



Online grocery shopping intention: Elderly's perspective in Malaysia

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ABSTRACT

Purpose: This study investigates the factors associated with the elderly's intention to use OGS. Building on the Technology Acceptance Model, we propose several elderly-specific and functional-ageing constructs related to the perceived ease of use and usefulness of OGS.

Methods: The questionnaire was distributed physically and digitally to non-OGS users aged above 60, living in the Klang Valley, Malaysia, using a non-probability sampling approach. A total of 302 data were analysed using PLS structural equation modelling.

Results: The findings indicate that perceived ease of use, functional ability, life-course events, and digital literacy are associated with the elderly's perception of OGS's usefulness, while life-course events, digital literacy, technology anxiety, and facilitating conditions are associated with the perceived ease of use.

Conclusion: This study contributes to the OGS literature by addressing ageing complexities with OGS adoption among the elderly population, thereby offering insights for marketers and the government to tailor services and provide relevant support.

1. Introduction

In many countries, the percentage of the ageing population has risen significantly [1]. According to the World Health Organization [2], the global population is experiencing an ageing trend, with the percentage of individuals aged over 60 projected to nearly double from 12 % in 2015 to 22 % by 2050. In Malaysia, the population aged 60 and above comprised 10.7 % of the total population in 2020. This country is expected to be ageing by 2030, with people aged 60 years and over exceeding 15 % of the total population [3]. These demographic changes have prompted researchers worldwide to study the characteristics of the elderly population and develop age-friendly infrastructure and services to accommodate their needs.

To achieve independent living and food security, the elderly must make regular grocery trips [4,5]. However, this endeavour might prove difficult due to declining functional abilities among people in this age group. Accessing physical stores to obtain food and ensure food security may be challenging for elderly people with difficulty walking, driving, or using public transportation when their functional abilities degenerate [6]. Therefore, providing an effective solution to substitute physical grocery trips for the elderly is imperative.

Online grocery shopping (OGS) is among the suggested technologies to assist the elderly in this issue [5,7,8]. OGS has the potential to deliver an effective method to replace physical grocery trips, respond to the ageing population's increasing demand for independent living, and ensure food security [5]. Besides that, OGS can also be leveraged to promote independent living, provide a healthy lifestyle,

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and enhance well-being [5]. Despite the significant advantages of using the OGS, the adoption of online shopping among the elderly is relatively low. Based on the Department of Statistics Malaysia [9], the elderly aged 60 and above comprise only 1.6 % of e-commerce consumers. Hence, it is vital to investigate in depth the factors associated with the elderly's OGS adoption, as the OGS could be a feasible option for the elderly to obtain groceries, maintain independent living, and inform the successful preparation of functional declines.

Furthermore, the research on OGS adoption within the elderly segment has received less attention than the numerous studies on OGS undertaken with a primary focus on younger cohorts [10]. Typically, younger consumers are more inclined towards OGS than traditional brick-and-mortar shopping due to situational considerations such as time savings, price savings, convenience, and access to specialized goods [11,12]. However, it is essential to recognize that these considerations might not hold the same weight for the elderly population. According to Refs. [13,14], the needs and preferences of the elderly segment have often been overlooked in product and service development, which predominantly caters to the younger consumer base. This oversight has consequently given rise to a critical gap in the existing literature, emphasising the necessity of investigating the factors influencing the elderly's OGS adoption. Hence, understanding the elderly's needs and requirements is essential for the effective and successful development of the OGS platform, which will lead to the widespread adoption of OGS within the elderly population.

There is a sizable body of research on general technology adoption among the elderly [15,16]. In recent years, there has also been a growing number of studies that discuss OGS adoption among the elderly [5,7,8]. Among the existing technology acceptance theories, the Technology Acceptance Model (TAM) is one of the most widely used theories in information system studies [17]. The fundamental concept of TAM included perceived usefulness (PU) and perceived ease of use (PEOU) to predict a person's intention to use technology [18]. Previous studies have highlighted the vital role of conventional TAM constructs (PEOU and PU) in predicting the elderly's adoption of OGS [19,20]. However, TAM is often criticised for its lack of clarity, as the fundamental TAM model does not investigate how this ease of use and usefulness perceptions are developed [21]. Limited studies that have been performed to study in depth how these perceptions are developed, especially from the elderly's point of view. An elderly-specific construct and considering the process of complex functional ageing experienced by the elderly to predict the PEOU and PU in the context of OGS for the elderly segment are still scarce.

Therefore, this study aims to fill these gaps by extending the Technology Acceptance Model (TAM) to investigate the factors associated with OGS adoption among the elderly. On top of that, this study considers functional ageing and age-specific characteristics as antecedents of TAM. Therefore, the study contributes to the elderly's OGS adoption literature by:

1. Investigating how TAM's key antecedents (perceived ease of use and perceived usefulness) were formed with specific attention to the elderly context.
2. Exploring how the elderly's functional ageing experiences (life course events and functional ability) relate to their perception of the TAM's key antecedents.
3. Exploring how the elderly's specific constructs (preference for human contact, digital literacy, technology anxiety, and facilitating conditions) relate to their perception of the TAM's key antecedents.

To address the research objectives, this study utilises a quantitative survey involving a sample of individuals aged 60 years and above who are non-OGS users and live in Klang Valley, Malaysia. By acknowledging OGS as an alternative to physical grocery trips, this study examines the factors associated with the elderly's intention to use this technology. This research provides significant theoretical and practical contributions. First, this study has addressed the gaps in the literature by shedding light on OGS adoption within the older demographic in Malaysia. Previous studies within the OGS context were mainly focused on the younger generation [10], with minimal consideration of the elderly segment of society. Second, this study ventures beyond the existing TAM literature by investigating how TAM's constructs – perceived ease of use and perceived usefulness – are formed with specific attention paid to the unique context of the elderly. It should be acknowledged that older people experience ageing, which involves changes in their physical and psychosocial abilities. The ageing process may cause their demand and requirements for technology to differ from younger generations [22]. In understanding the elderly's OGS adoption, a researcher must consider the biophysical, psychosocial, and other challenges specific to the aged and their abilities. With that, this study provides evidence on how the elderly's experience of functional ageing (life course events and functional ability) and elderly-specific constructs (preference for human contact, digital literacy, and others) function as TAM antecedents and relate to their OGS adoption.

Practically, the findings will give online marketers, designers, companies, and governments a better and more explicit mandate to design superior services. The findings may also help key stakeholders to innovatively create functionalities that assure that the OGS services are tailored to the requirements of the elderly. As a result, the elderly population will be more encouraged to use OGS, effectively popularising OGS practices among them. Eventually, OGS may replace physical grocery shopping trips, practically assisting the elderly in their preparation for functional declines and accomplishing food security and independent living. The paper is structured as follows. [Section 2](#) provides an extensive literature review that discusses the importance of grocery shopping for the elderly population, the type of technology currently existing in the grocery shopping domain, OGS behaviour from the general population perspective, and OGS behaviour from the elderly perspective. [Section 3](#) describes the theories and hypotheses for the proposed antecedents. [Section 4](#) describes the research methodology, including the development of instruments, data collection, and sample characteristics. Subsequently, [Section 5](#) and [Section 6](#) contain a detailed data analysis and discussion of findings. [Section 7](#) then outlines the study's conclusion, implications, limitations and recommendations for future research.

2. Literature review

2.1. The importance of grocery shopping for the elderly population

Consumer demands, preferences, and abilities vary as they become older. Groceries – like food – are among the necessities that remain constant regardless of age. Food accessibility and availability are fundamental human needs and rights without which one cannot survive. These rights must be protected at all costs, as people should be free from anxiety and uncertainty about being able to eat healthily. This is why the food security topic warrants continuous research and a search for a workable solution [23]. Previous research shows elderly people are more likely to suffer from food insecurity [5,6,24]. In Malaysia, one-tenth of the elderly are food insecure due to various factors, including the lack of physical functioning in grocery shopping [25]. *Food insecurity* is defined as consuming insufficient and unsafe food that harms one's overall health [26]. According to Ref. [27], food security is achieved when people have physical, social, and economic access to sufficient, nutritious, and safe food to fulfil their food preferences and dietary needs for a healthy and active lifestyle.

The existing literature provides sufficient evidence that grocery shopping is essential to ensure food accessibility and nutrition needs, especially for the elderly population. This promotes independence, a healthy lifestyle and a high-quality life among the elderly [4,28]. Economically, the elderly are important consumers in the grocery-retailing sector as they are likelier to spend much of their income on food [29]. Elderly people usually shop in supermarkets or grocery stores near their homes. Previous research has shown that elderly grocery shoppers are price sensitive, rational, service-oriented, store loyal, and favour own-label and branded goods when purchasing groceries [30,31]. However, due to their declining ability to travel to physical grocery stores, the elderly population is at a greater risk of food insecurity [6,32]. Accessing physical stores to obtain food and ensure food security may be challenging for elderly people with difficulty walking, driving, or using public transportation when their functional abilities degenerate [6]. For instance, the elderly will face several challenges when travelling to grocery stores, which may include having to deal with huge crowds, difficulties in finding an accessible parking spot, having to wait in long queues, and having to carry heavy groceries from the stores to their vehicles and from their vehicles to their homes.

Furthermore, the importance of OGS for the elderly population has become more significant during the coronavirus (COVID-19) outbreak. The elderly population is vulnerable, as COVID-19 poses a severe health risk. Moreover, the closure of physical stores due to lockdown and social distancing measures prompted customers to shift to online shopping. The elderly may experience troubles and difficulties making routine grocery trips while, at the same time, complying with the social isolation and lockdown policies [33]. The aged people, particularly those with disabilities, suffered the most when stores in their neighbourhoods were closed. During the pandemic, an elderly who lives alone and has no close relatives or helpers to assist will very likely feel helpless when trying to order food via OGS. Being incapable of making grocery trips will make the elderly feel insecure and vulnerable, leading to food insecurity and difficulties in achieving independent living. The challenges faced by the elderly in getting access to sufficient groceries have recently drawn much attention. It is concerning that an increasing number of elderly individuals cannot manage their regular grocery shopping and might rely exclusively on home assistance. Therefore, governments strive to address this social problem, with OGS being the key solution, as it can potentially substitute physical grocery trips [24,34,35]. With OGS, the elderly can maintain food accessibility, providing food security and independent living [5,7].

Given that OGS may improve food security for elderly people, it seems logical to believe that the elderly is eager to adopt OGS. A recent survey revealed that the Malaysian population aged 60 and above constitutes only 1.6 % of e-commerce consumers [9]. Other countries, such as Canada and France, also exhibit a similar trend of low online shopping adoption among the elderly [5]. Hence, to increase OGS adoption among elderly people, it is critical to investigate the factors related to the elderly's online grocery behaviour.

2.2. Type of technology present within the grocery shopping domain

The development of technology has changed the ways people do grocery shopping. In recent years, innovative technologies have significantly mediated interactions between customers and grocery retailers [14,36–38]. Grocery retailers have adopted new retail technologies to enhance consumers' shopping experiences to fulfil their specific and tailored needs. These retail technologies can be broadly divided into in-store and out-store technologies. In-store technologies include interactive displays, robots, and self-service check-out counters, while out-store technologies involve mobile store applications and OGS platforms. The relatively new trend of live-streaming e-commerce has also been experiencing significant growth [39].

This study focuses on out-of-store technology, specifically OGS. Generally, OGS can also be known as E-grocery. OGS is a subset of e-commerce where people can buy groceries and other household products, including perishables. OGS involves consumers buying groceries via online sellers' websites or mobile applications. These applications allow customers to purchase groceries at any time without having to leave their homes. The applications also allow the groceries to be delivered to the customers' doorsteps.

2.3. Online grocery shopping behaviour from the general population perspective

From the perspective of OGS adoption among the general population, several studies have revealed that the rate of OGS adoption is frequently associated with barriers, risks, perceived benefits, and trust [40,41]. Studies such as [41] found that the time pressure and physical efforts of traditional in-store shopping are positively related to consumers' perception of OGS. Meanwhile, the relative advantage, compatibility, and complexity of the OGS technology related to customers' intention to adopt it. Building on the Technology Acceptance Model (TAM) [42], indicated that the perceived usefulness and ease of use are significant predictors of OGS

adoption among the general population. In the Malaysian context [43], showed that perceived ease of use, usefulness, satisfaction, perceived risk, and perceived information accessibility are important elements of Malaysian consumers' intention to buy groceries online. The study also revealed that young customers surpass older ones in OGS adoption. In the Indian context [44], found that the consumers' online purchasing behaviour was related to various factors, including trust, security, convenience, flexible transaction, service support, price promotion, and personalised attention. Another study by Ref. [45], conducted in Thailand based on the TAM, revealed that perceived usefulness, ease of use, enjoyment, subjective norms, and intention to use are majorly associated with OGS adoption in the country.

Furthermore [46], demonstrated costs, convenience, risks, time pressures, perceived benefits, perceived behavioural control, technology, social and environmental aspects of personal norms and beliefs related to grocery shoppers' OGS intention. Besides that [12], found that financial resources, flexible working hours, knowledge about smartphone usage, a large variety of product choices in the OGS platform, time-saving features, availability of online grocery platforms, and smartphone technology are drivers of OGS usage among the general population. Moreover [47], examined the changes in grocery shopping behaviour among consumers in China's early phases of the COVID-19 outbreak. The results indicate that perceived usefulness is highly related to a person's intention to purchase groceries online. However, the researchers found that trust in retailers and government and perceived ease of use do not relate to use intention. Regarding consumer switching behaviour after the pandemic, the researchers' findings indicate that 76 % of shoppers continue buying goods online. At the same time, the remainder has relocated to locally owned, independent supermarkets (11 %) and small businesses (14 %).

Regarding the evolution of e-commerce [48], demonstrated a significant positive correlation between the quality of knowledge sharing and the development of a sense of virtual community. Furthermore, this sense of virtual community has been identified as having a beneficial association with the consumer-brand relationship within virtual communities.

An emerging avenue in the realm of e-commerce is streaming commerce. A study by Ref. [39] identified significant associations between social capital and purchase intentions in live streaming e-commerce. Building on the parasocial relationship theory and information asymmetry theory, this study revealed that consumers' inclination to buy online through live streaming is related to factors such as the streamer's professionalism and handling of unfavourable events, the establishment of parasocial relationships with consumers, and the reciprocal expectation of live-streaming.

In recent years [17,49,50], have used the TAM theory to investigate the consumer's intention to use online services. Integrating the TAM and Theory of Planned Behaviour [49] demonstrated that subjective norms had a more pronounced association with intentions than personal attitudes. During the COVID-19 crisis [50], highlighted the importance of perceived usefulness and ease of use, risk, and social influence related to the consumer's adoption of online purchasing. Similarly [20], also revealed that individuals who perceive the OGS as easy, useful, efficient, and convenient are inclined to continue its usage even after the COVID-19 pandemic. Collectively, these studies confirm the TAM as a valid and significant model for investigating online service adoption.

2.4. Online shopping behaviour from the perspective of the elderly

Numerous studies discuss younger people's online purchasing behaviour. An individual's attitudes and psychological characteristics play a significant role in predicting behaviour [51,52]. Younger people usually choose to adopt OGS due to various benefits, including greater access to different goods, time and price-saving opportunities, convenience, and others [10,12,53]. Researchers need to distinguish between consumers of different age groups regarding technology usage, as the elderly's online behaviour might somewhat differ from that of the younger generation. In particular, the younger population segment is usually perceived as digital natives. They grew up concurrently with the development of new technologies like the Internet. For this reason, the younger generation might act differently than the older ones, who would typically require extra time to learn how to use new technology properly [54]. As a result, a natural "digital divide" emerged between the two groups, possibility due to elderly people's lack of knowledge and training in such technologies.

Several studies have investigated the online shopping behaviours of older adults. These studies include the one by Ref. [55], which revealed that perceived benefits (in the form of price discounts) and financial risks are significantly related to older adults' online shopping intention. At the same time, older adults' past shopping experiences are strongly associated with their perception of the benefits and risks associated with online shopping. Besides that [56], conducted a study investigating the elderly's attitude toward online shopping using the TAM framework and the concept of trust. The study revealed that users' trust and perceived usefulness were positively associated with their online shopping behaviour. Specifically, the ease of use and trust affect older users' perception of online shopping's usefulness, while perceived ease of use relates to their trust. In 2014 [57], investigated the drivers and barriers to senior consumers' intention to purchase products online by adopting the UTAUT and the Innovation Resistance Theory. The findings revealed that social influence and performance expectations drive online shopping adoption among the elderly, while tradition, risks, and values act as barriers. However, effort expectation was found to have no significant association with online shopping among the elderly.

Moreover, the elderly more significant barriers and have lower motivation for online shopping than their younger counterparts [57]. suggest that further investigation into the elderly's adoption of online shopping is still required, as the adoption behaviour of this group remains uncertain. Furthermore [58], investigated the older adults' online mobile shopping usage in Finland by adopting the life course concept. The findings showed that higher education, age, and household type could significantly relate to mobile-based online shopping behaviour among the elderly. Building on the UTAUT and Innovation Resistance Theory [59], revealed that facilitating conditions, social influences, and performance expectations positively related to online shopping adoption in Malaysia. However, effort expectation appears to be not significant. In addition, usage, value, risk, and tradition barriers negatively related to the elderly's

online shopping adoption in Malaysia. Recently [60], investigated the elderly's online shopping adoption during the COVID-19 pandemic and social isolation. Findings indicate that performance expectancy, facilitating conditions, and herd behaviour predict online shopping intention significantly. In contrast, social influence and effort expectancy are insignificant in this context.

In a deeper survey of the OGS studies that focus on the elderly population, there seems to be an increasing trend and interest in recent years to investigate OGS adoption behaviour among this population segment. In recent years, relevant research such as the one by Ref. [61] has involved a qualitative study to examine the determinants related to OGS adoption and the mode of preference when grocery shopping in person among the elderly. The findings indicate that the elderly who use public transit and active modes are likelier to continue shopping in person. At the same time, those who drive cars constitute a target group for OGS. Rather than a complete shift to OGS, active modes and elderly with declining physical abilities are more likely to use deliveries over in-person shopping. The elderly who drives have a similar preference between shopping in-person and online. Hence, there is potential for them to shift and adopt OGS. Nevertheless, this study suggested that most elderly people still prefer to make physical grocery trips, and only a minority intend to use OGS.

Moreover [5], conducted another study to explore the relationships between the elderly's OGS behaviour and decision-making, OGS preferences, and mobility restrictions to improve our collective knowledge regarding OGS behaviour among the elderly. Regarding adoption rates and intentions, the researchers discovered that the elderly's OGS behaviour differs from the younger generations. While other research demonstrates that time-saving and product offering are significant drivers of OGS adoption among younger people [5], found that mobility restrictions and travel limitations are key factors related to OGS adoption among the elderly. In addition, the results suggest that getting over the first factor above appeared far more important than overcoming technological challenges – such as perceived ability or having the tools in the first place – in the entire process of switching from physical shopping to OGS. Most importantly, this study also supports the proposition that OGS may serve as an alternative to traditional grocery trips, especially among the elderly who experience mobility restrictions.

To extend the literature on the elderly's OGS adoption [7], proposes that this technology could replace physical grocery trips to promote independent living among the Malaysian elderly. With that, the researchers examined the OGS adoption among elderly people from human values, psychological, and functional technological perspectives, building on the Capabilities Approach Theory and TAM. Based on the findings, the extent of elderly people's OGS intention is related to how the technology can help them achieve their life goals of being able to live independently (human value perspective), their perception of OGS's features (perceived ease of use) or the tasks OGS can assist them (functional technological perspective), and the elderly's subjective well-being on OGS (psychological perspective).

Nevertheless [8], argued that previous studies do not account for variances in consumer behaviour, which include varying buying patterns – i.e., people who sometimes buy groceries in-store and other times online. According to Ref. [62], situational factors can explain variations in consumer behaviour. Previous studies such as [63,64] have discussed the significance of situational factors in purchasing groceries online. However, the results from those studies should only be taken as a starting point for our analysis [8]. investigates the role of situational factors in predicting the elderly's OGS behaviour. This study's results demonstrate that the elderly is either open to grocery shopping online or have already started including it in their everyday shopping habits. However, almost half of the respondents in the study were hesitant to purchase groceries online, a finding that is in line with earlier research where online grocery shopping is not preferable to in-store [5,65]. In addition, the elderly's health, delivery time, deteriorating mobility, and the distance to a store and price, are the key situational factors that elderly people consider most when deciding whether to make online purchases for groceries or not. In particular, elderly people who have health difficulties and cannot travel to the store or carry groceries are likelier to use OGS. This is consistent with the findings of prior studies by Refs. [5,66]. Surprisingly, social interaction plays the most minor role in determining the elderly's OGS decision. This finding contradicts [67,68], who suggested that the social aspect is essential for the elderly when grocery shopping.

Based on the literature review, it may be summarised that several studies were carried out in the past on OGS adoption from the general population's perspective. However, OGS studies focusing on the elderly segment remain scarce. Several studies highlighted the association of perceived ease of use and usefulness with online shopping adoption from the perspective of the elderly, such as [7,19,59]. However, neither study investigated how both perceptions were formed in-depth. None of the existing online shopping or OGS adoption studies investigates the elderly-specific factors associated with their perception of the ease of use and usefulness in the OGS context.

3. Theories and research hypothesis

3.1. Technology acceptance model (TAM)

This study develops a research model based on the Technology acceptance model (TAM) [69]. Initially developed to understand computer usage and behaviour, TAM was introduced based on the Theory of Reasoned Action (TRA) [70]. TAM is widely used to explain a person's acceptance or rejection of a specific information system. According to Refs. [19,21], TAM is one of the most widely adopted theories in the technology adoption and online grocery retailing literature [17]. The fundamental concept of TAM includes two variables: perceived ease of use (PEOU) and perceived usefulness (PU).

TAM has been applied in various technologies, settings, control factors, and subjects, and its robustness has been demonstrated [71]. In the elderly-related context, TAM has also been frequently adopted to predict the adoption of various technologies, including entertainment [72], healthcare [73], tablet devices [15], online shopping [57,59], online food delivery services [49,50], and others. In addition, previous studies have used TAM for OGS adoption-related research [7,45,46]. Building upon the above, we conclude that

TAM is suitable for this study to examine the elderly's OGS adoption.

Despite its significant adoption, researchers have raised doubts about using TAM's original constructs to explain consumers' behaviour toward new technologies. The parsimony nature of the TAM framework simplifies the theory and allows for its application in different settings. However, this generalizability comes with the cost of less understanding of the actual user behaviour. It has been found that TAM could not provide software developers with the adequate information they need to investigate users' acceptance of new technologies [74]. Many researchers have raised the necessity to introduce additional antecedents as part of the TAM constructs to gain a more holistic understanding of individuals' technology adoption [45,69]. Many have heeded this call as the theory undergoes continuous development and has grown. Over time, researchers have incorporated variables other than perceived ease of use and perceived usefulness into the theory. For instance, previous studies introduced new predictors to extend the parsimony of TAM. The new predictors include social pressure and trust [75], narrative, social interaction, and physical condition [72], perceived risks, visibility, and perceived enjoyment [45], information quality and medical service satisfaction [16], as well as food choices, convenience, trust and perceived risks [49]. A recent study by Ref. [76] also extends the TAM model by introducing new antecedents, such as perceived social image and well-being. This was done to better predict a technology's perceived ease of use and usefulness.

Based on the above observation, there seems to be a need to include other components to provide a broader view and better explanation of the elderly's OGS adoption [77]. With that, this study dedicates functional ageing constructs – life course events and functional ability – that may reflect how functional ageing experienced by the elderly affects their OGS adoption. Furthermore, four elderly-specific constructs, including the preference for human contact, digital literacy, facilitating conditions, and technology anxiety, are incorporated into the model. These constructs have been utilised in previous gerontology and marketing research. These constructs will be further discussed in Section 3.2 and Section 3.3.

3.1.1. Perceived ease of use & perceived usefulness

This study adopts two primary constructs from the original TAM model: perceived usefulness (PU) and perceived ease of use (PEOU). PEOU is defined as the degree to which an individual believes using a given system would be free of effort [18]. Therefore, if the elderly perceives online grocery shopping as easy to use and to adopt without much effort, they will usually intend to use it [59]. According to Ref. [69], PU is defined as the way a person assumes that utilising a specific technology will help them improve their job performance. Therefore, in this study, PU refers to how the elderly believe the OGS platform will be useful to them. For instance Ref. [60], revealed that the older adult's perceived usefulness of online shopping is highly related to their intention to use it. In earlier research, it was posited that the concept of PEOU and PU, as outlined in the TAM, aligns with the notion of effort expectancy and performance expectancy, respectively, introduced in the unified theory of acceptance and use of technology (UTAUT) [17].

Prior studies have shown strong empirical support that PEOU is a crucial component positively related to an individual's intention to use new technology [16,72]. Several studies also found that PEOU has a significant positive association with PU [50,69,78]. Furthermore, PU has also been shown to have a positive association with the intention of the elderly to use new technology [50,72,73,79]. For instance Ref. [20], demonstrated that consumers who perceive OGS as both useful and easy to use are significantly more inclined to adopt and utilise OGS in the future. Previous studies such as [7,49,56] also revealed that PEOU and PU positively related to the elderly people's online purchase intention. Hence, we hypothesise that.

H1a. The elderly's PEOU is positively associated with the PU of online grocery shopping in Malaysia.

H1b. The elderly's PEOU is positively associated with their intention to use online grocery shopping in Malaysia.

H1c. The elderly's PU is positively associated with their intention to use online grocery shopping in Malaysia.

3.2. Functional ageing constructs

To understand the elderly's adoption of new technologies, one must first comprehend the changes that occur as a person ages. The existing research on the elderly's technology adoption or ageing and communication commonly uses chronological age to measure old age. This is because chronological age is easier to obtain and measure than other metrics. However, the ageing process experienced by people is complicated, and the chronological age measure is unfortunately unable to describe an individual's feelings and functioning. Therefore [80], argued that this measure has minimal importance. For instance, an elderly aged 65 with mobility issues who has Alzheimer's and lives in a residential care home will have a different functional age than an elderly aged 75 who lives independently and exercise regularly. Another method to measure the ageing process is proposed, namely the functional age. Functional age measures the elderly's ability to perform daily life activities [81]. This section outlines the functional ageing construct, deemed a more plausible determinant of the elderly's technology adoption than chronological age.

Functional ageing consists of three major dimensions: biological, psychological, and social age-related changes [80]. Biological or physical ageing is defined as a person's physical changes, while psychological ageing refers to mental performance or cognitive functioning changes. Social ageing, on the other hand, relates to individuals and society's perspectives on the ageing process [80,82]. This study incorporates functional age instead of chronological age into its analysis, as the former provides a more realistic picture of the elderly complex ageing process. This study proposes two functional ageing constructs: the functional ability to reflect physical ageing and life course events to reflect psychosocial ageing. The following sections will investigate these two constructs in greater detail.

3.2.1. Functional ability (physical ageing)

In this study, *functional ability* is defined as a person's ability to perform activities of daily living independently [4]. Previous research, including [79,83,84], showed that physical condition significantly relates to the elderly's perceived ease of use, usefulness, and intention to use technology. Given that the current study's topic relates to older people living independently, it adopts the Instrumental Activities of Daily Living (IADL) method [4] – to evaluate the elderly's physical functioning. The IADL focuses on activities required for the elderly who want to live at home independently, including using the telephone, shopping, housekeeping, doing laundry, getting transportation, as well as managing medications and finances. We hypothesise that the elderly with lower physical functioning will perceive OGS as useful to them. This is because OGS may assist them in maintaining access to groceries and independent living. If the elderly with functional declines perceives the OGS as useful, OGS adoption among this group will increase. This relationship is validated in earlier research where elderly people who experience declining physical mobility tend to shift to online grocery shopping instead of physical grocery trips [5]. For instance Ref. [66], revealed that the elderly intends to use OGS when they have physical limitations, such as mobility challenges. Therefore, we propose the following hypotheses.

H2a. The elderly's functional ability is negatively associated with the perceived usefulness of online grocery shopping in Malaysia.

H2b. The elderly's functional ability is negatively associated with their intention to use online grocery shopping in Malaysia.

3.2.2. Life course events (psychosocial ageing)

This study also adopts the life course events (LCE) concept to reflect the psychosocial ageing that might relate to the elderly's OGS adoption behaviour. Psychosocial ageing represents the psychological and social perspectives of functional ageing, where a person experiences changes in "cognitive" and "views of the person and society" related to the ageing process [29,80]. The life course event (LCE) approach – frequently applied in marketing research – is leveraged to capture this concept. The LCE can be defined as a person's life events – such as the loss of spouses, retirement, and others – that become turning points in their life course. An elderly who experiences LCE will develop a shift and enter an old age [85]. In brief, an elderly person who experiences life-changing events in his/her later life will become a person with a normative role as an older person. This normative role might lead to changes in behaviour [71], which, in turn, might affect the elderly's perception of OGS' ease of use and usefulness.

Previous studies, such as the one by Ref. [79], reveal that the elderly who experience more LCEs would perceive most video user-created content services as not enjoyable and have a lower intention to use them. In an experimental study, the surveyed elderly people claimed they lacked computer knowledge and believed they are too old to use new technology. Consequently, they also feel that it is meaningless to adopt these new technologies due to their perceived old age [86]. Therefore, we hypothesise that experiencing more LCEs would influence the elderly's normative role as an "old" person. This would, in turn, influence their assumptions that the OGS is difficult to use and useless.

H3a. The elderly's life course events are negatively associated with the perceived ease of use of OGS in Malaysia.

H3b. The elderly's life course events are negatively associated with the perceived usefulness of OGS in Malaysia.

3.3. Elderly-specific constructs

Other than the functional ageing constructs discussed in earlier sections, this study proposes four additional elderly-specific constructs: preference for human contact, digital literacy, technology anxiety, and facilitating conditions. These four constructs are incorporated into this study to better understand the elderly's perception of OGS.

3.3.1. Preference for human contact

In this study, preferences for human contact can be defined as liking for obtaining services such as doing grocery shopping services that involve physical human interactions at brick-and-mortar stores instead of using technologies [87]. Preference for human contact is a construct developed based on the Continuity Theory. This construct proposes that the elderly seek to maintain their internal and external structures when making adaptive decisions. Generally, elderly people in their later years like to stick with the same habits, relationships, and activities they had in the past [88,89]. Therefore, they tend to develop routines based on prior experiences to help prevent environmental unpredictability. The elderly population grew up when technological innovations were not commonly utilised. As a result of their early experiences, they are more used to obtaining services through personal physical interactions. In the context of grocery shopping, elderly people typically consider travelling to a physical grocery store or supermarket to conduct this activity, where they will experience direct human contact with a salesperson. According to Ref. [73], this continuing behaviour will develop a persistent personal structure of concepts based on preferences among the elderly. In other words, the elderly has already preferred physical human contact when doing groceries. Furthermore, earlier research has demonstrated the noteworthy significance of human interaction during in-person grocery shopping among older adults [68]. Hence, the elderly's preference for human contact in grocery shopping is a de-motivator to the perceived usefulness of OGS.

Human contact is critical for evaluating a service, and using OGS may dehumanise human interactions [90,91]. OGS services are a form of information technology that enables self-service through an online platform. This service dehumanises purchasing groceries by excluding human contact from the process. With that, the elderly is concerned that technology's dehumanising nature might become so ubiquitous that it might gradually replace physical human intercommunication [92]. For the elderly, OGS can potentially change their traditional way of obtaining services at physical stores. OGS has become abstract and intangible due to the digitisation process. This increases the elderly's uncertainty as they always require more assurance before using the service.

Conversely, physical human contact is a more familiar method of obtaining grocery shopping services for the elderly, as it limits and prevents uncertainties. Because of this, the elderly's preference for human contact would diminish their perception of the usefulness of OGS. Building upon the above discussion, we formulated the following hypothesis.

H4. The elderly's preferences for human contact are negatively associated with the perceived usefulness of OGS in Malaysia.

3.3.2. Digital literacy

Digital literacy is defined as the knowledge and skills required for the effective usage of information and communication technologies – including software and hardware [93]. Digital literacy is crucial for the elderly as many daily activities – such as online shopping – involve multiple interactions with technology. To use an online shopping platform, a person should know how to operate digital devices and technologies. The term “digital literacy” is synonymous with computer literacy or media literacy. Researchers have broadly adopted these term variations when studying personal, academic, and professional technological usage. Due to the complexity of digital literacy, many academics aim to build different conceptualisations and instruments for digital literacy, especially in educational and e-learning settings [94–96].

Digital literacy enables people to work efficiently and boost their productivity. However, it is recognised that digital literacy across different age groups varies greatly. Previous research has been conducted across multiple age groups, such as children, adolescents, and the elderly, on this matter [96,97]. For example [97], revealed that elderly people with varying levels of digital literacy will have different levels of perceived usefulness of the social network. However, digital literacy measurement method that suits the specific level of digital literacy among the elderly is scarce. Most of the available digital literacy measurements are only suitable to be implemented within the context of the younger generation. Considering this observation, we evaluate the elderly's digital literacy with relatively straightforward measurements – including, among others, knowing how to activate the smartphone and access the Internet from the home screen. These procedures may appear relatively simple and fundamental to most tech-savvy people. Nevertheless, they can be quite complicated for elderly people with little ICT knowledge.

This study investigates the concept of digital literacy with a specific focus on the context of the elderly population. Consistent with the findings [95], an individual's level of digital literacy relates to their perceived usefulness and ease of use of a certain technology. In the context of OGS adoption among elderly people, we hypothesise that those with higher digital literacy levels will perceive the OGS is easy to use. This is because they may be more familiar with the technological interface and functions of said technology. Besides that, digitally literate elderly people would be confident that the OGS platform is useful, as it can help them obtain groceries more easily and conveniently. Therefore, we put forward the following hypotheses.

H5a. The elderly's digital literacy level is positively associated with the perceived usefulness of OGS in Malaysia.

H5b. The elderly's digital literacy level is positively associated with the perceived ease of use of OGS in Malaysia.

3.3.3. Technology anxiety

Technology anxiety (TA) is a concern that hinders the elderly from adopting new technologies [98]. TA is a term that refers to a person's fear when confronted with the chance of adopting new technology [99]. Regardless of age, many people may feel anxious when they encounter new technology. However, this anxious feeling may be especially pronounced among elderly people who grew up surrounded by non-digital technologies [92]. According to Ref. [100], elderly people with high levels of TA typically have low perceived ability and inclination to use technology. A few studies revealed that TA was related to the intention to use technology among the elderly population [73,79,101].

In this study, TA refers to the elderly people unpleasant and negative emotions toward OGS felt by them before or during the use of such technology. TA arises from the absence of experience or self-confidence in effectively using technologies [102]. Therefore, the elderly who feel apprehensive about adopting OGS tend to resist purchasing groceries online. Existing research has confirmed that TA among elderly people is negatively related to PEOU and PU [22,103]. For instance Ref. [104], revealed that individuals afraid of using technology would perceive it as challenging to use and useless. In other words, when elderly people's anxiety levels rise, their impression of a technology's ease of use or perceived usefulness will decrease. Despite the effect of TA being widely examined in psychology [73], very little research has been undertaken to examine its association with OGS adoption among the elderly. In line with previous studies outlined above, we hypothesise a negative relationship between technological anxiety and PEOU and PU. Therefore, we propose the following hypotheses.

H6a. The elderly's TA levels are negatively associated with the perceived usefulness of OGS in Malaysia.

H6b. The elderly's TA levels are negatively associated with the perceived ease of use of OGS in Malaysia.

3.3.4. Facilitating conditions

Another potential construct that properly captures the elderly-specific context is facilitating conditions (FC). FC is defined as an individual's perception that adequate technical and organisational infrastructure is available to enable the use of a specific technology [105]. The facilitating conditions construct is drawn from the unified theory of acceptance and use of technology (UTAUT). As a result of their age and lack of familiarity with new technology, elderly people may require more assistance than other age groups. For example, accessible and readily available technical support will increase the elderly's intention to use health-related [106]. Regarding the elderly people's adoption of new technology, FC significantly increases the intention to use it [107]. However [73,108], found that FC does not impact technology adoption intention among the elderly [79]. indicated that “perceived user resources” – which include

leisure time, basic knowledge, hardware/software capacity, financial resources, and technical support – were positively associated with the elderly's perceived benefit, perceived ease of use, and intention to take part in video user-created content services.

Similarly [8], revealed that FC positively associates with the elderly's perceived ease of use and usefulness of gerontechnology. In addition [60], found that FC was significantly related to the elderly's online purchasing behaviour. In Malaysia, a positive correlation between FC and the elderly's online shopping acceptance was also found [59]. A recent study by Ref. [109] also found that FC positively related to e-commerce intention in Portugal. In the context of OGS [12], also discovered that in financial resources and knowledge of technology, FC was associated with OGS adoption. Therefore, we investigate the FC and its components, including knowledge, assistance, support from others, accessibility, and financial assistance related to the elderly's perceived ease of use and usefulness of OGS. Likewise, we propose that an increase in FC is positively associated with the elderly's perceived usefulness and ease of use of OGS.

H7a. The elderly's FC is positively associated with the perceived usefulness of OGS in Malaysia.

H7b. The elderly's FC is positively associated with the perceived ease of use of OGS in Malaysia.

A summary of the proposed research model and hypotheses is presented in Fig. 1.

4. Research methodology

4.1. Participants

Across various countries and scenarios, the term “elderly” denotes different age ranges. Referring to the guidelines provided by the Ministry of Health Malaysia and the United Nations, “the elderly or ageing population” refers to those 60 years and older. Consistent with the guidelines, this study's sample includes respondents aged 60 and above, living in Klang Valley, Malaysia and are non-online grocery users. Klang Valley is the urban agglomeration in Malaysia that covers the area of the adjoining central town and cities within the state of Selangor. The Greater Klang Valley area also encompasses the Malaysian capital city of Kuala Lumpur. As of 2021, Klang Valley has achieved the highest urbanisation rate in Malaysia [110]. In addition, the Greater Klang Valley area in Selangor, including Kuala Lumpur, are the two major areas in Malaysia with high internet broadband subscriptions and penetration rates. As a result, numerous OGS platforms concentrate on serving these two areas.

Furthermore, Klang Valley has the highest rate of internet users and computer-savvy people in Malaysia [111]. Selangor also registered the highest number of individuals aged 60 and above in the country, while Kuala Lumpur had the highest population density in 2021. On top of that, Klang Valley has witnessed an increasing number of people belonging to the elderly segment each year from 2010 to 2020. We choose to profile elderly individuals from the Klang Valley, considering the high internet penetration, soaring urbanisation level, and increasing proportion of the elderly population in this area.

Furthermore, this study uses a power analysis and a sample size calculator to determine the sample size. Following the recommendation of [112], G*Power 3.1 was used for power analysis to determine the required sample size. The results of the power analysis recommended a minimum sample size of 153. In addition, considering the size of the elderly population in Malaysia, an online sample

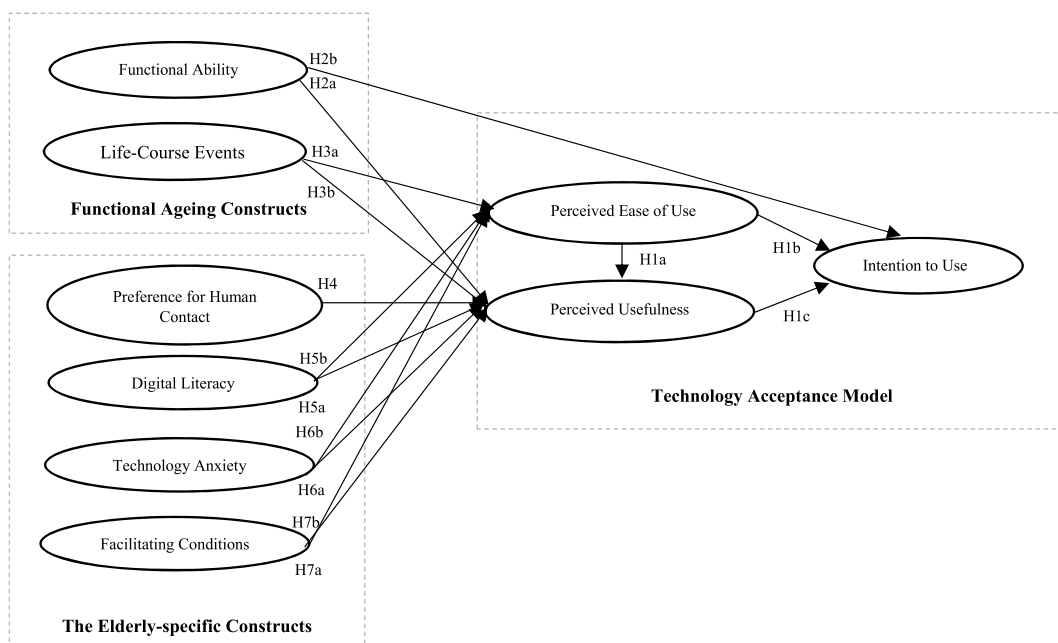


Fig. 1. Research model.

Table 1
Instrument development.

Constructs and Sources	Items																																												
<i>Section B: Fundamental TAM Constructs</i>																																													
Perceived Ease of Use [45]	PEOU1- Online grocery shopping is/might be easy to use. PEOU2- It is/might be easy to become skilful at using online grocery shopping. PEOU3- It is/might be easy for me to follow the procedures when ordering groceries online. PEOU4- Overall, I believe that online grocery shopping is easy to use.																																												
Perceived Usefulness [18,45]	PU1- Using online grocery shopping will be useful to me. PU2- Using online grocery shopping is valuable to me. PU3- Using online grocery shopping can overcome my obstacles. PU4- Using online grocery shopping can make my grocery shopping easier. PU5- Using online grocery shopping is convenient for my grocery shopping.																																												
Intention [105,113,114]	INTENTION1- I will use online grocery sites to shop for groceries, if possible. INTENTION2- I will use online grocery sites to shop for groceries as soon as I can. INTENTION3- I will use online grocery shopping platform and share these with others, if possible. INTENTION4- I will use online grocery shopping platform in the near future.																																												
<i>Section C: Elderly's Specific Constructs</i>																																													
Preference for human contact [87]	HUMAN1- Human contact is more enjoyable than using online grocery shopping. HUMAN2- Like interacting with service personnel more than using online grocery shopping. HUMAN3- Personal attention is important. HUMAN4- Prefer human contact than to use online grocery shopping.																																												
Digital Literacy [93]	DL1- I know how to activate the smartphone. DL2- I know the manoeuvres (i.e., tapping the screen) are required to operate the smartphone. DL3- I know how to access the Internet from the home screen (through the use of an app or by opening a browser). DL4- I know how to navigate to a search engine (e.g., Google). DL5- I know how to use a search bar. DL6- I know how to choose a search result.																																												
Technology Anxiety [105]	TA1- I feel nervous about using online grocery shopping. TA2- It scares me to think that I could lose a lot of information using online grocery shopping by hitting the wrong key. TA3- I hesitate to use online grocery shopping for fear of making mistakes I cannot correct. TA4- Online grocery shopping is somewhat scary to me.																																												
Facilitating Condition [22]	FC1- I have the knowledge necessary to use the system. FC2- A specific person (or group) is available for assistance with technology difficulties. FC3- My financial status does not limit my activities in using technology. FC4- When I want or need to use technologies, they are accessible for me. FC5- My family and friends think/support that I should use technology.																																												
<i>Section D: Functional Ageing</i>																																													
Life Course Event [79]	Which life course events did you experience before? (Can tick more than one) 1 Retirement 2 Loss of a spouse 3 Birth of the first grandchild 4 Last child moved out of household 5 First chronic condition diagnosed 6 Death of father and death of mother																																												
Functional Ability – IADL Scale' Scoring Guidelines [4]	In each category, please tick (✓) based on your highest functioning level at the appropriate box given. (Please tick only one for each activity). Notes: A summary score for total 8 activities will range from 0 (low function, dependent) to 8 (high function, independent). <table> <tr> <td>1. Ability to use telephone</td><td>Score</td></tr> <tr> <td>I am able to operates telephone based on own initiative search and dials numbers, etc.</td><td>1</td></tr> <tr> <td>I am able to dial a few well-known numbers.</td><td>1</td></tr> <tr> <td>I am able to answer telephone but does not dial.</td><td>1</td></tr> <tr> <td>I do not use telephone at all.</td><td>0</td></tr> <tr> <td>2. Shopping at store</td><td></td></tr> <tr> <td>I am able to take care of all shopping needs independently.</td><td>1</td></tr> <tr> <td>I am able to shop independently for small purchases.</td><td>0</td></tr> <tr> <td>I need to be accompanied by someone on any shopping trip.</td><td>0</td></tr> <tr> <td>I am completely unable to shop.</td><td>0</td></tr> <tr> <td>3. Mode of Transportation</td><td>1</td></tr> <tr> <td>I am able to travel independently by using public transport or drive own car.</td><td></td></tr> <tr> <td>I am able to arrange own travel via taxi, but does not use public transportation.</td><td>1</td></tr> <tr> <td>I will travel by using public transport when I am accompanied by someone.</td><td>1</td></tr> <tr> <td>I have limited travel via taxi or automobile and need the assistance by someone.</td><td>0</td></tr> <tr> <td>I do not travel at all.</td><td>0</td></tr> <tr> <td>4. Responsible of own medication</td><td></td></tr> <tr> <td>I will take my own medicine in the correct dosages at the correct time by myself.</td><td>1</td></tr> <tr> <td>I will take my medicine if the medicine is prepared in the advance at the separate dosage.</td><td>0</td></tr> <tr> <td>I am unable to dispense own medication.</td><td>0</td></tr> <tr> <td>5. Ability to handle finance</td><td></td></tr> <tr> <td>I can manage the financial matters independently (budgets, writes checks, pays rent, bills, goes to bank), collects and keeps track of income.</td><td>1</td></tr> </table>	1. Ability to use telephone	Score	I am able to operates telephone based on own initiative search and dials numbers, etc.	1	I am able to dial a few well-known numbers.	1	I am able to answer telephone but does not dial.	1	I do not use telephone at all.	0	2. Shopping at store		I am able to take care of all shopping needs independently.	1	I am able to shop independently for small purchases.	0	I need to be accompanied by someone on any shopping trip.	0	I am completely unable to shop.	0	3. Mode of Transportation	1	I am able to travel independently by using public transport or drive own car.		I am able to arrange own travel via taxi, but does not use public transportation.	1	I will travel by using public transport when I am accompanied by someone.	1	I have limited travel via taxi or automobile and need the assistance by someone.	0	I do not travel at all.	0	4. Responsible of own medication		I will take my own medicine in the correct dosages at the correct time by myself.	1	I will take my medicine if the medicine is prepared in the advance at the separate dosage.	0	I am unable to dispense own medication.	0	5. Ability to handle finance		I can manage the financial matters independently (budgets, writes checks, pays rent, bills, goes to bank), collects and keeps track of income.	1
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(continued on next page)

Table 1 (continued)

Constructs and Sources	Items	
	I can manage the day-to-day purchases, but needs help with banking, major purchases, etc.	1
	I am incapable of handling money.	0
	6. Food preparation	
	I can plan, prepare and serve adequate meals independently.	1
	Prepares adequate meals if supplied with ingredients.	0
	I can heats, serves and prepares meals, but does not maintain adequate diet.	0
	I need someone to prepare and serve the meals for me.	0
	7. Housekeeping	
	I can maintain housekeeping alone or with occasional assistance (e.g. "heavy work domestic help").	1
	I can perform light daily tasks such as dish washing, and bed making.	1
	I can perform light daily tasks but cannot maintain acceptable level of cleanliness.	1
	I need help with all housekeeping tasks.	1
	I do not participate in any housekeeping tasks.	0
	8. Laundry	
	I do all the personal laundry completely.	1
	I launder small items-rinses stockings, and etc.	1
	I do not do any laundry at all.	0
Marker variable		
Fantasizing [115,116]	MV1- I daydream a lot	
	MV2- When I go to the movies, I find it easy to lose myself in the film.	
	MV3- I often think of what might have been.	

size calculator ([Rasoft.com](https://www.rasoft.com)) indicated a requirement of 271 respondents. Hence, a minimum sample size of 271 is deemed appropriate.

4.2. Instrument development

There are four sections in the survey questionnaire: (A) demographic profile, (B) fundamental TAM constructs, (C) the elderly's age-specific constructs, and (D) functional ageing assessment. The details of the instruments are presented in Table 1. The majority of items present in the questionnaire are adapted from earlier studies, and they have been validated therein. Certain items, however, are revised to fit into the context of this research. The items for the digital literacy constructs were adapted from Ref. [93] with relatively simple measurements that suit the elderly's context. These measurements include knowing how to activate the smartphone, manoeuvre the smartphone operations, access the Internet from the home screen, navigate a search engine, use a search bar, and choose a search result. The demographic items in section A utilised a self-developed nominal scale. In contrast, items in sections B and C are measured using a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree. The Likert scale was employed for its simplicity and to ease our understanding of the elderly's behaviour.

Section D consists of two constructs: "functional ability" and "life course event". The "life course event" construct was measured using a six-event measurement adapted from Ref. [79]. This measurement signifies a transition into "old age" (and its related roles), with a total of 6 life-course events (0–6) used for the final measurement. Furthermore, this study assesses the "functional ability" construct by examining the elderly's ability to carry out the following eight activities: the ability to use the telephone, go shopping, prepare food, do housekeeping and laundry, mode of transportation used, the responsibility for own medications, and the ability to handle finances according to the Lawton IADL scale [4]. Using the Lawton IADL scale, the participants must tick only one item description that closely matches their highest functional level in each category. The respondent will receive a score of 1 for each activity if his competence level reaches a minimum level or higher, as determined by the scoring guidelines developed by Ref. [4]. For instance, within the category that assesses the respondent's ability to use the telephone, the respondents will receive one tally if they can answer telephones or do better based on their highest level of functioning. However, they will not receive a tally if they do not use telephones. Similarly, in the category that assesses the respondents' ability to physically shop at a store, they will also receive a tally if they can take care of all their shopping needs independently and zero otherwise. After that, scoring from the eight items is summed up to form a single score with a scale that ranges from 0 (low function, dependent) to 8 (high function, independent). The Lawton IADL scale has exhibited good predictive validity in previous elderly-related studies [22,117–119].

4.3. Data collection

The data collection employed a non-experimental quantitative survey approach. Given that Malaysia is a multiracial country that comprises Malay, Chinese, and Indian ethnic groups, the questionnaires were translated into Malay and Mandarin—by native speakers of each respective language. Prior to data collection, the survey instrument was developed, validated, and refined through pre-test methods, including expert evaluation, cognitive interviews, and pilot testing. After confirming there were no issues, data collection was conducted.

The data collection adopted a non-probability sampling technique, targeting the elderly aged 60 and above living in Klang Valley who were not users of OGS. Questionnaires were distributed to target respondents either physically or digitally (online). Target respondents were given the Google Form survey links through social networking sites, including WeChat, WhatsApp, and Facebook. On the other hand, some questionnaires were handed out to the respondents at several public recreation places in the community,

including the community centre, event venues, parks, basketball courts, playgrounds, and others. The elderly population in Klang Valley tends to gather in these places for daily exercise and social networking. Realizing this, we figured that these places serve as excellent locations for data collection.

At the beginning of the questionnaire, a cover page explaining the objective of the study, the respondent's inclusion criteria, and ethical deliberations were included on the front page of the questionnaire. If the respondents do not fulfil the inclusion criteria, their data are excluded from this study. Next, a brief introduction to the concept of online grocery shopping was explained before entering the actual survey. To eliminate the social desirability bias, we've assured participants and specified clearly in the information sheet that all collected data is confidential and solely for academic use. The surveys are anonymous, uniform, and have no identifying questions for the participants. In addition, no personal information is recorded, and findings are only presented in aggregate form. Furthermore, participation in the survey is entirely voluntary, and participants are free to withdraw at any time. These measures have been implemented to minimize the potential for social desirability bias.

Finally, a total of 433 forms were returned to us. A thorough filtering procedure was performed before the statistical analysis to ensure the dataset was useable, complete, and met predetermined criteria. After filtering, 302 responses were retained. The sample size of 302 responses is adequate for further evaluation and analysis, as it effectively surpasses the minimum target sample size ($n = 271$) determined by both G-power and the sample size calculator.

5. Data analysis and results

Firstly, this study leveraged the descriptive analysis feature in IBM SPSS Statistics to assess the demographic profile of the respondents. This is then followed by an estimation of the measurement and structural models using partial least squares structural equation modelling (PLS-SEM), SmartPLS 3.3.3 version. The statistical analyses were performed using PLS-SEM for several considerations. The present research aims to predict the determinants associated with older people's intention to adopt OGS. PLS-SEM is, therefore, ideally suited to examine and predict the main factors of interest [112]. Secondly, PLS-SEM can also be used to explain models with complicated relationships, such as the one used in this study. Thirdly, the assumption of normally distributed data is not required in PLS-SEM. Lastly, PLS-SEM has greater predictive power than its alternative, CB-SEM.

5.1. Descriptive statistics of the samples

A total of 302 useable responses were obtained from the data collection stage. Among the respondents, 54.3 % and 45.7 % are females and males, respectively. Furthermore, 54.6 % of respondents indicated they intended to use OGS platforms designed as social media, while 45.4 % had no such intention. Lastly, 44.7 % of respondents indicated they intend to use the OGS platform incorporating live streaming features, while the remaining 55.3 % indicated no intention to use such a service.

5.2. Common method variance

The data analysed in this study were gathered from a single source. Therefore, there is a need to check for common method bias (CMB). The CMB was assessed using both the marker-variable technique and full-collinearity testing. Firstly, we examined full collinearity to identify the CMB [120,121]. Using this technique, all variables were regressed against a common variable. If the variance inflation factor (VIF) is less than five, there is no bias from the single source of data [103]. The analysis yielded a VIF of less than five. Therefore, single-source bias is not an issue that needs consideration. The results of the full collinearity testing are displayed in Table 2. Afterward, we run the marker variable test, regarded as a reliable tool to assess CMB [122]. The construct "fantasizing" was included in the questionnaire as an unmeasured marker variable [115]. This marker variable was conceptually unrelated to the other variables. The results indicate that the R^2 changes were less than 10 % despite the model having a marker variable included, as indicated in Table 3. Therefore, it is evident that CMB is not an issue in our study.

5.3. Measurement model

We tested our measurement model using a two-step approach [123]. This is to confirm the reliability and validity of the instruments employed [112,124]. Once the model's reliability was established, we ran the structural model to test our hypothesis.

This study assessed the loadings, average variance extracted (AVE), and the measurement model's composite reliability (CR). As a rule of thumb, the loadings, CR, and AVE values should be ≥ 0.5 , ≥ 0.7 , and ≥ 0.5 , respectively. Except for functional ability and life course events (single-measure constructs), all AVEs are greater than 0.5, and all CRs are greater than 0.7. The loadings were all acceptable, with only two loadings – FC1 & FC2 – being less than 0.708 [112]. The results are displayed in Table 4.

Table 2
Full collinearity testing.

DL	FC	FA	HUMAN	INTENTION	LCE	PEOU	PU	TA
4.316	1.809	2.131	3.315	4.805	2.064	3.696	4.219	2.414

Note: DL = Digital Literacy, FC = Facilitating Conditions, FA = Functional Ability, HUMAN = Preference for Human Contact, INTENTION = Intention, LCE = Life Course Event, PEOU = Perceived Ease of Use, PU = Perceived Usefulness, TA = Technology Anxiety.

Table 3
Changes in R^2 after adding marker variable.

	R^2 (Before add in marker variable)	R^2 (After add in marker variables)
INTENTION	0.751	0.756
PEOU	0.626	0.627
PU	0.746	0.747

Note: INTENTION = Intention, PEOU= Perceived Ease of Use, PU= Perceived Usefulness.

Table 4
Measurement model.

Constructs	Items	Loadings	CR	AVE
Digital Literacy	DL1	0.908	0.970	0.845
	DL2	0.873		
	DL3	0.941		
	DL4	0.917		
	DL5	0.942		
	DL6	0.932		
Facilitating Conditions	FC1	0.691	0.875	0.584
	FC2	0.696		
	FC3	0.771		
	FC4	0.854		
	FC5	0.796		
Preference for Human Contact	HUMAN1	0.951	0.973	0.899
	HUMAN2	0.955		
	HUMAN3	0.944		
	HUMAN4	0.942		
Technology Anxiety	TA1	0.886	0.945	0.810
	TA2	0.875		
	TA3	0.919		
	TA4	0.920		
Intention	INTENTION1	0.948	0.976	0.910
	INTENTION2	0.955		
	INTENTION3	0.957		
	INTENTION4	0.955		
Perceived Ease of Use	PEOU1	0.917	0.960	0.856
	PEOU2	0.938		
	PEOU3	0.915		
	PEOU4	0.931		
Perceived Usefulness	PU1	0.918	0.964	0.844
	PU2	0.931		
	PU3	0.892		
	PU4	0.915		
	PU5	0.938		
Life Course event	LCE	SIM	NA	NA
Functional Ability	SUM FA	SIM	NA	NA

Note: SIM = Single Item Measure; NA = Not Applicable.

In step 2, we used the heterotrait-monotrait (HTMT) criterion proposed by Ref. [125] and modified by Ref. [126] to evaluate discriminant validity. The HTMT values should be ≤ 0.90 according to the mode lenient criterion. Table 5 illustrates that the HTMT values for this study are all lower than the lenient threshold of 0.90. Therefore, we may assert that the respondents acknowledge that the nine constructs are distinctive. Based on the validity tests, we may conclude that the measurement items used in this study are valid and reliable.

Table 5
Discriminant validity (HTMT).

	1	2	3	4	5	6	7	8
1. Digital Literacy								
2. Facilitating Conditions	0.682							
3. Functional Ability	0.493	0.163						
4. Preference for Human Contact	0.622	0.231	0.668					
5. Intention	0.822	0.541	0.653	0.680				
6. Life Course Event	0.684	0.458	0.457	0.536	0.673			
7. Perceived Ease of Use	0.795	0.601	0.482	0.580	0.808	0.632		
8. Perceived Usefulness	0.825	0.567	0.535	0.586	0.840	0.664	0.853	
9. Technology Anxiety	0.590	0.308	0.507	0.780	0.560	0.474	0.589	0.538

5.4. Structural model

We evaluated the multivariate skewness and kurtosis based on recommendations by Refs. [127,128]. The Mardia's multivariate skewness coefficient of $\beta = 10.39948$ ($p < 0.01$) and Mardia's multivariate kurtosis coefficient of $\beta = 112.40643$ ($p < 0.01$) indicate that the data were not multivariate normal distributed. Following [112], we reported the structural model's path coefficients, standard errors, t-values, and p-values using a 5000-sample re-sample bootstrapping procedure [124]. Additionally [129], claimed that p-values alone are inadequate to determine the significance of a hypothesis. Hence, they offered a unique criterion comprising a combination of p-values, confidence intervals, and effect sizes to determine the hypotheses' significance. Table 6 summarises the criteria we employed to test the developed hypotheses, while Fig. 2 presents the structural model.

Firstly, perceived ease of use ($\beta = 0.306$, $p < 0.01$) and perceived usefulness ($\beta = 0.411$, $p < 0.01$) were found to be positively related to the elderly's OGS intention. The functional ability ($\beta = -0.284$, $p < 0.01$) was negatively related to the elderly's OGS intentions. From here, we may conclude that ample evidence supports H1b, H1c, and H2b. The model revealed that the explanatory variables are able to explain 75.1 % of the variations in intention. ($R^2 = 0.751$, $Q^2 = 0.678$). The model had substantive explanatory power, as the R square values of 0.75, 0.50, and 0.25 are considered substantial, moderate, and weak, respectively.

Next, the results suggest that the perceived ease of use ($\beta = 0.450$, $p < 0.01$) and digital literacy ($\beta = 0.328$, $p < 0.01$) were found to be positively related to the perceived usefulness. In contrast, functional ability ($\beta = -0.113$, $p = 0.010$) and life course events ($\beta = -0.107$, $p = 0.015$) were found to negatively related to the perceived usefulness. Therefore, there seems to be ample evidence to support H1a, H2a, H3b and H5a. However, no significant relationship was found between the perceived usefulness and preference for human contact ($\beta = -0.015$, $p = 0.389$), technology anxiety ($\beta = 0.042$, $p = 0.155$), and facilitation condition ($\beta = 0.015$, $p = 0.349$). Therefore, H4, H6a, and H7a are all rejected. The model revealed that the explanatory variables explained 75 % variances in perceived usefulness (PU) ($R^2 = 0.75$, $Q^2 = 0.624$), indicating that the model has substantive explanatory power.

Besides that, digital literacy ($\beta = 0.469$, $p < 0.01$), facilitating conditions ($\beta = 0.130$, $p = 0.004$) positively related to the perceived ease of use. Meanwhile, life course events ($\beta = -0.161$, $p < 0.01$) and technology anxiety ($\beta = -0.182$, $p < 0.01$) were found to be negatively related to the perceived ease of use. From these observations, we may conclude that H3a, H5b, H6b, and H7b are all supported in this study. The 63 % variation in perceived ease of use (PEOU) is explained by the explanatory variables ($R^2 = 0.63$, $Q^2 = 0.527$), indicating a moderate explanatory power.

Lastly, we examined the confidence intervals to further validate the significance of the hypotheses. Except for H4, H6a, and H7a, the 95 % bias-corrected confidence intervals of the hypotheses do not include zero, further confirming the validity of our findings.

5.5. PLS-prediction

Following Shmueli et al.'s [130] recommendation, this study assessed the PLS-Predict with a 10-fold procedure to check for predictive relevance. PLS-predict is executed by estimating the model on a training sample and then analysing its predictive performance on a holdout sample. Researchers must emphasise the model's key endogenous construct indicators when evaluating the PLS-predict results. Therefore, this study focuses on endogenous constructs, including perceived ease of use, perceived usefulness, and intention. Firstly, we estimate the Q^2_{predict} statistics to ensure that the PLS-SEM-based predictions outperform the most naïve benchmark [131].

Then, we assessed the root-mean-square error (RMSE), the most common metric to measure the degree of prediction error used to examine a model's predictive power [132]. We compare the RMSE values with each indicator's naïve linear regression model (LM) benchmark. As a rule of thumb, the model has a high predictive power if the PLS-SEM analysis yields lower prediction errors in terms of RMSE compared to the LM for all indicators. If the RMSE is lower for *most* indicators, then the model has a medium predictive power. Accordingly, lower RMSE for the *minority* of the indicators represents low predictive power. In contrast, *none* of the indicators exhibits

Table 6
Hypothesis testing.

Hypothesis	Relationship	Std. Beta	Std. Deviation	t-values	p-values	BCI LL	BCI UL	f ²
H1a	PEOU → PU	0.450	0.050	8.978	0.000	0.370	0.534	0.293
H1b	PEOU → INTENTION	0.306	0.051	6.037	0.000	0.228	0.395	0.129
H1c	PU → INTENTION	0.411	0.055	7.461	0.000	0.321	0.501	0.216
H2a	FA → PU	-0.113	0.048	2.329	0.010	-0.191	-0.030	0.027
H2b	FA → INTENTION	-0.284	0.039	7.216	0.000	-0.348	-0.218	0.234
H3a	LCE → PEOU	-0.161	0.051	3.171	0.001	-0.245	-0.078	0.037
H3b	LCE → PU	-0.107	0.049	2.164	0.015	-0.190	-0.029	0.022
H4	HUMAN → PU	-0.015	0.052	0.281	0.389	-0.099	0.072	0
H5a	DL → PU	0.328	0.064	5.153	0.000	0.220	0.430	0.117
H5b	DL → PEOU	0.469	0.067	6.987	0.000	0.357	0.581	0.21
H6a	TA → PU	0.042	0.042	1.017	0.155	-0.025	0.113	0.003
H6b	TA → PEOU	-0.182	0.049	3.734	0.000	-0.262	-0.102	0.059
H7a	FC → PU	0.015	0.038	0.387	0.349	-0.050	0.078	0
H7b	FC → PEOU	0.130	0.049	2.670	0.004	0.049	0.207	0.028

Note: INTENTION = Intention, PEOU= Perceived Ease of Use, PU= Perceived Usefulness, FA= Functional Ability., LCE= Life Course Event, HUMAN= Preference for Human Contact, DL= Digital Literacy, TA= Technology Anxiety, FC= Facilitating Conditions.

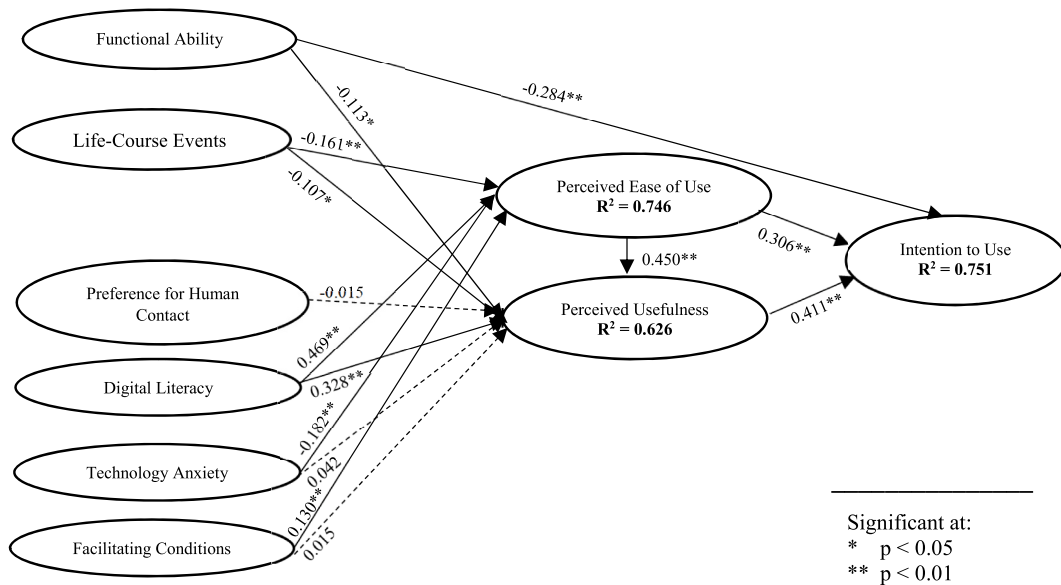


Fig. 2. Structural model (dotted lines indicate non-significant paths).

lower RMSE, which is a sign of a lack of predictive power.

The results of the PLS-predict model are shown in Table 7 and are based on the above guidelines. For instance, when using PLS-SEM to estimate the model, the indicators for perceived usefulness, PU1, PU2, PU3, PU4 and PU5, have RMSE values of 0.817, 0.824, 0.843, 0.892, and 0.903, respectively. Meanwhile, the LM produces RMSE values of 0.829, 0.846, 0.861, 0.922, and 0.926 for these indicators in the same order (from PU1 to PU5). Hence, for perceived usefulness, all PLS model errors were lower than those of the LM model. Therefore, we may conclude that the model has strong predictive power. On the other hand, intention (INTENTION) and perceived ease of use (PEOU) only have moderate predictive powers, as only 50 % of their PLS model errors were lower than the LM model.

6. Discussions

Building on the TAM, this study attempts to further understand the determinants of perceived ease of use and usefulness of OGS by focusing on how these perceptions are formed. We introduced several elderly-specific and functional ageing constructs as TAM antecedents that may related to the elderly's perception of OGS adoption. A summary of the results from the hypothesis testing stage is presented in Table 8.

Table 7
PLS predict.

Constructs	Q ² _{predict}		
INTENTION	0.713		
PEOU	0.613		
PU	0.653		
Items	PLS RMSE	LM RMSE	PLS-LM
INTENTION1	0.784	0.782	0.002
INTENTION2	0.842	0.848	-0.006
INTENTION3	0.829	0.817	0.012
INTENTION4	0.806	0.815	-0.009
PEOU1	0.924	0.921	0.003
PEOU2	0.928	0.932	-0.004
PEOU3	0.87	0.89	-0.020
PEOU4	0.935	0.935	0.000
PU1	0.817	0.829	-0.012
PU2	0.824	0.846	-0.022
PU3	0.843	0.861	-0.018
PU4	0.892	0.922	-0.030
PU5	0.903	0.926	-0.023

Table 8
Summary of hypothesis testing.

Hypothesis	Relationship	Supported
H1a	PEOU → PU	Yes
H1b	PEOU → INTENTION	Yes
H1c	PU → INTENTION	Yes
H2a	Functional Ability → PU	Yes
H2b	Functional Ability → INTENTION	Yes
H3a	Life course event → PEOU	Yes
H3b	Life course event → PU	Yes
H4	Preference for Human Contact → PU	No
H5a	Digital Literacy → PU	Yes
H5b	Digital Literacy → PEOU	Yes
H6a	Technology Anxiety → PU	No
H6b	Technology Anxiety → PEOU	Yes
H7a	Facilitating Conditions → PU	No
H7b	Facilitating Conditions → PEOU	Yes

Note: Refer to Table 6.

6.1. TAM-related constructs

This study has provided several significant findings. As hypothesised, according to the conventional TAM-related constructs, this study's findings have supported the positive relationship between PEOU and PU (H1a). This positive relationship is consistent with the results from previous studies [22,79,83], which found similar positive relationships within the context of the elderly's adoption of various technologies such as video UCC services, healthcare technology, and gerontechnology. This positive relationship suggests that elderly people are more likely to consider OGS useful if they think it is simple or if acquiring the skills needed to use it is straightforward. Besides, our data analysis results also support the correlation between the perceived ease of use and perceived usefulness to OGS intention. Therefore, H1b and H1c are both supported. These results verify the viewpoint of previous studies such as [7,49], and [56]. These findings indicate that older adults may intend to use OGS if they believe that using this technology is easy and beneficial. As depicted in Table 7, the results reveal that perceived usefulness ($f^2 = 0.216$) has a medium effect, while perceived ease of use ($f^2 = 0.129$) has a small effect. We may conclude that perceived usefulness has a stronger association with intention to use than perceived ease of use. In other words, older individuals prioritise the perceived usefulness of the OGS over the ease of its operation. This finding aligns with a study investigating OGS adoption in Thailand [45].

6.2. Elderly-specific constructs

Regarding the elderly-specific constructs, digital literacy appears to be a significant antecedent for perceived ease of use and usefulness. This finding aligns with the previous findings of [95], which indicated the positive association between digital literacy and the perceived usefulness and ease of use of technology. In particular, this shows that the elderly expects OGS to be beneficial (useful) and easy to use if they have a better fundamental knowledge of operating digital devices (higher digital literacy). These findings are quite predictable in the elderly population context, as using OGS might require individuals to choose products on an online platform, make payments, and arrange delivery. These actions may seem complicated for elderly people not born in the technological era. Therefore, the elderly with a high level of digital literacy will perceive OGS as easy to use and useful, as they might be more familiar with the technological functions. Consequently, digitally literate elders will be more confident that using the OGS platform to buy groceries is easy and convenient.

Moreover, this study's results suggest that technology anxiety and facilitating conditions are significantly associated with perceived ease of use. Elderly people with lower levels of technology anxiety tend to feel that the technology is relatively easy to use. The negative association of technology anxiety on perceived ease of use in this study is in accordance with previous technology adoption studies among the elderly [22,103,133]. For example, the significance of technology anxiety aligns with the findings of [104], which focused on the elderly's technology adoption context. This relationship can be further explained by the Social Cognitive Theory, which asserts that people usually choose to engage in activities they are skilled at and resist those they are not proficient in. In general, elderly people experience more worry and fear that they might lack control over the technology they use. This may help explain why they are less likely to employ advanced technologies like OGS, as such technology requires significant effort to learn the skills needed to operate them.

Next, this study reveals a significant positive association between facilitating conditions and perceived ease of use. This finding is consistent with the work of [109] in the context of Portugal. Similarly, it aligns with prior research on the elderly's online shopping behaviour, such as [59,60]. This result highlights the importance of knowledge, guidance, assistance from others, and accessibility of OGS to encourage OGS use intention among the elderly. Other studies, however, have recognised the importance of environmental support (as part of facilitating conditions) in influencing OGS intention [22,134]. Moreover, the elderly is considered less accessible to OGS than other age groups. In Malaysia, the internet user base for people aged 60 and up is only 3.4 %. Modern technologies like smartphones and tablets (required equipment to access OGS) are perceived as high-cost innovations for the elderly. For this reason, financial concern is especially prevalent among the elderly, as most of them are retirees living on fixed incomes [135]. Moreover, the

current study's findings are consistent with others in the literature, including [22], who found that the availability of assistance and support from family and friends would be associated with technology's perceived ease of use among elderly people. Elderly people would feel that OGS is easier to use when they get assistance from others to resolve the obstacles that arise when using the technology. From this perspective, facilitating conditions such as knowledge, assistance, support from others, accessibility, and financial assistance are related to the elderly's perceived ease of use of OGS.

Contrary to previous studies, the results from this study suggest that both technology anxiety and facilitating conditions are not significantly related to perceived usefulness. This demonstrates that the elderly will not regard OGS as useless and not beneficial simply because they fear it. Based on the data analysis, we found that the elderly's perceived usefulness of OGS is more relevant to the functional ageing constructs than the elderly-specific ones.

Interestingly, another ageing-specific construct – preference for human contact – was also exhibited no relationship with perceived usefulness. This result supports the findings of [8], who asserted that interactions with humans are the least significant factor when elderly individuals contemplate purchasing groceries online. However, the result of this study is contrary to earlier research, as outlined in Ref. [68], which proposed that the elderly attach great importance to the social dimension when engaging in grocery shopping activities. These contradictory results may indicate that the surveyed elderly people may not value human interaction as an essential element when expecting services. The non-preference for human contact might be due to two main reasons. Firstly, based on the theory of modernisation, against the background of this modern society, elderly people may no longer value human interaction as they used to because the knowledge gained from books is more highly valued than the knowledge gained from personal interactions [136]. Consequently, the elderly's preference for human contact over technology may gradually decline, so much so that this construct no longer impacts the usefulness of the OGS. Secondly, the elderly's non-preference for human contact may be due to the COVID-19 pandemic [68]. COVID-19, by its nature, spreads rapidly via human-to-human contact. As a result, this virus may also increase the elderly's fear of having human contact with others during grocery shopping. As the data for this research were gathered when the pandemic was still ongoing, we believe this might be one of the reasons for the insignificance of the construct.

6.3. Functional ageing constructs

Among the functional ageing constructs, functional ability is negatively related to perceived usefulness and intention. The result suggests that elderly people who experience functional decline may have issues with physical grocery shopping. This correlation aligns with the [5,8] findings, suggesting that elderly individuals facing reduced physical mobility and constraints are often inclined to use OGS. Therefore, they would perceive OGS as useful to them as the technology may make buying groceries easier and living independently, effectively increasing their intention to use it.

Another interesting finding in this study is that the life course events is negatively associated with the perceived ease of use and usefulness of OGS. This result, however, is surprisingly inconsistent with [79], where the researchers concluded that life course events were not related to perceived ease of use and usefulness. The findings in the current study indicate that life-changing events may stimulate and form the elderly's normative role as an "old" person. This feeling of being "too old" will influence the elderly's perception of OGS as too difficult and meaningless to use. From the analysis, we can conclude that older people's perceived ease of use would be associated with functional ageing and elderly-specific constructs. In contrast, perceived usefulness is mainly associated with functional ageing and digital literacy constructs.

7. Conclusion and implication

7.1. Conclusion

Building on the Technology Acceptance Model, this study investigated the factors associated with the elderly's intention to use OGS. Specifically, this study proposed elderly-specific constructs (preference for human contact, digital literacy, technology anxiety, and facilitating conditions) and functional-ageing constructs (life-course events and functional ability) as the TAM antecedents related to their OGS adoption. The results show the following main conclusions:

Firstly, the results highlighted a positive correlation between the elderly's perception of the ease of use and usefulness of OGS and their intention to use it. Furthermore, it was observed that higher levels of functional ability among the elderly were associated with decrease intention to adopt OGS.

Secondly, elderly people who perceive the OGS as easy to use and have higher digital literacy are positively related to their perception of the OGS's usefulness. Functional ability and life-course events are negatively related to the perceived usefulness of OGS. Surprisingly, no correlations were found between preferences for human contact, technology anxiety, and facilitating conditions with perceived usefulness.

Thirdly, this study indicated that the elderly's digital literacy and facilitating conditions were positively associated with their perceived ease of use of OGS. Meanwhile, life-course events and technology anxiety were linked negatively with perceived ease of use.

The findings of this study will make a valuable contribution to the OGS literature by focusing specifically on the elderly population. It offers insights into how the complex ageing process will relate to the elderly's intention to use OGS. Practically, the findings provide valuable information to online marketers, designers, online companies, and governments, giving them a better and clearer more explicit to design superior services and innovatively create functionalities that assure that the OGS services are tailored to the requirements of the elderly.

7.2. Theoretical contribution

Within the realm of technology adoption among the elderly, this study makes a notable contribution that holds great significance for research and academia. First, this study has addressed a distinct gap in the literature by shedding light on OGS adoption within the older demographic. While previous studies into OGS adoption mainly focused on the younger generation [10], the elderly population has remained relatively understudied. Second, this study not only expands upon the existing literature concerning OGS adoption but also contributes to the TAM theory by addressing a fundamental critique of the TAM [21]—the lack of clarity in the formation of TAM constructs (Perceived ease of use and perceived usefulness), particularly when applied to the elderly's OGS context. In explaining the elderly's OGS intentions, this study has attempted to extend beyond the existing TAM literature by extensively exploring the antecedents related to the perceived ease of use and usefulness of OGS. Specifically, this study delves deeper into the elderly's OGS intentions, recognizing the complex ageing process that involves related changes in physical and psychosocial abilities that may cause the elderly's demand and requirements for technology to differ from those of younger generations [22]. Therefore, this study takes into account the biophysical, psychosocial, and other challenges specific to the aged and their abilities to understand the elderly's OGS adoption. Specifically, this research extends the literature and TAM by introducing two functional ageing constructs: life course events and functional ability. Moreover, this study also introduces four elderly-specific constructs, namely preference for human contact, digital literacy, facilitating conditions, and technology anxiety, into the TAM model. This extended TAM enables an in-depth investigation of how these constructs are related to the formation of TAM antecedents from the perspective of the elderly. The study's results reveal that OGS' perceived ease of use is significantly associated with the elderly's digital literacy, technology anxiety, facilitating conditions, and life course events. Meanwhile, OGS' perceived usefulness is significantly associated with perceived ease of use, digital literacy, functional ability, and life course events. This study significantly contributes to the TAM theory as well as the OGS literature, focusing specifically on the elderly segment.

7.3. Practical implication

The findings in this study offer valuable evidence to OGS platform developers, online marketers, and the government to develop better strategies and policies to encourage the elderly's intention to adopt OGS.

Firstly, the results demonstrate that the elderly's level of anxiety significantly relates to their perception of OGS' ease of use. To mitigate the elderly's anxiety due to OGS, platform developers should design a low-threat situation where the elderly will feel in control and comfortable using the software. In addition, the developers should create a senior-friendly OGS platform to reduce the elderly's anxiety, as most are not as digitally literate as the younger generation. Besides that, online marketers should provide technical support for the elderly, which may involve detailed step-by-step instruction videos, convenient interactive communication, and direct click-through procedures to complete the order.

Moreover, efforts should be made to boost the elderly's digital literacy to improve their perception of OGS' ease of use and usefulness. The government, local universities, and non-governmental organisations (NGOs) play critical roles in this domain by providing digital training programs for senior citizens. The Malaysian government is encouraging digital adoption by boosting local capabilities and encouraging companies to embrace digitalisation. However, there is still a significant lack of policy and budget allocation for the necessary training to learn the digital skills needed to properly utilise digital devices among the elderly [137]. Therefore, government agencies may form more coordinated efforts with NGOs or local universities to conduct technical training programs for the elderly. For instance, the "Senior Technology Workshop," held in 2019, is a two-day workshop that educates the Malaysian elderly on cyber security. The workshop also assisted them in developing independent social skills through mobile phones, such as food ordering and online shopping [138].

On the other hand, facilitating conditions – knowledge, assistance, support from others, accessibility, and financial assistance – were also significantly related to OGS' perceived usefulness. Compared to younger people, the elderly usually has fewer resources and frequently lack physical access to the equipment required to participate in online activities – such as mobile devices and internet accessibility. Policymakers should continue to provide enough facilities and resources for the elderly. Besides that, financial constraints may also be regarded as the obstacles to the elderly's technology adoption. As [135] suggested, cost surpasses perceived advantages in determining an elderly's willingness to adopt a technology. With that in mind, online marketers may use low-price strategies, free-delivery campaigns, or rebates to attract consumers in the silver-hair segment.

Moreover, assistance from friends and family also plays a critical role. The younger family member has to guide the elderly on how to use OGS at home. They will also need to answer the elderly's inquiries and provide hands-on guidance to them. Recognizing the importance of support from family and friends, online business marketing personnel may engage with elderly people's families and friends to promote the benefits of OGS. This would generate positive word-of-mouth marketing for OGS among the elderly.

Regarding the functional ageing constructs, the findings indicate that elderly people experiencing declining functional ability (physical ageing) are more inclined to recognize OGS as beneficial and intend to use it. This is because OGS can assist them in obtaining groceries instead of physical grocery trips. Therefore, the government can provide financial assistance to support and motivate the elderly to adopt OGS practices and slowly replace physical grocery shopping before their functional abilities are compromised. To achieve this, the government may offer subsidies or tax credits to motivate people to utilise OGS. For instance, the Canadian government grants elderly people who participate in government-sponsored ageing-in-place programmes tax credits on shipping charges.

Furthermore, the current study discovered that elderly people who experience more life-course events (social-psychological ageing) would perceive the OGS as ineffective and difficult to use. This is because those who experience more life-course events will develop a normative role as "old" people. As a result, they may believe they are incapable and too old to learn to use these new

technologies [86]. According to Ref. [139], the elderly generation is usually introverted and fearful of being judged for their inability to adopt new technologies. Hence, it is vital to prevent stereotyping the elderly as “technophobic”. Family members should encourage and positively guide the elderly to make them feel valued. Marketing personnel can create elderly-oriented campaigns and strategies by providing an impression of an elderly-friendly OGS environment. This is important to let the elderly feel that OGS is not a technology meant only for the younger generation; even the elderly is capable of using it as well. Assistance from family and friends, help from the government, and the development of an age-friendly OGS platform can motivate the elderly to adopt OGS routines. This may gradually replace physical trips to the store, effectively resulting in food security, independent living, and better preparation for functional deterioration.

7.4. Limitations and future research

Notwithstanding the considerable work developing this study, it still harbours some limitations. Firstly, this study was carried out in Klang Valley, Malaysia. This choice was made since the Klang Valley is Malaysia's largest urban agglomeration region, with OGS as an accessible resource. As a result, the research might overlook the perceptions of elderly people living in rural regions, who may view OGS differently from their urban counterparts. Therefore, future research should investigate and compare the elderly perception of OGS in urban and rural settings.

Secondly, this study emphasises only the intention of non-users to adopt OGS. The OGS perception among existing users is, therefore, unclear. In addition, the cross-sectional data in this study limits our ability to establish causal relationships. Hence, future researchers should consider conducting longitudinal studies to investigate existing users' actual OGS usage behaviour and casual relationships. Lastly, this study used self-reported questionnaires, which might be subject to social desirability bias. Future research should take into account techniques (e.g., use of social desirability scales, rating of item desirability, etc.), as suggested by Refs. [140, 141], to cope with the issue of social desirability bias.

Furthermore, the data for the current research were collected during the pandemic, potentially altering the respondents' perceptions of OGS. Therefore, future researchers should consider conducting qualitative research to investigate how the pandemic can change the elderly's perception of OGS adoption. Lastly, future research can further investigate changes in technological advancements and evolving business strategies – such as the click-collect option - and their impacts on OGS adoption.

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Data availability statement

Data included in article/supp. material/referenced in article.

Ethics statement

This study has obtained approval from the Research Ethics Committee of Multimedia University (Approval Number: EA2882021). Moreover, written consent has been obtained from all respondents, and the gathered information is treated with utmost confidentiality.

Credit authorship contribution statement

Yee-Yann Yap: Formal analysis, Methodology, Validation, Writing – original draft, Writing – review & editing. **Siow-Hooi Tan:** Funding acquisition, Investigation, Software, Writing – review & editing. **Siow-Kian Tan:** Visualization, Writing – review & editing. **Shay-Wei Choon:** Investigation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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