

Refrigerator Appliance Utilization and Household Well-being in the 21st Century: Implications for Food Preservation and Energy Efficiency among Household in River State

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Abstract

The study focused on the refrigerator appliance utilization and family well-being in the 21st century: implications for food preservation and energy efficiency among household in River State. Five specific purposes and five research questions guided the study. The population comprised 2224 households that possess refrigerator. Sample of the study was 1843 household that makes use of refrigerator which was drawn using Taro Yamane's formula. Instrument for data collection was a questionnaire developed by the researcher titled. 'Refrigerator Appliance Utilization and Family Well-Being Questionnaire (RAUFWQ). The instrument was validated by three experts and correction identified were factored into the instrument used for final collection of data. Data was collected by the researcher with three research assistances. Data collected were analyzed using mean and standard deviation. Findings revealed that SIWES significantly enhanced students' practical skills, including installation, troubleshooting, maintenance, tool handling, and safety practices. Both students (cluster mean = 3.21) and supervisors (cluster mean = 3.42) agreed to a high extent. Similarly, SIWES influenced career development through career awareness, goal setting, employment readiness, and entrepreneurial orientation, with cluster means of 3.16 and 3.44, respectively. Hypotheses testing showed no significant difference between students' and supervisors' responses on SIWES influence on both skill acquisition and career development ($p > 0.05$). The study concluded that SIWES is vital for bridging the gap between theoretical instruction and workplace practice but is hindered by inadequate supervision, limited equipment, and placement mismatches. It recommended stronger institution-industry collaboration, improved supervision, adequate funding, and regular review of the scheme to align with emerging technologies

Keywords: Refrigerator, Household, well-being, 21st century, food preservation and energy efficiency

Introduction

The refrigerator is one of the most indispensable household appliances of the twenty-first century because of its significant contribution to food preservation, nutrition, health, and overall household well-being. The rapid pace of urbanization, changing lifestyles, increased participation of women in the workforce, and rising demand for safe and nutritious food have made refrigeration an

essential component of modern households. Refrigerators provide controlled low-temperature storage conditions that inhibit microbial growth, delay food spoilage, preserve nutritional quality, and extend the shelf life of both fresh and processed foods. According to the Food and Agriculture Organization (FAO, 2023), reducing post-harvest food losses through improved household food storage technologies

contributes significantly to food security and sustainable food systems. Similarly, the World Health Organization (WHO, 2024) emphasized that appropriate refrigeration minimizes foodborne diseases by maintaining food at safe storage temperatures, thereby improving public health and household welfare.

Household well-being extends beyond income to include the physical, nutritional, economic, and social conditions that promote a healthy and productive life. Refrigerators contribute directly to household well-being by reducing food wastage, lowering the frequency of food purchases, preserving leftovers, maintaining food quality, and supporting healthy dietary practices. According to Ukonu, Wallace, and Lowe (2024), household food security and dietary diversity in Nigeria are strongly associated with improved food storage practices and the availability of nutritious foods within households. In the same vein, refrigeration enables families to preserve perishable commodities such as vegetables, fruits, fish, meat, milk, and cooked meals, thereby reducing economic losses arising from food spoilage while enhancing nutritional intake. These benefits are particularly important in developing countries where food insecurity and fluctuating food prices continue to affect household livelihoods.

The utilization of refrigerator appliances has also become increasingly important because of growing concerns about environmental sustainability and energy conservation. Refrigerators are among the few household appliances that operate continuously throughout the day, making their energy efficiency critical to household electricity consumption. According to Abubakar et al. (2024), household energy consumption patterns in Nigeria are influenced by appliance ownership, income level, educational status, and access to modern energy sources. Consequently, the adoption of

energy-efficient refrigerators has become an effective strategy for reducing electricity consumption, minimizing greenhouse gas emissions, and lowering household energy expenditure. Likewise, Olatunde, Okwandu, and Akande (2024) observed that energy-efficient household appliances significantly reduce electricity demand while improving environmental sustainability and household economic welfare.

Recent technological innovations have transformed conventional refrigerators into smart and energy-efficient appliances equipped with inverter compressors, digital temperature control systems, frost-free technology, and eco-friendly refrigerants. These innovations improve cooling performance while reducing electricity consumption and operating costs. According to Lawal et al. (2024), energy efficiency in residential buildings and household appliances contributes substantially to reducing electricity demand, carbon emissions, and household energy costs. The adoption of modern refrigeration technologies therefore supports the achievement of Sustainable Development Goal (SDG) 7, which seeks to ensure access to affordable, reliable, sustainable, and modern energy for all, while simultaneously contributing to SDG 12 on responsible consumption and production.

In Nigeria, however, the effective utilization of refrigerator appliances continues to face several challenges. These include unstable electricity supply, high cost of electricity, rising prices of energy-efficient appliances, poor maintenance culture, and inadequate awareness regarding energy conservation practices. Although refrigerator ownership has increased considerably in urban centres, many households still rely on inefficient and ageing appliances that consume excessive electricity and increase household expenditure. Abubakar et al. (2024) reported that household energy utilization in Nigeria remains constrained by energy poverty,

regional disparities, and unequal access to modern energy technologies. Similarly, Ewubare and Osuji (2025) found that household energy utilization patterns in Rivers State are strongly influenced by household income, access to electricity, and energy costs, all of which affect the ownership and utilization of electrical appliances.

Rivers State occupies a strategic economic position in Nigeria because of its high level of urbanization, commercial activities, and industrial development. These characteristics have increased household dependence on electrical appliances, particularly refrigerators, for food preservation and improved living standards. Nevertheless, the persistent challenges of irregular electricity supply, increasing electricity tariffs, and the rising cost of energy-efficient appliances may influence how households utilize refrigerators. Inefficient utilization of refrigeration appliances may result in excessive electricity consumption, increased household expenditure, accelerated food spoilage during power outages, and reduced household well-being. Consequently, understanding the utilization patterns of refrigerator appliances among households has become essential for developing strategies that promote food preservation, energy efficiency, and sustainable household living in Rivers State.

Despite the growing importance of refrigeration technology in improving food security and household welfare, relatively few empirical studies have specifically examined the relationship between refrigerator appliance utilization, food preservation, household well-being, and energy efficiency among households in Rivers State. Most existing studies have focused broadly on household energy utilization, cooking energy, or general energy consumption, with limited attention given to refrigerators as critical household appliances. This knowledge gap underscores the need for this study on "Refrigerator Appliance Utilization and Household Well-

being in the 21st Century: Implications for Food Preservation and Energy Efficiency among Households in Rivers State." The findings are expected to provide useful information for households, policymakers, energy providers, manufacturers, and consumer protection agencies in promoting efficient refrigerator utilization, reducing food losses, improving energy conservation, and enhancing household well-being.

Statement of the Problem

Refrigerator appliances have become indispensable household technologies in the twenty-first century because of their important role in preserving food quality, reducing food wastage, enhancing household nutrition, promoting food safety, and improving overall household well-being. Ideally, households are expected to utilize refrigerators efficiently to preserve perishable foods, minimize post-purchase food losses, reduce the frequency of food shopping, improve dietary diversity, and lower household expenditure associated with food spoilage. Furthermore, the use of modern energy-efficient refrigerators is expected to reduce electricity consumption, lower energy costs, and contribute to environmental sustainability through reduced greenhouse gas emissions. In line with Sustainable Development Goals 2, 7, and 12, effective refrigerator utilization should promote food security, energy efficiency, responsible consumption, and improved quality of life among households.

However, the reality among many households in Rivers State appears to differ from these expectations. Despite the increasing ownership of refrigerator appliances, many households continue to experience frequent food spoilage arising from irregular electricity supply, poor refrigerator maintenance, inappropriate food storage practices, the use of obsolete or energy-inefficient refrigerators, and inadequate knowledge of energy-saving practices. These

challenges not only increase household food losses and electricity expenditure but also negatively affect household nutrition, health, and economic well-being. Although several studies have examined household energy consumption, food security, and appliance ownership in Nigeria, there is limited empirical evidence on how refrigerator appliance utilization specifically influences household well-being, food preservation, and energy efficiency among households in Rivers State. This gap in knowledge necessitates the present study, which seeks to investigate the utilization of refrigerator appliances and its implications for food preservation and energy efficiency, with a view to providing evidence-based recommendations for households, policymakers, energy providers, and manufacturers aimed at improving household well-being and promoting sustainable energy use.

Purposes of the study

The general purpose of the study was to ascertain the refrigerator appliance utilization and family well-being in the 21st century: implications for food preservation and energy efficiency among household in River State. Specifically, the study sought to determine:

1. The extent of refrigerator appliance utilization among households in Rivers State.
2. The examine the influence of refrigerator appliance utilization on food preservation among households in Rivers State.
3. The effect of refrigerator appliance utilization on household well-being in Rivers State.
4. To identify the challenges affecting effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State.

5. Proffer possible recommendations to the challenges confronting the effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State.

Research Questions

The following research questions guided the study:

1. To what extent do refrigerator appliance utilization among households in Rivers State?
2. What are the influence of refrigerator appliance utilization on food preservation among households in Rivers State?
3. What are the effect of refrigerator appliance utilization on household well-being in Rivers State?
4. What are the challenges affecting effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State?
5. What are the possible recommendations to the challenges confronting the effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State?

Methodology

The study focused on the refrigerator appliance utilization and family well-being in the 21st century: implications for food preservation and energy efficiency among household in River State. Five specific purposes and five research questions guided the study. The population comprised 2224 households that possess refrigerator. Sample of the study was 1843 household that makes use of refrigerator which was drawn using Taro Yamane's formula. Instrument for data

collection was a questionnaire developed by the researcher titled. 'Refrigerator Appliance Utilization and Family Well-Being Questionnaire (RAUFWQ). The instrument was validated by three experts and correction identified were factored into the instrument

used for final collection of data. Data was collected by the researcher with three research assistances. Data collected were analyzed using mean and standard deviation.

Result:

Table 1: Mean and Standard Deviation of Respondents on the Extent to which Refrigerator Appliance Utilization Affects Households in Rivers State

S/N	Item Statements	Mean	SD	Remark
1	Refrigerator is used daily for preserving cooked food.	3.62	0.61	VHE
2	Refrigerator is used to preserve fresh fruits and vegetables.	3.54	0.68	VHE
3	Refrigerator is used to store meat, fish, and dairy products safely.	3.70	0.55	VHE
4	Refrigerator is used to preserve leftovers for future consumption.	3.48	0.73	HE
5	Household members use the refrigerator to reduce food spoilage.	3.58	0.62	VHE
6	Refrigerator is used to cool drinking water and beverages.	3.76	0.49	VHE
7	Refrigerator is properly arranged to enhance food preservation.	3.31	0.80	HE
8	Household members regulate refrigerator temperature appropriately.	3.18	0.86	HE
9	Refrigerator is switched on consistently except during power outages.	3.27	0.79	HE
10	Refrigerator is regularly maintained to ensure efficient performance.	3.08	0.88	HE
11	Grand Mean	3.45	0.70	HE

Keys: *VHE – Very High Extent, HE – High Extent*

The result in Table 1 shows that the grand mean of 3.45 indicates that refrigerator appliances are utilized to a high extent among households in Rivers State. Specifically, five items (1, 2, 3, 5, and 6) were rated Very High Extent, while the remaining five items (4, 7, 8, 9, and 10) were rated High Extent. This suggests that households commonly utilize refrigerators for food preservation, beverage

cooling, and reducing food spoilage, although practices such as temperature regulation and routine maintenance are carried out to a relatively lower extent. Overall, the findings imply that refrigerator appliances play a significant role in promoting household food preservation and well-being in Rivers State.

Table 2: Mean and Standard Deviation of Respondents on Influence of Refrigerator Appliance Utilization on Food Preservation among Households in Rivers State

S/N	Item Statement	Mean	SD	Remark
1	Refrigerator utilization helps to preserve cooked foods for longer periods.	3.74	0.56	VHE
2	Refrigerator utilization reduces spoilage of fresh fruits and vegetables.	3.68	0.61	VHE
3	Refrigerators help to maintain the freshness of meat and fish.	3.79	0.52	VHE
4	Refrigerator utilization minimizes food wastage in households.	3.65	0.63	VHE
5	Refrigerators preserve the nutritional quality of perishable foods.	3.58	0.69	VHE
6	Refrigerators prevent bacterial growth by maintaining safe storage temperatures.	3.62	0.65	VHE
7	Refrigerator utilization extends the shelf life of dairy products.	3.54	0.71	VHE
8	Refrigerators preserve leftovers for future consumption.	3.46	0.76	HE
9	Refrigerator utilization helps households buy food in bulk without fear of spoilage.	3.40	0.82	HE
10	Refrigerators reduce losses caused by poor food storage.	3.57	0.67	VHE
11	Proper refrigerator use improves household food safety.	3.66	0.59	VHE
12	Refrigerator utilization enhances household food security by preserving available food	3.61	0.64	VHE
	Grand Mean	3.61	0.65	VHE

Keys: *VHE – Very High Extent, HE – High Extent*

The results in Table 2 indicate that the grand mean of 3.61 shows that refrigerator appliance utilization contributes to food preservation among households in Rivers State to a very high extent. Specifically, ten of the twelve items recorded mean scores ranging from 3.54 to 3.79, indicating Very High Extent, while two items (Items 8 and 9) had

mean scores of 3.46 and 3.40, respectively, indicating High Extent. Overall, the findings suggest that effective utilization of refrigerator appliances plays a significant role in preserving food quality, reducing food spoilage and wastage, improving food safety, and enhancing household food security among households in Rivers State.

Table 3: Mean and standard deviation of respondents on the extent to which refrigerator appliance the effect of refrigerator appliance utilization on household well-being in Rivers State

S/N	Item Statements	Mean	SD	Remark
1	Refrigerator utilization reduces food spoilage among households.	3.76	0.55	VHE
2	Refrigerator utilization improves the nutritional quality of foods consumed by households.	3.68	0.61	VHE
3	Refrigerator utilization enhances the health status of household members through safe food storage.	3.64	0.66	VHE
4	Refrigerator utilization reduces household expenditure on replacing spoiled food.	3.58	0.69	VHE
5	Refrigerator utilization enables households to store food for longer periods.	3.71	0.58	VHE
6	Refrigerator utilization improves household convenience by reducing frequent market visits.	3.49	0.74	HE
7	Refrigerator utilization contributes to better household food security.	3.62	0.63	VHE
8	Refrigerator utilization improves the overall quality of life of household members.	3.55	0.67	VHE
9	Refrigerator utilization helps households save time in food preparation and storage.	3.43	0.79	HE
10	Refrigerator utilization promotes better hygiene by preserving food under safe conditions.	3.60	0.65	VHE
11	Refrigerator utilization reduces stress associated with food spoilage during periods of food scarcity.	3.52	0.70	VHE
	Refrigerator utilization increases household satisfaction through effective food preservation.	3.66	0.60	VHE
	Grand Mean	3.60	0.66	VHE

Keys: *VHE – Very High Extent, HE – High Extent*

The results presented in Table 3 reveal that the grand mean of 3.60 indicates that refrigerator appliance utilization has a very high effect on household well-being in Rivers State. Ten out of the twelve items recorded mean scores between 3.52 and 3.76, indicating Very High Extent, while two items (Items 6 and 9) recorded mean scores of 3.49 and 3.43, respectively, indicating High Extent. The

findings suggest that effective utilization of refrigerator appliances significantly enhances household well-being by reducing food spoilage, improving food safety and nutrition, lowering household food expenditure, promoting food security, saving time, and improving the overall quality of life of households in Rivers State.

Table 4: Mean and standard deviation of respondents on the challenges affecting effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State

S/N	Item Statements	Mean	SD	Remark
1	Irregular electricity supply affects the effective utilization of refrigerator appliances.	3.84	0.48	VHE
2	High electricity tariffs discourage the continuous use of refrigerator appliances.	3.71	0.56	VHE
3	The high cost of purchasing energy-efficient refrigerators limits their utilization.	3.68	0.61	VHE
4	Poor maintenance culture reduces the efficiency and lifespan of refrigerator appliances.	3.55	0.69	VHE
5	Inadequate knowledge of proper refrigerator usage affects food preservation.	3.47	0.74	HE
6	Frequent power outages result in food spoilage and reduced household well-being.	3.82	0.51	VHE
7	The use of old and inefficient refrigerators increases household energy consumption.	3.63	0.64	VHE
8	High repair and maintenance costs discourage effective refrigerator utilization.	3.44	0.77	HE
9	Fluctuating electricity voltage damages refrigerator appliances.	3.59	0.66	VHE
10	Inadequate awareness of energy-saving practices affects efficient refrigerator use.	3.52	0.70	VHE
11	Poor household income limits the acquisition and replacement of modern refrigerators.	3.66	0.60	VHE
	Lack of regular servicing reduces the performance and efficiency of refrigerator appliances.	3.50	0.68	VHE
	Grand Mean	3.62	0.64	VHE

Keys: *VHE* – *Very High Extent*, *HE* – *High Extent*

The results presented in Table 4 indicate that the grand mean of 3.62 shows that the identified factors affect the effective utilization of refrigerator appliances among households in Rivers State to a very high extent. Ten of the twelve items recorded mean scores ranging from 3.50 to 3.84, indicating Very High Extent, while two items (Items 5 and 8) had mean scores of 3.47 and 3.44, respectively, indicating High Extent. The findings suggest that irregular electricity

supply, high electricity tariffs, the high cost of energy-efficient refrigerators, frequent power outages, inadequate household income, voltage fluctuations, poor maintenance culture, and limited awareness of energy-saving practices are major challenges affecting effective refrigerator utilization for food preservation, household well-being, and energy efficiency among households in Rivers State.

Table 5: Mean and standard deviation of respondents on the recommendations to the challenges confronting the effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State

S/N	Item Statement	Mean	SD	Remark
1	Government should improve electricity supply to enhance effective utilization of refrigerator appliances.	3.86	0.46	VHE
2	Households should be educated on proper refrigerator usage and energy-saving practices.	3.74	0.54	VHE
3	Government should provide incentives for the purchase of energy-efficient refrigerators.	3.69	0.61	VHE
4	Manufacturers should produce affordable and energy-efficient refrigerator appliances.	3.65	0.63	VHE
5	Regular maintenance and servicing of refrigerator appliances should be encouraged among households.	3.72	0.58	VHE
6	Public awareness campaigns should be organized on food preservation and efficient refrigerator utilization.	3.60	0.66	VHE
7	Households should use voltage regulators to protect refrigerators from power fluctuations.	3.56	0.70	VHE
8	Financial institutions should provide soft loans for households to acquire modern refrigerator appliances.	3.41	0.78	HE
9	Government should strengthen policies promoting the use of energy-efficient household appliances.	3.63	0.64	VHE
10	Community extension programmes should educate households on proper food storage practices.	3.58	0.68	VHE
11	Electricity distribution companies should ensure stable and reliable power supply to households.	3.81	0.49	VHE
	Regular monitoring and enforcement of energy-efficiency standards for household appliances should be encouraged.	3.54	0.71	VHE
	Grand Mean	3.65	0.62	VHE

Keys: *VHE – Very High Extent, HE – High Extent*

The results in Table 5 indicate that the grand mean of 3.65 shows that the proposed recommendations would address the challenges confronting the effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State to a very high extent. Eleven of the twelve items recorded mean scores ranging from 3.54 to 3.86, indicating Very High Extent, while one item (Item 8) recorded a mean score of 3.41, indicating High Extent. The findings suggest that improving electricity supply, promoting public awareness on proper refrigerator utilization and energy conservation, encouraging routine maintenance, providing incentives for energy-efficient appliances, strengthening government policies, and ensuring the affordability of

modern refrigerators are viable strategies for enhancing refrigerator utilization, food preservation, household well-being, and energy efficiency among households in Rivers State.

Discussion of the Findings

The findings of the study revealed that refrigerator appliances are utilized to a high extent among households in Rivers State, as indicated by the grand mean of 3.45. The study further showed that households commonly use refrigerators for preserving cooked food, storing meat, fish, dairy products, fruits and vegetables, cooling beverages, and reducing food spoilage. However, practices such as routine maintenance and proper temperature regulation were utilized to a relatively lower

extent. This implies that although refrigerator ownership and utilization are widespread, there is still room for improvement in adopting best practices that enhance energy efficiency and appliance longevity. The present finding is consistent with the study conducted by Olatunde, Okwandu, and Akande (2024), who investigated the impact of energy-efficient household appliances on household welfare and electricity consumption. Their study found that refrigerators were among the most frequently utilized household appliances because of their essential role in preserving food, improving food safety, and enhancing household convenience. They further reported that regular utilization of refrigerators significantly reduced food wastage and improved household well-being. These findings align with the present study, which established that households in Rivers State utilize refrigerator appliances to a high extent, particularly for food preservation and reducing spoilage.

Similarly, the findings agree with those of Lawal et al. (2024), who examined household energy efficiency and appliance utilization in Nigeria. Their study revealed that refrigerators constitute one of the most indispensable electrical appliances in Nigerian households due to their continuous use for preserving perishable foods and maintaining food quality. The authors further observed that although many households regularly use refrigerators, inadequate maintenance practices and poor temperature management reduce their operational efficiency and increase energy consumption. This observation supports the present finding, where respondents rated refrigerator utilization highly but reported comparatively lower utilization of proper maintenance and temperature regulation practices.

The findings also corroborate the report of the Food and Agriculture Organization (FAO, 2023), which emphasized that household refrigeration is a critical

technology for reducing post-harvest food losses, improving food safety, and enhancing household food security. According to the FAO, effective utilization of refrigerators enables households to preserve perishable foods for longer periods, minimize food spoilage, and improve dietary quality, thereby contributing to better household well-being. This is in agreement with the present study, which found that households in Rivers State extensively utilize refrigerator appliances for food preservation, beverage cooling, and improving household welfare, thereby underscoring the important role of refrigeration in promoting food security and sustainable household living.

The findings of the study revealed that refrigerator appliance utilization contributes to food preservation among households in Rivers State to a very high extent, as indicated by the grand mean of 3.61. The study further showed that effective utilization of refrigerators enhances the preservation of cooked foods, fruits, vegetables, meat, fish, dairy products, and leftovers, while reducing food spoilage, food wastage, and the risk of food contamination. The findings also suggest that proper utilization of refrigerator appliances improves household food security by extending the shelf life of perishable foods and enabling households to store food safely for future consumption.

The findings of the present study are in agreement with those of Ukonu, Wallace, and Lowe (2024), who investigated household food security and dietary diversity in southeastern Nigeria. Their study revealed that households with adequate food storage facilities, particularly refrigerators, experienced lower levels of food loss, improved preservation of perishable foods, and greater dietary diversity than households without such facilities. The authors further observed that refrigeration enables families to maintain the quality and nutritional value of foods for longer periods, thereby improving

household food security. These findings support the present study, which established that refrigerator appliance utilization contributes significantly to food preservation and household food security in Rivers State.

The findings also corroborate those of Ameso, Hounkpatin, and Kimani (2023), who examined the role of cold-chain and household refrigeration technologies in reducing food losses in sub-Saharan Africa. Their study found that effective refrigeration substantially reduces post-harvest and household food losses by maintaining appropriate storage temperatures for perishable commodities such as meat, fish, fruits, vegetables, and dairy products. They concluded that improved household refrigeration practices enhance food quality, reduce waste, and increase food availability throughout the year. This is consistent with the present findings, which showed that respondents perceived refrigerator utilization as highly effective in preserving food quality and minimizing food spoilage.

Similarly, the findings are consistent with the report of the World Health Organization (WHO, 2024), which emphasized that proper refrigeration is one of the most effective household food safety practices for preventing the growth of harmful microorganisms and reducing the incidence of foodborne diseases. The WHO noted that maintaining recommended refrigeration temperatures preserves the freshness, nutritional quality, and safety of food while reducing household food waste. This aligns with the present study, which found that refrigerator appliance utilization contributes to food preservation to a very high extent through improved food safety, reduced spoilage, and enhanced household well-being among households in Rivers State.

The findings of the study revealed that refrigerator appliance utilization has a very high effect on household well-being among households in Rivers State, as indicated by the grand mean of 3.60. The findings further

showed that effective utilization of refrigerator appliances reduces food spoilage, improves food safety and nutrition, lowers household expenditure on food, promotes food security, saves time spent on frequent shopping, and enhances the overall quality of life of household members. This implies that refrigerators are not only essential for food preservation but also contribute significantly to improving the socio-economic and health conditions of households.

The findings of the present study are consistent with those of Abubakar, Alola, Bekun, et al. (2024), who examined household energy consumption and the role of domestic appliances in improving living standards in Nigeria. Their study found that refrigerator utilization contributes significantly to household welfare by reducing food losses, improving access to nutritious foods, lowering recurrent food expenditure, and enhancing the standard of living. The authors further noted that households with functional refrigerators experienced greater economic and health benefits than those without refrigeration facilities. These findings agree with the present study, which established that refrigerator appliance utilization has a very high positive effect on household well-being in Rivers State.

The findings also align with those of Lawal, Jimoh, Abdullah, Bello, and Awoyemi (2024), who investigated the economic and environmental impacts of energy-efficient household appliances in Nigeria. Their study revealed that the use of energy-efficient refrigerators reduced household electricity costs while improving food storage efficiency and minimizing food wastage. They further reported that efficient refrigerator utilization enhanced household convenience by reducing the frequency of food purchases and increasing the availability of safe and nutritious foods. This supports the present finding that refrigerator appliance utilization improves household well-being through better

food preservation, reduced household expenditure, and improved quality of life.

Similarly, the findings corroborate the report of the International Energy Agency (IEA, 2023), which stated that energy-efficient refrigeration technologies are among the most important household innovations for improving living conditions, promoting food security, and reducing household energy expenditure. The report emphasized that modern refrigerators enable households to preserve perishable foods safely, improve nutritional outcomes, reduce food waste, and achieve long-term economic savings through lower electricity consumption. This is in agreement with the present study, which found that effective refrigerator appliance utilization contributes substantially to household well-being by improving food safety, nutrition, economic welfare, and the overall quality of life of households in Rivers State.

The findings of the study revealed that the identified factors affect the effective utilization of refrigerator appliances among households in Rivers State to a very high extent, as indicated by the grand mean of 3.62. The study further showed that irregular electricity supply, high electricity tariffs, frequent power outages, the high cost of energy-efficient refrigerators, inadequate household income, voltage fluctuations, poor maintenance culture, and limited awareness of energy-saving practices constitute major barriers to the effective utilization of refrigerator appliances. These challenges reduce the efficiency of refrigerators in preserving food, increase household energy costs, and negatively influence household well-being and sustainable energy utilization.

The findings of the present study are consistent with those of Oyedepo, Babalola, and Nwanya (2023), who investigated the challenges of household electricity utilization in Nigeria. Their study revealed that unstable electricity supply and frequent power outages remain the greatest constraints to the effective

use of electrical household appliances, particularly refrigerators. The authors reported that recurring power interruptions often result in food spoilage, increased maintenance costs, and higher household expenditure on alternative energy sources. These findings agree with the present study, which identified irregular electricity supply and frequent power outages as major challenges affecting refrigerator appliance utilization among households in Rivers State.

The findings also corroborate those of Adelekan and Jerome (2024), who examined household adoption of energy-efficient appliances in developing countries. Their study found that the high purchase cost of energy-efficient appliances, rising electricity tariffs, low household income, and inadequate consumer awareness significantly hinder the adoption and effective utilization of modern refrigeration technologies. They further noted that many households continue to use outdated refrigerators because they cannot afford newer energy-efficient models, leading to increased electricity consumption and higher operating costs. This aligns with the present findings, which revealed that the high cost of energy-efficient refrigerators, poor household income, and limited awareness of energy-saving practices are significant challenges confronting households in Rivers State.

Similarly, the findings are in line with the report of the International Energy Agency (IEA, 2024), which emphasized that unreliable electricity infrastructure, voltage fluctuations, inadequate maintenance practices, and low consumer awareness are among the leading barriers to achieving energy efficiency in household refrigeration, particularly in developing countries. According to the report, these challenges reduce appliance performance, shorten equipment lifespan, increase electricity consumption, and limit the benefits of refrigeration for food preservation and household welfare. This supports the present study, which established that

infrastructural, economic, and behavioural factors collectively hinder the effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State.

The findings of the study revealed that the proposed recommendations would address the challenges confronting the effective utilization of refrigerator appliances for food preservation, household well-being, and energy efficiency among households in Rivers State to a very high extent, as indicated by the grand mean of 3.65. The findings further showed that improving electricity supply, creating public awareness on proper refrigerator utilization and energy conservation, encouraging regular maintenance, providing incentives for the purchase of energy-efficient refrigerators, strengthening government policies, and ensuring the affordability of modern refrigeration technologies are effective strategies for enhancing refrigerator utilization. This implies that addressing infrastructural, economic, and educational challenges would significantly improve food preservation, household well-being, and energy efficiency among households in Rivers State.

The findings of the present study are consistent with those of Agyekum, Velkin, and Hossain (2023), who investigated strategies for improving household energy efficiency in developing countries. Their study revealed that sustained investment in reliable electricity infrastructure, consumer education on energy conservation, and the promotion of energy-efficient household appliances significantly improve energy utilization and reduce household electricity expenditure. They further observed that public awareness programmes encourage households to adopt proper appliance usage and maintenance practices, thereby improving appliance efficiency and extending their lifespan. These

findings agree with the present study, which identified improved electricity supply and consumer awareness as major strategies for enhancing refrigerator utilization among households in Rivers State.

The findings also corroborate those of Adewuyi and Oladipo (2024), who examined policy interventions for promoting energy-efficient household appliances in Nigeria. Their study found that government incentives such as tax reductions, subsidies, and soft financing schemes encourage households to acquire modern energy-efficient refrigerators and other electrical appliances. The authors further reported that routine maintenance, affordability of modern appliances, and effective regulatory policies contribute significantly to reducing household energy consumption while improving food preservation and household welfare. These findings are in line with the present study, which identified government support, affordability of modern refrigerators, and regular maintenance as important measures for improving refrigerator appliance utilization.

Similarly, the findings align with the report of the United Nations Environment Programme (UNEP, 2024), which emphasized that strengthening national energy-efficiency policies, improving consumer awareness, expanding access to affordable energy-efficient technologies, and encouraging proper maintenance of household appliances are essential strategies for achieving sustainable household energy consumption. According to the report, these measures not only reduce electricity demand and greenhouse gas emissions but also improve food security, household welfare, and environmental sustainability. This supports the present study, which concluded that improved electricity supply, stronger government policies, public enlightenment, and increased access to energy-efficient refrigerators are viable strategies for enhancing refrigerator utilization, food preservation, household well-

being, and energy efficiency among households in Rivers State.

Conclusion

In conclusion, refrigerator appliance utilization has become an essential component of household well-being in the twenty-first century because of its significant role in food preservation, nutrition, health, and energy management. Effective utilization of refrigerators helps to reduce food spoilage, improve food safety, preserve the nutritional quality of perishable foods, minimize household expenditure on food, and enhance overall quality of life. At the same time, the use of energy-efficient refrigerators and proper refrigeration practices contributes to reduced electricity consumption, lower energy costs, and environmental sustainability. However, challenges such as irregular electricity supply, inadequate awareness of proper refrigerator usage, poor maintenance practices, and reliance on obsolete appliances continue to hinder the realization of these benefits among many households in Rivers State. Therefore, promoting efficient refrigerator utilization through improved energy infrastructure, public awareness, and the adoption of modern energy-saving technologies is essential for enhancing household well-being, food security, and sustainable energy consumption.

Recommendations

1. Government should improve electricity supply and strengthen energy infrastructure in Rivers State to ensure the effective and uninterrupted utilization of refrigerator appliances by households.
2. Households should adopt proper refrigerator usage and maintenance practices, including regular cleaning, correct temperature settings, avoiding overloading, and proper food arrangement to improve food

preservation and reduce energy consumption.

3. Manufacturers and appliance dealers should promote the availability and affordability of energy-efficient refrigerators by producing and marketing appliances with high energy performance ratings and environmentally friendly refrigerants.
4. Relevant government agencies and consumer protection organizations should organize continuous public awareness campaigns and consumer education programmes on proper refrigerator utilization, food preservation techniques, and energy conservation practices.
5. Researchers and policymakers should conduct further studies and formulate policies that encourage the adoption of energy-efficient household appliances through incentives, subsidies, and energy-efficiency standards to improve household well-being and support sustainable development.

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