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Household Labor and Gender Roles in the Age of Smart Homes: A Systematic Literature Review

Systematic Literature Review: Pekerjaan Rumah Tangga dan Peran Gender di Era Smart Home

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ABSTRAK

Dalam beberapa tahun terakhir, perangkat rumah pintar dipromosikan sebagai alat untuk meningkatkan efisiensi dan kenyamanan dalam pengelolaan rumah tangga. Namun, pengaruhnya terhadap pekerjaan domestik dan peran gender masih kurang dieksplorasi, terutama dampaknya terhadap kehidupan pekerjaan domestik perempuan. Tinjauan sistematis ini mengkaji pengaruh teknologi rumah pintar terhadap pekerjaan domestik dan implikasinya terhadap peran gender. Penelitian ini menggunakan strategi pencarian komprehensif di database Scopus untuk memilih artikel relevan, untuk memastikan pemeriksaan menyeluruh terhadap literatur yang ada mengenai persinggungan antara teknologi rumah pintar, pekerjaan domestik, dan peran gender. Pedoman PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) membantu peneliti merencanakan dan melaksanakan tinjauan sistematis secara metodis, menjaga transparansi, mengurangi bias, serta memastikan ketelitian dalam proses tinjauan. Hasil penelitian mengungkapkan bahwa teknologi rumah pintar memiliki potensi untuk sekaligus memberdayakan dan membatasi pekerjaan domestik. Di satu sisi, teknologi ini dapat meringankan pekerjaan dengan mengurangi tuntutan fisik dari pekerjaan domestik. Di sisi lain, teknologi ini dapat meningkatkan pengawasan dan kontrol terhadap pekerjaan domestik dengan memperkuat norma-norma gender tradisional. Integrasi teknologi rumah pintar ke dalam pekerjaan domestik memiliki implikasi kompleks terhadap kesetaraan gender. Meskipun teknologi ini menawarkan peluang untuk menantang peran gender tradisional, teknologi ini juga dapat memperkuat ketidaksetaraan yang ada jika tidak diimplementasikan dengan bijaksana.

ABSTRACT

In recent years, smart home devices have been promoted as tools for enhancing efficiency and convenience in household management. However, their influence on domestic labor and gender roles remains underexplored, particularly regarding their impact on the lives of female domestic workers. This systematic review examines the impact of smart home technologies on domestic workers and the implications for gender roles. This study employs a comprehensive search strategy across Scopus databases to select relevant articles, ensuring a thorough examination of existing literature on the intersection of smart home technology, domestic labor, and gender. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines help researchers plan and carry out systematic reviews systematically, maintain transparency, reduce bias, and achieve rigor in review processes. The results point out that potential smart home technologies can both empower and constrain domestic workers. On the one hand, these technologies can enhance workers' autonomy by reducing the

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physical demands of domestic tasks. On the other hand, they can increase surveillance and control over domestic workers, potentially intensifying their workload and reinforcing traditional gender norms. The integration of smart home technologies into domestic settings has complex implications for gender equity. While these technologies offer opportunities to challenge traditional gender roles, they can also reinforce existing inequalities if not carefully implemented.

INTRODUCTION

The advancements in smart home technology have seen significant developments, with smart homes being defined as residences equipped with computing and information technology that anticipate and respond to occupants' needs to promote comfort, convenience, security, and entertainment through technology management within the home and connections to the outside world (Cook, 2012; Yar et al., 2021). Smart home technology comes in many forms, ranging from built-in systems to wireless sensor networks, ZigBee technology, and virtual reality applications (Lu, 2022; Wright & Shank, 2020). The development of smart home systems is further pushed forward by the enhancement of technologies such as embedded hardware, wireless communication, microcontrollers, and networks (Seo et al., 2021; Yang, 2021). Smart home technology, on the other hand, is applicable to various fields such as healthcare, aging in place, energy efficiency, and safety (Shin et al., 2013; Tan et al., 2021).

Smart home technology is becoming increasingly popular because of the ease with which it allows home systems to be automated, providing ease and saving time from the constant struggle of a home master. Smart home technologies are said to be capable of facilitating tasks related to cleaning, cooking, washing, etc. with the help of their innovative systems (Hansen et al., 2024; Strielkowski et al., 2022). In industrial kitchens, smart cooking systems can simplify operations and reduce errors, thereby increasing efficiency (Güngör & Yücel Güngör, 2024). The integration of smart home technologies not only improves comfort but also contributes to energy efficiency and sustainability by reducing dependence on fossil fuels and enabling homeowners to generate green energy (Sintov & Schultz, 2017; Taiwo & Ezugwu, 2021). The application of technology in smart homes not only provides convenience but also raises several relevant questions. The use of technology in smart homes can raise considerations around privacy, security, and the comfort of the home's occupants (Mols et al., 2022; Zheng et al., 2018). The implementation of technology in smart homes can also trigger questions around the social, psychological, and cultural impacts of using such technology (Furszyfer Del Rio et al., 2021; Hargreaves et al., 2018; Sadowski et al., 2024).

To date, scholarly investigations on the adoption of technology in smart homes can raise questions around environmental impact, sustainability, and the need for energy in the household (Meng et al., 2023; Sinanan & Horst, 2021). Considerations around data security, privacy boundaries, and control over technology are also relevant questions in the context of smart homes (Burrows et al., 2018; Ehrenberg & Keinonen, 2021; Rihar et al., 2015). However, investigations surrounding implications for domestic workers, particularly household labor, and the potential impact on gender roles and equality, remain limited. The adoption of smart home technologies raises questions around traditional gender roles and the division of household labor (Aagaard & Madsen, 2022; Aggeli et al., 2022; Strengers & Nicholls, 2017). The gendered division of domestic labor remains a key issue in gender and family studies, reflecting the unequal distribution of household responsibilities between men and women (Guppy et al., 2019; Koster et al., 2022). This backlog of division has a

significant effect on parity in the distribution of roles among genders, and it weighs on the neck not only of the women but also of their families as well. Various studies have claimed that regardless of the progress made, women are still dominant in carrying out the majority of the household chores, such as meal preparation, cleaning, childcare, and shopping. And their partners do quite a bit less significant chores than they do (Tonoyan et al., 2020; Waddell et al., 2021).

In societies with patriarchal structures, women are often assigned the primary responsibility for domestic labor, such as cleaning, cooking, and childcare, while men are typically expected to take on roles outside the home (Hu, 2018; Kocabicak, 2022; McClelland & Sliwa, 2023). This gendered division of labor is perpetuated by capitalism and patriarchy, enabling men to control women's labor power and maintain dominance (Frader, n.d.; M. R. Singh, 2019).This solid demarcation of labor is connected far and wide to gender equality by way of women's performance in the labor market, their mental and physical health, and their social and economic status. The era of smart home technology has inevitably led to the occurrence of a change in household gender roles (Gram-Hanssen & Darby, 2018). Households that are smart have robotic servants to assist in the cleaning, washing, and cooking, a characteristic that, in the past, women used to claim as their own (Strengers & Nicholls, 2017). So home appliances of that caliber, practically everyone is involved in the family ramblings of this kind, the smart devices being a touch of their tailored state-of-the-art household choices (Gram-Hanssen & Darby, 2018).

This study seeks to carry out a systematic review of technology interventions in smart homes that cause changes to gender roles in household labor, as well as their implications for domestic workers. By being aware of all such effects, ways of creating smart home technologies and the formulation of policies that are sensitive to the needs of women can be developed. While very few have studied it in a systemic literature review, there are lots of scholars who have scrutinized the interface of technological appliances and gender identity and the division of tasks in a family. A systematic review of the literature can facilitate intimate knowledge of the recent situation regarding the particular topics and identify the missing parts or directions that require more investigation. In other words, it is of the utmost importance to figure out the way that intelligent house technologies can shape gender stereotypes and housework allocation and whether these changes strengthen or weaken women's rights and gender equality. The researcher is guided by the following research questions: How do smart home technologies influence the gendered division of household labor?

This research aims to synthesize existing evidence on the relationship between smart home technologies, gender roles, and household labor, with the goal of informing policies and design approaches that promote gender equality and protect vulnerable domestic workers. The topic of gender roles and domestic labor was chosen based on the understanding that the rapid advancement of smart home technologies has the potential to reshape traditional gender dynamics within households. The promise of smart home devices has always been the 'solution' to the perceived problem of having women do unpaid labor at home. This investigation, therefore, aims to shed light on the potential implications of these technologies for gender equality and the welfare of domestic workers by investigating the ways in which they shape the organization of housework between men and women.

METHOD

This study uses a systematic literature review method to gather together existing research on smart home technologies, gender roles, and household labor. This review will be conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The rest of this review will follow a PRISMA protocol. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines help researchers plan and carry out their systematic reviews systematically, maintain transparency, reduce bias, and achieve rigor in their review processes. They systematically guide authors in reporting how a review was conducted, why a review is being reported, and what the results of the review are (Page et al., 2021).

Following the PRISMA principles, researchers can systematically find, filter, and choose relevant papers, thus improving the quality and reliability of the review (Kirsch et al., 2020). Researchers used the PRISMA checklist and flowchart to document the whole review process, from developing research questions to synthesizing findings. The checklist covers the reason for the review, the databases utilized to identify studies, the outcomes of meta-analyses, and the significance of the findings (Haddaway et al., 2018).

Identification of Relevant Literature

The identification process involves a comprehensive search of relevant databases to search for articles that address the relationship between smart home technologies, gender roles, and household labor. This study relies on the Scopus database as the primary source for literature retrieval due to several methodological and practical considerations. Scopus is one of the largest and most comprehensive abstract and citation databases of peer-reviewed literature, covering a wide range of disciplines, including social sciences, humanities, and interdisciplinary studies. The database is known for its rigorous journal selection process, ensuring that the publications indexed are of high academic quality and relevance.

The decision to use only Scopus was also influenced by the nature of the research topic, which is predominantly discussed within journals indexed in Scopus. In contrast, other databases such as Web of Science (WoS), PubMed, or EBSCO tend to have a stronger focus on the natural sciences, medical, and health-related fields, which may not provide as many relevant articles for the scope of this study (V. K. Singh et al., 2021).. The authors managed to identify relevant keywords and search strings based on boolean combinations (table 1). The main search queries are based on the following terms and their combinations of keywords and subject terms, such as: "smart home technolog*" OR "smart home" OR "IoT home" OR "household technolog*" AND "household" OR "household labor" OR "household practices" OR "housework" OR "domestic labour" OR "housekeep*" OR "gender* role*" OR "gender* dynamic*", from of the keywords we find 1890 document.

Table 1. Keywords Applied During the Systematic Literature Review Process

Database	Data String
Scopus databases	TITLE-ABS-KEY (("smart home technolog*" OR "smart home" OR "IoT home" OR "household technolog*") AND ("household" OR "household labor" OR "household practices" OR "housework" OR "domestic labour" OR "housekeep*" OR "gender* role*" OR "gender* dynamic*"))

Screening

Researchers screened all 1890 selected articles by selecting criteria. Article selection is carried out automatically based on the sorting function available in the Scopus database. In the screening process of a systematic review, the selection criteria play a crucial role in determining which studies are included in the review. (Nazneen et al., 2022) suggest that the selection criteria should be based on the research question to ensure that only relevant studies are considered. (Boelens et al., 2017) recommend that researchers establish a specific timeframe within which they will review articles, as it is impractical to review all existing publications. On the other hand, (Boelens et al., 2017) advise that restrictions on the publication timeline should only be applied if it is known that relevant studies would have been reported during a specific period.

Based on the search process in the selected database, 1,587 relevant documents were found. This shows that the trend of studies related to smart home technologies, gender roles, and household labor has been increasing over the past decade, with a significant rise observed in the last 10 years, namely in the period 2014–2024. Given the rapid advancement of smart home technologies and their potential impact on gender dynamics, it is crucial to focus the review on the most recent and relevant literature to understand the current state of the field. The author filtered the 211 articles by subject area to focus on relevant fields, such as social sciences, and arts and humanities, as these disciplines are most relevant to the research questions. We then filtered by document type, narrowing it down to 135 documents. Moreover, following the publication stage filter, there were 133 documents in the final category. Filtering by source type, journal, resulted in 133 documents, and after applying the language filter for English, 131 documents remained.

Table 2. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclution
Periode	2014-2024	2013 and below
Subject Area	Social Sciences and Arts and Humanities	Other Subject
Document Type	Article	Book chapter, Review, Conference paper, Book, Editorial, Letter, Short survey
Publication Stage	Publish/Final	Article in press
Source type	Journal	Conference proceeding, book series, book, undefined and trade journal.
Language	English	Non-English

Eligibility

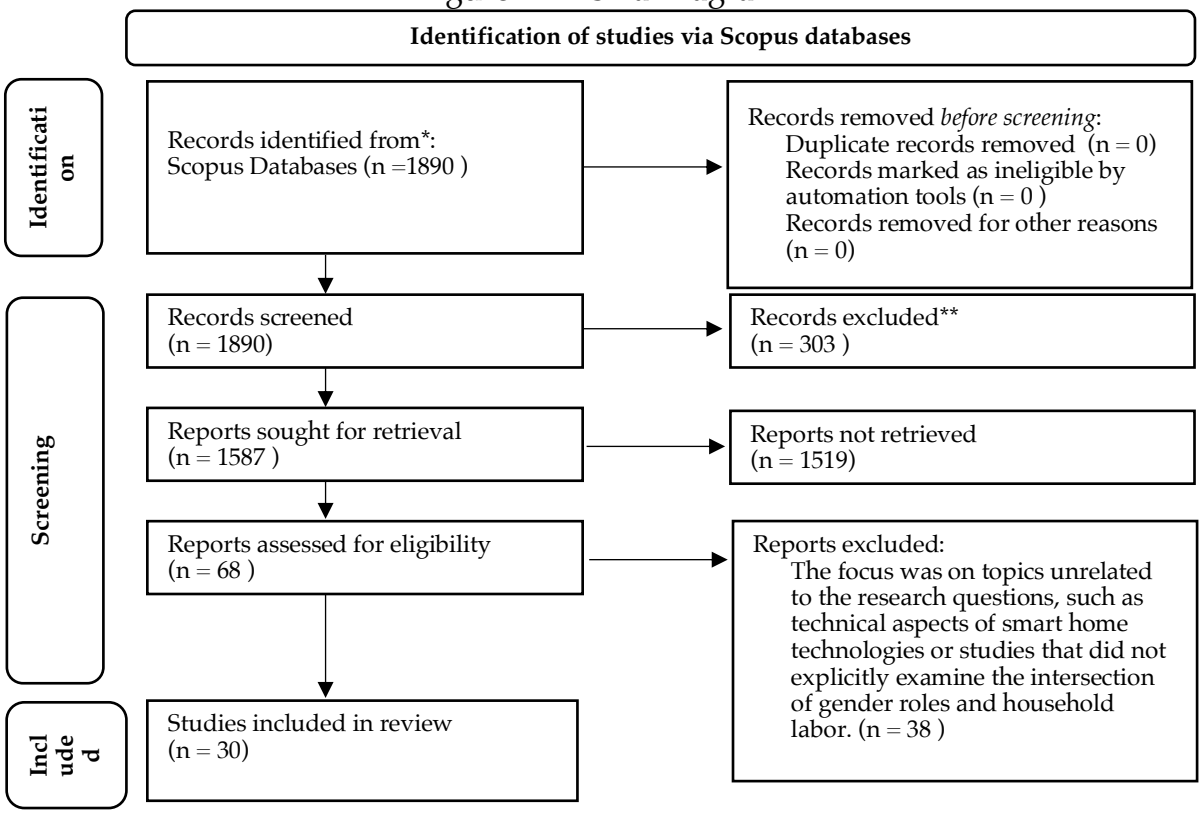
In the eligibility process of a systematic review, researchers manually assess the retrieved articles to ensure that they align with the predefined criteria. This step involves reviewing the titles and abstracts of the articles to determine if they meet the inclusion criteria set during the screening process (Okoli, 2015). The eligibility process is crucial as it ensures that only relevant studies progress to the next stage of full-text review, thereby maintaining the quality and focus of the systematic review. Given the complexity of the research topic and the multifaceted nature of the relationship between smart home technologies, gender roles, and household labor, this review aims to include a diverse range of studies from various disciplines. The authors will carefully review the titles and abstracts of the 131 articles to assess their eligibility for inclusion in the review. In this process, we discarded 63 articles that did not meet the eligibility criteria, the study design, the object of research characteristics, measures of gender roles and household labor, or the overall

findings. The remaining 68 articles were then subjected to a full-text review to assess their suitability for inclusion in the systematic review.

Included

The included studies in this systematic review were carefully selected based on their relevance to the research questions and their ability to provide insights into the relationship between smart home technologies, gender roles, and household labor. The authors reviewed the full text of the remaining 68 articles and applied the pre-defined inclusion criteria to ensure that only the most relevant studies were included in the final synthesis. The researcher read through the papers carefully and extracted key information on topics unrelated to the research questions, such as technical aspects of smart home technologies or studies that did not explicitly examine the intersection of gender roles and household labor. The final article for this systematic review consists of 30 articles that met the inclusion criteria. Through these articles, we gain a fuller picture of the ways in which smart home technologies and gendered norms and expectations about design and housework interact with one another, and the challenges this presents us with in our ongoing quest to understand and account for this interplay. The study reported that smart home technologies tend to reproduce the traditional gender roles and division of unpaid labor in households or to initiate change. A number of studies point out how the introduction of smart home technologies can result in changes to the division of household labor and the domestic burden and thus potentially impact gendered power relations within the home. However, other studies point to the ways in which these technologies may perpetuate existing gender norms and inequalities, as women often remain primarily responsible for household management and domestic labor.

Figure 1. Prisma Diagram



RESUL AND DISCUSSION

This systematic review includes selected publications from a variety of areas, such as gender studies, computer science, and the social sciences. We identified 11 publications from Australia, 6 from the UK, 5 from Denmark, 2 from the USA, and 1 each from studies done in Mexico, Jordan, Kenya, and Sweden. Numerous research techniques were employed in the publications, including surveys, experimental investigations, qualitative interviews, and ethnographic observations. Thirty publications were chosen for the review (Table 3). The majority of the chosen publications were released in the previous five years, and they were published between 2014 and 2024. This indicates the growing scholarly interest in the relationship between gender roles, household labor, and smart home technologies. A variety of smart home technologies, such as voice assistants, smart appliances, and home automation systems, were examined in the chosen articles.

Table 3. The Articles Selected

NO	Name/ Year	Title	Journal	Affiliation / Country
1	Aagaard, L. K. (2023)	When Smart Technologies Enter Household Practices: The Gendered Implications of Digital Housekeeping	Theory and Society (Q1)	Aalborg University, Denmark
2	Aagaard, L. K., Christensen, T. H., & Gram-Hanssen, K. (2023).	My smart home: an auto-ethnography of learning to live with smart technologies.	Personal and Ubiquitous Computing (Q1)	Aalborg University, Denmark
3	Aagaard, L. K. (2022)	Technological fascination and reluctance: gendered practices in the smart home	Buildings and Cities (Q1)	Aalborg University, Denmark
4	Aggeli, A., Christensen, T. H., & Larsen, S. P. A. K. (2022)	The gendering of energy household labour	Buildings and Cities (Q1)	Aalborg University, Denmark
5	Badstue, L., Eerdewijk, A. V., Danielsen, K., Hailemariam, M., & Mukewa, E. (2020).	How local gender norms and intra-household dynamics shape women's demand for laborsaving technologies: insights from maize-based livelihoods in Ethiopia and Kenya.	Gender, Technology and Development (Q2)	International Maize and Wheat Improvement Center, Mexico
6	Brown, Susan A. (2014)	Technology Adoption Decisions in the Household: A Seven-Model Comparison	Journal of the Association for Information Science and Technology (Q1)	University of Arizona, USA
7	Burrows, A., Coyle, D., & Gooberman-Hill, R. (2018)	Privacy, boundaries and smart homes for health: An ethnographic study	Health and Place (Q1)	University of Bristol, United Kingdom
8	Chambers, D. (2020).	Domesticating the "smarter than you" home. Gendered agency scripts embedded in smart home discourses.	M&K Medien & Kommunikation swissenschaft (Q2)	Newcastle University, United Kingdom
9	Chambers, D. (2022).	Attuning smart home scripts to household and energy care.	Buildings and Cities (Q1)	Newcastle University, United Kingdom

10	Dahlgren, K ., Pink, S (2021)	Personalization and the Smart Home: questioning techno-hedonist imaginaries	Convergence (Q1)	Monash University, Australia
11	Dahlgren, K., Kaviani, F., Strengers, Y., Pink, S., & Korsmeyer, H (2024)	Bringing energy futures to life: Anticipatory household storylines as possible energy futures	Futures (Q1)	Monash University, Australia
12	Furszyfer Del Rio, D. D., Sovacool, B. K., & Martiskainen, M (2021)	Controllable, frightening, or fun? Exploring the gendered dynamics of smart home technology preferences in the United Kingdom.	Energy Research and Social Science (Q1)	University of Sussex, United Kingdom
13	Gram-Hanssen, K., & Darby, S. J. (2018)	Home is where the smart is"? Evaluating smart home research and approaches against the concept of home	Energy Research and Social Science (Q1)	Aalborg University, Denmark
14	Hargreaves, T., Wilson, C., & Hauxwell-Baldwin, R. (2018)	Learning to live in a smart home	Building Research and Information (Q1)	University of East Anglia, UK
15	Larsen, S. P. A. K., & Gram-Hanssen, K. (2020).	When space heating becomes digitalized: Investigating competencies for controlling smart home technology in the energy-efficient home	Sustainability (Q1)	Aalborg University, Denmark
16	Mamonov, S., & Benbunan-Fich, R. 2021	Unlocking the smart home: exploring key factors affecting the smart lock adoption intention.	Information Technology and People (Q1)	Montclair State University, USA
17	Martin, R. (2022)	Energy housekeeping: intersections of gender, domestic labour and technologies	Buildings and Cities (Q1)	Monash University, Australia
18	Mashal, I., & Shuhaiber, A. (2019)	What makes Jordanian residents buy smart home devices?: A factorial investigation using PLS-SEM	Kybernetes (Q2)	Aqaba University of Technology, , Jordan
19	Mpiira, S., Kipsat, M., Mose, P. B., Kalyango, F. X., & Staver, C. (2024)	The Influence Of Gender Specific Decisions On Household Technology Choice Within The Farming Households In Central Uganda	African Journal of Food, Agriculture, Nutrition and Development (Q3)	Maseno University, Kenya
20	Nicholls, L., & Strengers, Y. (2019)	Robotic vacuum cleaners save energy? Raising cleanliness conventions and energy demand in Australian households with smart home technologies	Energy Research and Social Science (Q1)	University, Melbourne, Australia
21	Pink, S., Strengers, Y., Martin, R., & Dahlgren, K. (2022)	Smart Home Masculinities.	Australian Feminist Studies (Q3)	Monash University, Australia
22	Sadowski, J., Y. Strengers,, & Kennedy, J. (2024)	More work for Big Mother: Revaluing care and control in smart homes	EPA: Economy and Space (Q1)	Monash University, Australia
23	Sinanan, J., & Horst, H. A. (2021)	Gendered and generational dynamics of domestic automations	Convergence (Q1)	Western Sydney

				Universty, Australia
24	Shirani, F., O'Sullivan, K., Henwood, K., Hale, R., & Pidgeon, N. (2022).	Living in an Active Home: household dynamics and unintended consequences.	Buildings and Cities (Q1)	Cardiff University, United Kingdom
25	Strengers, Y., Hazas. M (2019)	Pursuing pleasance: Interrogating energy-intensive visions for the smart home	International Journal of Human-Computer Studies (Q1)	Monash University, Australia
26	Strengers, Y., Gram-Hanssen, K., Dahlgren, K., & Aagaard, L. K. (2022)	Energy, emerging technologies and gender in homes	Buildings and Cities (Q1)	Monash University, Australia
27	Strengers, Y., Dahlgren, K., & Nicholls, L. (2022).	Emerging technologies' impacts on 'man caves' and their energy demand.	Buildings and Cities (Q1)	Monash University, Australia
28	Strengers, Y., & Nicholls, L. (2017)	Convenience and energy consumption in the smart home of the future: Industry visions from Australia and beyond	Energy Research and Social Science (Q1)	Monash University, Australia
29	Strengers, Y., & Nicholls, L. (2018)	Aesthetic pleasures and gendered tech-work in the 21st-century smart home	Media International Australia (Q1)	Monash University, Australia
30	Tarasova, Ekaterina, (2023)	Marginalising household users in smart grids	Technology in Society (Q1)	Linkoping University, Sweden

Source: Research results that have been elaborated by researchers

Technological Interventions and the Impact on Domestic Labor

The benefits of smart home technology, which include improved convenience, safety, and energy economy, have completely changed domestic environments. Numerous user groups are served by these technologies, and they have an effect on family life (Hargreaves et al., 2018). The further advancement and integration of smart home technology is expected to improve people's quality of life across a wide range of age groups and living conditions (Gram-Hanssen & Darby, 2018). People's interactions with their living environments have changed dramatically with the introduction of smart home technology, which provides advanced automation and communication systems (Strengers & Nicholls, 2017).

These technologies, which meet the various demands and preferences of many user groups, have shown to be advantageous in improving efficiency, security, and convenience within houses. In fact, smart home technology has fundamentally changed living spaces and offers a number of benefits like improved energy efficiency, safety, and convenience (Chambers, 2022; Dahlgren et al., 2024). People's quality of life could be considerably enhanced by these technologies' ongoing development and integration in a range of contexts and age groups.

The use of smart home technologies has had a big impact on how households divide up household work. The distribution of domestic tasks within families has been significantly impacted by the introduction of smart home devices. Some of the primary

benefits of smart home technology have been shown in multiple studies to be its capacity to decrease the amount of time spent on domestic chores (Aggeli et al., 2022; Hargreaves et al., 2018; Martin, 2022; Nicholls & Strengers, 2019; Strengers & Nicholls, 2017). For example, research investigations have shown that the strain of household chores can be reduced by employing smart appliances and devices to automate certain tasks, such as meal preparation, cleaning, and laundry. This is particularly true for women, who frequently take on an excessive amount of domestic duty.

Smart home technologies have the potential to reduce the time spent on domestic tasks, benefiting individuals who traditionally bear a larger share of household responsibilities. Studies have shown that the automation of household chores like laundry, cleaning, and meal preparation through smart appliances can alleviate the domestic burden (Aagaard et al., 2023; Strengers & Nicholls, 2018). While smart home technologies offer convenience, comfort, and energy efficiency, they also require adaptation and familiarization from users, which can limit their use (Burrows et al., 2018; Hargreaves et al., 2018; Mashal & Shuhaiber, 2019). Smart home devices have the potential to reduce some physical burdens related to household chores, but their actual impact on the division of labor is multifaceted. Despite the convenience and efficiency that smart home technologies provide, they do not inherently result in a fairer distribution of domestic responsibilities. Women often continue to shoulder the majority of household tasks, albeit in a less physically demanding manner, indicating that traditional gender roles persist even with technological integration (Gram-Hanssen & Darby, 2018).

Gender Roles and the Smart Home Paradigm

The introduction of smart home technologies has also raised questions about their impact on gender roles and the dynamics within the household. Among the provided references, (Gram-Hanssen & Darby, 2018; Hargreaves et al., 2018; Mpiira et al., 2024) explore the impact of smart home technologies on the concept of home and the potential for conflict-free living. These studies shed light on the broader implications of integrating smart technologies into domestic spaces and how they may influence household dynamics. Additionally, Sadowski et al, (2024) discuss the fluid and flexible nature of the gender-technology relationship, emphasizing that feminist politics play a crucial role in achieving gender equality, which is pertinent when considering the impact of smart home technologies on gender roles within households (Aagaard & Madsen, 2022; Sadowski et al., 2024).

Strengers & Nicholls (2018) delves into the gendered dynamics of smart home technology preferences, highlighting the gendered 'tech-work' involved in researching, setting up, maintaining, and upgrading smart home systems (Strengers & Nicholls, 2018). This gendered technology can influence the distribution of domestic tasks within the household and impact gender roles. Additionally, (Mamonov & Benbunan-Fich, 2021) suggest the need for gendered models to understand technology adoption in contexts where gender roles intersect with technology adoption, providing insights into how gender influences the adoption of smart home devices.

This technology not only provides comfort and efficiency but also gives rise to social consequences such as changes in communication processes and social interactions. Smart home technologies have the potential to influence the gendered division of household labor in various ways. The introduction of smart home devices can lead to new forms of gendered

technology, impacting the division of housework and potentially placing additional time burdens on both men and women (Strengers et al., 2022). These technologies can create disruptions in household dynamics, requiring adaptation and familiarization from household members, which can limit their use and lead to increased time demands (Hargreaves et al., 2018). Additionally, the adoption and use of labor-saving technologies are influenced by existing gender norms and intra-household dynamics, which in turn affect the gender division of labor (Badstue et al., 2020).

Smart home technologies may exacerbate existing gender inequalities in the division of household labor by introducing additional demands for coordination, potentially reinforcing traditional gender roles (Aggeli et al., 2022; Pink et al., 2022). Studies have shown that smart energy technologies, such as energy feedback systems, may reproduce or further entrench the unequal distribution of household labor between men and women (Martin, 2022; Strengers et al., 2022). The gendered implications of digital housekeeping associated with smart technologies can create more work for men, often framed as "tinkering" rather than labor (Sinanan & Horst, 2021). The gendered dynamics of smart home technology preferences can lead to a gender imbalance in the adoption and use of these technologies (Furszyfer Del Rio et al., 2021). Smart home technologies that prioritize personalization may fail to consider the intricate socio-material dynamics that exist inside homes, such as power imbalances based on age and gender (Dahlgren et al., 2021). When designing smart home technologies, the gendered aspects of routine household tasks are frequently overlooked, which could discourage users and negatively impact the devices' functionality (Shirani et al., 2022).

The gendered division of work and household relations has been significantly impacted by the introduction of smart home devices. Although these technological advancements can improve efficiency and convenience, they can also exacerbate or maintain gender disparities that already exist in the home. Because of the potentially profound effects on the well-being of both individuals and families, researchers have stressed the importance of developing sophisticated knowledge of the interactions among gender roles, household work, and smart home technologies. There are several ways in which smart home technology affects how domestic labor is distributed. On the other hand, women, who sometimes bear a disproportionate amount of household tasks, may find it easier to manage the home when chores are automated by smart appliances and gadgets. Convenience, comfort, and energy efficiency are possible with this. However, current gender norms and intra-household dynamics have an impact on the adoption and usage of these technologies, which can restrict their impact on the gender distribution of labor.

Smart home technology has the potential to create new categories of gendered "tech-work," including system setup, maintenance, upgrades, and research. This gendered technology can influence the distribution of domestic tasks within the household and impact gender roles. Additionally, the disruptions in household dynamics caused by the integration of smart home technologies may require additional adaptation and familiarization from household members, potentially leading to increased time demands. Research has also emphasized the gendered dynamics of preferences for smart home technologies, implying that the focus on customization could obscure the intricate socio-material dynamics that exist within families, such as power differences based on age and gender. The gendered aspects of routine household tasks are frequently overlooked in the development of smart home technology, which could hinder user engagement and

performance. Gender disparities in the distribution of household work could be strengthened or made worse by the advent of smart home technologies. A sophisticated knowledge of how these technologies interact with gender roles and household dynamics is critical to ensuring that the advantages of smart home technologies are spread equally and do not perpetuate or reinforce existing gender norms. Addressing these difficulties is critical to achieving gender equality and increasing individual and family well-being in the smart home paradigm.

Complex Dynamics of Technological Adoption

The adoption and use of smart home technologies within households are influenced by various factors, including gender, socioeconomic status, cultural norms, and personal preferences. Research has indicated that smart home technologies have the potential to cause disruptions in both technical and social aspects, necessitating adjustments and education from users, which can limit their use (Aggeli et al., 2022; Chambers, 2020; Larsen et al., 2023). Privacy concerns have also been identified as a factor that can hinder enthusiasm for smart home technology adoption (Gram-Hanssen & Darby, 2018). Gender dynamics play a significant role in smart home technology preferences, with research indicating that homes are often studied as neutral spaces, overlooking the complex relationships within them (Furszyfer Del Rio et al., 2021). The gender division of labor influences the adoption and use of technology within households, impacting labor allocation patterns (Badstue et al., 2020). Models of technology adoption in households provide valuable insights into the reasons behind technology purchases and usage (Brown et al., 2015). The interest in and adoption of smart home technologies appear to be less appealing to women, indicating a gendered dynamic in their adoption (Shirani et al., 2022). The integration of smart technologies and energy systems in homes can add physical and mental labor due to the coordination and practice changes required (Aggeli et al., 2022). Gender, domestic labor, and technologies intersect in the context of energy housekeeping, where men may interpret energy feedback, police energy use, and influence consumption patterns (Martin, 2022).

The complex dynamics of smart home technology adoption and use highlight the need for a more nuanced understanding of the interplay between gender, domestic labor, and technological change within households. This includes investigating how gender roles, power dynamics, and gendered division of household activities influence the adoption, use, and effect of smart home technology. It is critical to evaluate how these technologies can reinforce or exacerbate current gender disparities, as well as how they may produce new kinds of gendered technology and labor. By taking a more holistic and gender-sensitive approach to understanding the integration of smart home technologies into domestic spaces, researchers and designers can work together to develop solutions that promote gender equality and better address the diverse needs and experiences of all household members.

CONCLUSION

This study examined the intricate relationships that exist between gender, domestic work, and smart home technology. In addition to their potential to increase efficiency and convenience, smart home technologies also run the risk of escalating or maintaining gender inequality in the home. The division of household labor based on gender is significantly

affected by the introduction of smart home technologies into residential areas. Although these technologies can increase productivity and convenience, they can also reinforce or exacerbate already-existing gender disparities. To guarantee that the advantages of smart home technologies are fairly distributed and do not perpetuate established gender norms, it is imperative to have a sophisticated understanding of the intricate relationships among gender roles, family labor, and smart home technology. Gender, power, and household behaviors are intertwined, so addressing the gendered aspects of smart home technology uptake and use calls for a multidimensional strategy. In the framework of the smart home paradigm, researchers and designers must collaborate to develop solutions that take into consideration the varied needs and experiences of all household members, fostering more gender equality and enhancing the well-being of individuals and families.

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