influences energy usage [9,10,13,14]. In their study argued that, socio-demographic variables influences the possibilities and hindrances people face, which in turn affect the rate of electrical energy usage. Intentions to reduce electrical energy use seem to be more strongly related to psychological variables, probably because intentions to reduce electrical energy are voluntary in nature and may be less constrained by contextual factors. The authors were of view that intentions may particularly depend on the perceived costs and benefits of energy conservation, as reflected in psychological variables, such as attitudes towards energy. These variables such as income, age, and education can greatly influence electrical energy usage in residential buildings.

Household income is a dominant predictor of electrical energy management practices [15]. agreed that income is a definitive factor of consumer behaviour. He sees income as a monetary and natural value, which a person receives from business, or from other people or organizations for covering personal expenditures. Income is a key driver of residential energy demand and it is perhaps more important. The higher income earners have the capacity to make intra-fuel substitutions and switch from one heating to another that is likely to be more efficient. A study conducted by [16] revealed that wealthier households tend to purchase electrical energy efficient equipment to reduce the rate of energy consumption [17]. Proved that income level of the households is positively and statistically related to larger electrical energy conservation investments. Since investment in electrical energy efficiency is costly at first investment the low income earners may not have such ability to purchase such equipment [11]. argued that the uses of efficient technology are likely to be imbibed by electricity users with high income and with behavioural measures being the least acceptable for high income earners. The low income earners may feel financially unstable and lack the capital to invest in residential energy efficient improvements [11,18]. observed that, wealthier households have been shown to; purchased and own more energy efficiency appliances and afford high energy costs. The poor households may likely own and purchase fewer energy efficient services and appliances which are often older and they may also not afford the high energy expenditure.

Age can be referred to as a predictor variable for electrical energy conservation [19]. Argued that the younger heads of households have potential to be more likely to have conservation improvement but the older persons may not be more likely to invest on efficient technology and that may be associated with their social status. The choice and use of energy-consuming appliances was also found to be influenced by the age of the head of the household; younger households preferred up-to-date technology that is often more efficient, while older households accept their old appliances and replace them more seldom [11,12,20,21,22] stated some likely reasons why the older age may not adopt energy conservation and efficiency strategies as;

1. They may likely have older houses with decayed insulation.
2. They may lack physical ability for conservation and efficient improvement.
3. Elderly are likely to be educated on energy – know – how.
4. Elderly do not relate well efficiency that is spending now to save – later philosophy.

There are several debates on the level of education and energy usage [11]. Argued that a person with higher level of educational qualification may likely be associated with lower residential energy use [23]. In their study concluded that the appliances and equipment used in residential buildings can be directly linked to the education of the head of household and those with higher level of education may prefer to purchase efficient equipment because of the knowledge of the use of efficient equipment. They further explained that the person with higher level of education may certainly have higher income which may move him or her to purchase efficient equipment and energy savings technology but may lack behaviour of switching off the light when not in use. Some studies suggested that there is a strong and positive correlation between level of energy user's education, energy saving activities and the use of energy efficient technology [11,12]. Among the reasons of positive correlation is that the level of educational attainment reduce cost of information acquisition and low level of education may lead to careless attitude towards energy savings [24].

1.1 Research Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance:

H_{O1}: There is no significant difference among the mean responses of low income, medium income and high income earners on electrical energy management practices adopted in residential buildings in Niger State, Nigeria (P< .05)

H_{O2}: There is no significant difference among the mean responses of young adults, middle adults and old adult on electrical energy management practices adopted in residential buildings in Niger State, Nigeria (P< .05).

H_{O3}: There is no significant difference among the mean responses of Non-formal educators, Primary/Secondary, Diploma/ NCE, First degree and Postgraduates degree holders on electrical energy management practices adopted in residential buildings in Niger State, Nigeria (P< .05).

2. RESEARCH METHODOLOGY

This study adopted a cross sectional survey research design. This design enables the researcher to describe the attitudes, opinions, behaviours or characteristic of the population based on data collected from a sample of the users of electricity in residents on their practices of electrical energy management. The study was carried out in Niger State, Nigeria, Niger State has twenty five local government areas and divided into three geo - political zones namely, Zone A. B and C. The choice of this area is because residents in Niger State is highly indebted to Abuja Electricity Distribution Company (AEDC) and power supply is epileptic for operating electrical equipment/appliances in residential buildings despite the fact that the state housed three hydro- electric generation stations, hence the choice of Niger State as the area of study.

The target population of the study was made up of 191,416 heads of households in residential buildings connected to the distribution network in 25 Local Governments of Niger State. The sample for the study consisted of 1,290 heads of households in residential buildings drawn through Multistage Sampling Techniques. Firstly, Stratified Sampling was used to draw 15 towns, five towns from each zone in the state and one town from each local government area. Proportional stratified random sampling was used to drawn only 1% of head of household from each town.

The instrument used for data collection is a structured questionnaire. Out of 1,290 numbers of questionnaires administered to residents, 987 were returned representing 76.5% returned rate. The questionnaire was designed to generate data for answering the research questions of the study. The data collected for the study was organized and analyzed on the basis of the research questions and hypotheses. SPSS version 19 was used for the analysis. Mean and Standard Deviation were used to answer the research questions, One – way Analysis of Variance (ANOVA) was used to analysed hypothesis to determine the no significant different at ($P < .05$). A decision on the hypothesis was based on comparing the significant value with ($P < .05$) level of significance. Where the significance value is less than ($P < .05$), it was considered rejected, while equal or greater than ($P < .05$) level of significant, the hypothesis is upheld. Levene's test of homogeneity of variances is carried to test for similarity; If the significant value is greater than 0.05, then there is homogeneity of variances and the assumption of homogeneity of variances is met. However, if the Levene's F statistic is significant and less than 0.05, then there are no similar variances and it is necessary to refer to the tests of equality of means table instead of the ANOVA table. Tukey Honest Significant Different (HSD) test of multiple comparisons were employed where significant mean differences exist, in other to locate the groups that are responsible for or that contributed to the rejection of the null hypotheses.

Demographic information for respondents is presented in Tables 1, 2 and 3. The data were collected from a group of respondents such as income group, age group and educational level.

Table 1 on the distribution of respondents by the monthly income group revealed that (538 or 54.9%) of the respondents were of the medium income group, while (307 or 31.1%) of the respondents were in the high income group and the low income group respondents were (142 or 14.4%).

Respondents distributed according to age are in Table 2. Medium age (40 to 59 years) is the majority with the highest number of respondents (494 or 50.10%). Respondents from the youngest age group (18 to 39 years) were 396 representing 40.10%, while 97 or 9.80% of the respondents are from old age (greater than 59 years).

Table 3 on the distribution of respondents by highest educational level revealed that (303 or 30.70%) of respondents were holders of First degree; The holders of Diploma/ NCE as respondents were (280 or 28.40%); Respondents that hold Primary/ Secondary qualification were (273 or 27.7%). 73 or 7.4% of respondents belong to Non-formal education while the respondents that hold a Postgraduate degree were (58 or 5.90%).

2.1 Hypothesis One

There is no significant difference among the mean responses of low income, medium income and high income earners on electrical energy management practices adopted in residential buildings in Niger State, Nigeria (P< 0.05).

The analysis of the result of the one-way ANOVA of mean responses of respondents on electrical energy management practices in Niger State, Nigeria with respect to residents' income level is presented in Table 4. Levene's statistics has a significant value of 0.11 and therefore, suggested that, the assumption of homogeneity of variances is met. (Since the value is greater than the significant level of (*P*< 0.05). Therefore ANOVA can be used for analysis.

The result of analysis as presented in Table 4 indicated that there was a statistically significant difference (*P*< 0.05) in the mean responses of the respondents. The data supported the hypothesis, F (2, 985) = 68.41, P = 0.01. The mean and the standard deviations for the group with low income were 2.22 and 0.42 respectively. The mean and the standard deviations for the group with medium income were 1.96 and 0.31 respectively. The mean and the standard deviations for the group with high income were 2.26 and 0.48 respectively.

Table 1. Distributions of respondents by monthly income group

Category	Frequency	Percentage	Cumulative percentage
Low income	142	14.40	14.40
Medium income	538	54.50	68.90
High income	307	31.10	100.00
Total	987	100.00	

Table 2. Distribution of respondents by age group

Category	Frequency	Percentage	Cumulative percentage
Young age (18 to 39 years)	396	40.10	40.10
Medium age (40 to 59 years)	494	50.10	90.2
Old age (greater than 59 years)	97	9.80	100.00
Total	987	100.00	

Table 3. Distributions of respondents by educational level attainment

Category	Frequency	Percentage	Cumulative percentage
Non formal education	73	7.40	7.40
Primary/ secondary	273	27.70	35.10
Diploma/ NCE	280	28.40	63.40
First degree	303	30.70	94.10
Postgraduate degree	58	5.90	100.00
Total	987	100.00	

Table 4. One-way ANOVA of mean scores of respondents on the electrical energy management practices by the income levels of residents in Niger State Nigeria

Source	Sum of square	df	Mean square	F	Sig
Between group	20.42	2	10.21	68.41	0.01
Within group	146.69	985	0.15		
Total	167.10	987			

2.2 Hypothesis Two

There is no significant difference among the mean responses of young adults, middle adults and old adults on electrical energy management practices adopted in residential buildings in Niger State, Nigeria (P< 0.05).

The result of the one-way ANOVA of the mean responses of respondents on electrical energy management practices in Niger State with respect to residents' age group is presented in Table 5.

Levene's statistics has a significant value of 0.21. Since the value is higher than the significant level value of (*P*< 0.05), the assumption of homogeneity of variances is met. Therefore ANOVA can be used for analysis.

The result of analysis as presented in Table 6 shows that, there was a statistically significant difference (*P*< .05) in the mean responses of the respondents. The data supported hypothesis, *F* (2, 985) = 8.55, *P* = 0.00. The mean and standard deviations for young adults were 2.12 and 0.370 respectively. The mean and standard deviations for middle adult were 2.09 and 0.46 respectively. The mean and standard deviations for old adults were 1.93 and 0.28 respectively.

Table 5. Post hoc tests of income group

Multiple comparisons							
Dependent variable:							
	(I) Income status monthly	**(J) Income status monthly**	**Mean difference (I-J)**	**Std. error**	**Sig.**	**95% Confidence interval**	
						Lower bound	**Upper bound**
LSD	Low income	Medium income	.26022*	.03655	.100	.1885	.3319
		High income	-.04037	.03930	.030	-.1175	.0368
	Medium income	Low income	-.26022*	.03655	.100	-.3319	-.1885
		High income	-.30059*	.02763	.100	-.3548	-.2464
	High income	Low income	.04037	.03930	.015	-.0368	.1175
		Medium income	.30059*	.02763	.100	.2464	.3548

**. The mean difference is significant at the 0.05 level.*

Post-Hoc (Tukey HSD) revealed that there were significant difference in the responses between low income and high income earners (P = 0.03 and P = 0.02) while other groups were no significant in their responses as their significant levels are higher than (P< 0.05).

Table 6. One-way ANOVA of mean scores of respondents on electrical energy management practices by the age group of residents in Niger State

Source	Sum of square	df	Mean square	F	Sig
Between group	2.856	2	1.428	8.548	0.0001
Within group	164.246	985	0.167		
Total	167.102	987			

Table 7. Post hoc tests of age group

Multiple comparisons							
Dependent variable:							
	(I) Age group	**(J) Age group**	**Mean difference (I-J)**	**Std. error**	**Sig.**	**95% Confidence interval**	
						Lower bound	**Upper bound**
LSD	young	Middle	.02363	.02759	.392	-.0305	.0778
		Old	.18993*	.04632	.000	.0990	.2808
	Middle	young	-.02363	.02759	.392	-.0778	.0305
		Old	.16631*	.04540	.000	.0772	.2554
	Old	young	-.18993*	.04632	.000	-.2808	-.0990
		Middle	-.16631*	.04540	.000	-.2554	-.0772

**. The mean difference is significant at the 0.05 level.*

Post-Hoc (Tukey HSD) indicated that there were significant difference in the responses between old and young adults and old and middle adults. There is no significant between middle and young adults (P = 0.39).

2.3 Hypothesis Three

There is no significant difference among the mean responses of Non-formal educators, Primary/Secondary, Diploma/NCE, First degree and Postgraduates degree holders on electrical energy management practices adopted in residential buildings in Niger State, Nigeria (P< 0.05).

The result of the one-way ANOVA of the mean responses of respondents on electrical energy management practices in Niger State with respect to residents' educational level is presented in Table 8. Levene's statistics has a significant value of 0.09. Then, since the value is higher than the significant level value of (*P*< 0.05), the assumption of homogeneity of variances is met. Therefore, ANOVA can be used for analysis.

The analysis of result as presented in Table 8 revealed that, there was statistically significant difference (*P*< 0.05) in the mean responses of respondents The data supported the hypothesis, F (4, 983) = 71.17, P = 0.01. The mean and the standard deviations for non formal educators were 1.87 and 0.28 respectively, the mean and the standard deviations for primary/ secondary certificate holders were 1.95 and 0.18 respectively, the mean and the standard

Table 8. One-way ANOVA of mean scores of respondents on electrical energy management practices adopted by the educational qualification of residents in Niger State

Source	Sum of square	df	Mean square	F	Sig
Between group	37.58	4	9.39	71.17	0.01
Within group	129.52	983	0.13		
Total	167.10	987			

Table 9. Post hoc tests of educational qualification of residents

Multiple comparisons							
Dependent variable: MEANB_E							
	(I) Educational qualification	**(J) Educational qualification**	**Mean difference (I-J)**	**Std. error**	**Sig.**	**95% confidence interval**	
						Lower bound	**Upper bound**
LSD	Non-formal	Primary/secondary	-.08824	.04788	.066	-.1822	.0057
		Diploma/NCE	-.08680	.04777	.069	-.1805	.0069
		First degree	-.48833*	.04737	.000	-.5813	-.3954
		Post graduate	-.43021*	.06391	.000	-.5556	-.3048
	Primary/ secondary	Non-formal	.08824	.04788	.066	-.0057	.1822
		Diploma/NCE	.00144	.03093	.963	-.0593	.0621
		First degree	-.40009*	.03032	.000	-.4596	-.3406
		Post graduate	-.34196*	.05254	.000	-.4451	-.2389
	Diploma/NCE	Non-formal	.08680	.04777	.069	-.0069	.1805
		Primary/secondary	-.00144	.03093	.963	-.0621	.0593
		First degree	-.40153*	.03015	.000	-.4607	-.3424
		Post graduate	-.34341*	.05244	.000	-.4463	-.2405
	First degree	Non-formal	.48833*	.04737	.000	.3954	.5813
		Primary/secondary	.40009*	.03032	.000	.3406	.4596
		Diploma/NCE	.40153*	.03015	.000	.3424	.4607
		Post graduate	.05812	.05208	.265	-.0441	.1603
	Post graduate	Non-formal	.43021*	.06391	.000	.3048	.5556
		Primary/secondary	.34196*	.05254	.000	.2389	.4451
		Diploma/NCE	.34341*	.05244	.000	.2405	.4463
		First degree	-.05812	.05208	.265	-.1603	.0441

**. The mean difference is significant at the 0.05 level.*

Post-Hoc (Tukey HSD) revealed that there were significant difference in the responses between first degree certificate holders and non formal educators and postgraduate degree holder and non formal educators. While other qualifications were no significant difference in their responses as their significant level is less than (P< 0.05)

deviations for diploma/ NCE holders were 1.95 and 0.42 respectively, the mean and the standard deviations for first degree certificate holders were 2.35 and 0.40 respectively and the mean and the standard deviations for postgraduate degree holders were 2.29 and 0.55 respectively.

3. DISCUSSION OF FINDINGS

The findings on hypothesis one presented in Table 4 revealed that, there was a statistical significant difference (P< .05) in the mean responses of low, medium and high income earners on electrical energy management practices in residential buildings in Niger State, Nigeria. The Post- Hoc (Tukey HSD) revealed that there were significant differences between low and high income earners (P = 0.03, P = 0.02) and medium income earners causes no significant difference. This indicated that people with medium income responses of electrical energy management practices differ with other income groups. The result agreed with the assumption of the theory of planned behaviour which said structural variables like socio-demographic influence behaviour and intention indirectly [8]. The theory further assumed that humans make plans and rational decisions that are motivated by self- interest [25]. These findings were in consonance with the work of [26] as they agreed that, the uses of efficient technology are likely to be imbibed by electricity users with high income and with behavioural measures being the least acceptable for high income earners. A study conducted by [16] supported the findings as they say that, wealthier households tend to purchase electrical energy efficient equipment to reduce the rate of energy consumption. The findings were also in agreement with the work of [18] as they said low income earners may feel financially unstable and lack capital to invest in residential energy efficiency improvements but may easily adopt good behaviour towards energy conservation.

The findings on hypothesis two presented in Table 6 indicated that, there was a statistical significant difference (P< 0.05) in the mean responses of young, middle and old adults on electrical energy management practices in residential buildings. The Post- Hoc (Tukey HSD) shows that, there was a significant difference in the mean responses between old and young adults (P = 0.00, P = 0.01) and between middle and old adults (P = 0.00, P = 0.00) but there is no significant difference between middle and young adults (P = 0.39). These findings imply that the old adults' ways of managing electricity differ from young and middle adults. The outcome of these findings agreed with the work of [19] which said that, the older heads of households have potential to be more likely to have conservation improvement but the younger persons may not be more likely to invest on efficient technology and that may be associated with their social status. It is supported by [20] which also revealed that the choice and use of energy consuming appliances and equipment usually influenced by the age of the head of household as younger household head may prefer up-to-date technological devices that are often more efficient while older head of household may accept their as it is and replace then more seldom. The findings differ with the work of [14], which concluded that, the decision to imbibe in some energy measures is not influenced by age. In other words, whether a household head is young, middle or older do not really determine his or her desire to conserve energy at home.

The findings on hypothesis three presented in Table 8 revealed that, there was a statistical significant difference (P< 0.05) in the mean responses of non-formal educators, Primary/ secondary, Diploma/ NCE, first degree and postgraduate degree holders on electrical energy management practices in residential buildings. The Post-Hoc (Tukey HSD) indicated that there is a significant difference in the mean responses of first and postgraduate degree holders to others level of education (P = 0.00). This means that, the way first and postgraduate degree holders managed electricity was quite different from other people. This may likely be associated to education they have received or level of their exposure to the outside environment. The findings agreed with the study conducted by [11], which argued that, a higher level of education is associated with lower household electrical energy consumption. The findings also conformed to the study conducted [23], as they advocated positive relationship between education levels of heads of household and electrical energy management practices. They concluded that the appliances and equipment used in residential buildings can be directly linked to the education of the head of household and those with higher levels of education may prefer to purchase efficient equipment because of the knowledge of the use of efficient equipment. Among the reasons of positive correlation is that the level of educational attainment reduces cost of information

acquisition and low level of education may lead to the careless attitude towards energy savings [24].

4. CONCLUSION

The shortage and wastages of electricity supply from AEDC and cost implications among residents in Niger State and Nigeria in general is disheartening and it serve as a drawback to the economic and development of the nation. The shortage and wastages is having negative impact to the environment, economic and technology development of the state. The study revealed the high income and low income earners influences electrical energy management practices, young adult (18 to 39 years) wasted electricity more compare to other age group while on the level of education, the residents with highest qualification (primary/secondary certificate) waste more of electricity. It is therefore clear that income level, age and educational level of electricity user contribute significantly to electrical energy usage.

5. RECOMMENDATIONS

Based on the findings the following recommendations were made:

1. The Electricity management board in collaboration with energy commission should intensify effort to organize enlightenment campaigns on electrical energy management practices targeting low and high income earners.
2. The enlightenment campaigns on electrical energy management should focus on young adult (18 to 39 years) as they wasted more of electricity, since they find it difficult to applied right behaviour towards energy management in residential buildings.
3. Residents with low educational qualification should be well informed on implications of electrical energy management, as they waste more of electricity compare to others.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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