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Beyond Digital Access: Algorithmic Inclusion and Universal Access for Older Adults on Digital Platforms

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Abstract

Purpose

This study examines how algorithm-driven platforms reshape universal access for older adults after they have entered digital environments. It asks how platform design, recommendation systems, commercial targeting, and digital-by-default services create barriers to informed and autonomous participation.

Methods

A qualitative and explanatory design combines a narrative review, policy-document analysis, and mechanism-oriented comparison. Evidence was organized across four recurring settings: information access, health communication, online consumption, and digital public services. The analysis links technological accessibility, user capability, and rights protection.

Results

Four recurrent barriers were identified: narrowed information exposure through algorithmic filtering; amplified risk and misplaced trust in health communication; targeted consumer inducement accompanied by difficult redress; and participation exclusion created by digital-by-default public services. These barriers are reinforced by attention-based business models, reductionist profiling, superficial age-friendly design, and uneven family and community support.

Conclusion

Universal access requires more than readable interfaces or basic operational support. Algorithmic inclusion depends on understandable recommendation processes, meaningful user control, reversible personalization, accessible human assistance, and effective remedies. Policy, design, community support, intergenerational assistance, and older adults' participation in evaluation should be treated as complementary elements of inclusive platform governance.

1 Introduction

Population ageing and digital transformation are jointly changing the conditions of social participation. By the end of 2025, China had 323.38 million people aged 60 years or above, representing 23.0% of the national population; 223.65 million people were aged 65 years or above, accounting for 15.9% [1]. This demographic transition has made access to digital services, health information, public administration, mobility, and online consumption a mainstream governance issue rather than a marginal form of assistance. At the global level, ageing societies are also confronting the risk that digitalization may

reproduce or deepen existing inequalities unless institutions are designed around inclusion, autonomy, and social participation [2].

Mobile platforms have evolved from optional communication tools into infrastructures of everyday life. Information seeking, medical consultation, bill payment, transport, social interaction, entertainment, and consumer decision-making are increasingly organized through platform interfaces. These platforms are not neutral conduits. Data collection, profiling, ranking, recommendation, interface design, and commercial conversion continuously shape what users can see, how choices are presented, and which risks receive attention. Digital inclusion for older adults therefore cannot be reduced to whether a person owns a smartphone or can open an application. It also concerns whether platform rules are intelligible, choices are meaningful, commercial persuasion is recognizable, and remedies remain accessible when rights are affected.

Research on the older-age digital divide has traditionally examined inequalities in access, skills, frequency of use, and the benefits derived from internet participation. International studies show that age-related digital inequality is shaped by education, income, health, prior experience, and social support [3–5]. Chinese scholarship similarly distinguishes access, use, knowledge, and outcome gaps, while showing that internet participation can improve social adaptation but may also create new exclusions when public services and social interaction become digital by default [6–9]. This literature has established that non-use is socially patterned; however, it is less equipped to explain inequalities that arise after users have entered platform environments.

The policy agenda has also shifted. China's national programme on helping older adults use smart technologies addressed barriers in transport, medical care, consumption, and other high-frequency settings [10]. The Provisions on the Administration of Algorithmic Recommendation in Internet Information Services subsequently brought recommendation services into a formal regulatory framework [11]. The national policy on the silver economy further linked age-friendly products and services to broader economic and social development [12]. These changes indicate a transition from assisting older adults to operate digital devices toward governing the platform systems that organize visibility, choice, data use, and market exposure.

Universal access provides a more direct framework for this transition. It concerns whether information-society technologies remain usable across the life course, whether opportunities are distributed fairly, and whether participation can be sustained without surrendering autonomy. Recent work has likewise treated older adults' digital inclusion as a multidimensional challenge involving social, economic, technological, and institutional conditions [13]. The present study advances this discussion through the concept of algorithmic inclusion: the capacity to participate in platform environments under conditions that are understandable, controllable, reversible, and supported by effective remedies.

Accordingly, the study addresses three questions. First, what forms of exclusion emerge when older adults participate in algorithm-driven platforms? Second, through what structural and institutional mechanisms are these exclusions generated? Third, what policy and design arrangements can align

platform participation with universal access and procedural fairness? The contribution lies in moving the analysis from device ownership and operational skills to platform power, user control, and institutional responsibility.

Table 1
Core contexts and implications for universal access among older adults

Context	Key fact or institutional development	Analytical implication
Population ageing	In 2025, people aged 60 + accounted for 23.0% of China's population [1].	Digital inclusion has become a large-scale social governance issue.
Age-friendly digital services	National policy addresses barriers in health care, transport, consumption, and other essential services [10].	Age-friendly transformation must extend beyond interface adjustment to service processes.
Algorithm governance	Recommendation services are subject to formal regulation and user-rights requirements [11].	Digital inclusion must include platform accountability and algorithmic fairness.
Silver economy	Older adults are positioned as both service recipients and participants in platform markets [12].	Consumer protection and autonomy must accompany market expansion.
Note: Compiled from publicly available statistical and policy documents.		

2 Materials and methods

2.1 Research design and sources

The study uses a qualitative, normative, and explanatory research design. Its purpose is not to estimate causal effects between individual variables but to identify recurrent forms of exclusion, clarify their institutional origins, and develop a governance framework. Three categories of material were examined: peer-reviewed research on the digital divide, older adults' digital participation, digital literacy, algorithmic visibility, and platform governance; laws, regulations, policy plans, and official documents relating to age-friendly digital transformation, algorithmic recommendation, public-service accessibility, and the silver economy; and documented practices and recurring problems in short-video platforms, online health communication, live-streaming commerce, and digital public services.

Materials were selected purposively on the basis of direct relevance, institutional authority, and explanatory value. The review combined Chinese and international scholarship to connect the institutional context of China with broader debates on digital inequality, platform power, and universal access. Policy documents were treated as statements of formal governance priorities rather than as evidence that implementation outcomes had already been achieved.

2.2 Analytical procedure

The analysis proceeded in three stages. First, the literature was synthesized to trace the conceptual movement from access and use toward participation, outcomes, and rights. Second, policy texts were examined for the responsibilities assigned to governments, platforms, communities, families, and users. Third, a mechanism-oriented comparison was conducted across four recurring platform settings: information access, health communication, consumer participation, and public services. The comparison focused on the relationship between visible user-facing design and less visible processes of profiling, ranking, commercial targeting, default settings, and redress.

The study adopts analytical generalization rather than statistical generalization. Claims are therefore limited to the mechanisms and governance patterns supported by the reviewed materials. No personal data, interviews, experiments, or private platform records were used. This boundary is important because publicly observable platform functions cannot fully reveal the intensity or personalization of individual recommendation streams.

2.3 Analytical framework: from digital access to algorithmic inclusion

Traditional digital-divide research generally begins with access to devices and connectivity, then examines skills and outcomes. This approach explains why some older adults remain outside digital environments, but it does not fully capture the unequal positions of those who are already active users. Platform participation is partly organized by recommendation rules, commercial objectives, interface architecture, and service workflows. What users repeatedly see, which products are made salient, how consent is obtained, and whether personalization can be disabled are therefore institutional questions as well as questions of individual competence.

The proposed framework links three levels. Technological access concerns affordability, accessibility, and usability. Capability concerns the knowledge and support needed to interpret information, recognize advertising, manage privacy, and make informed choices. Rights protection concerns explanation, control, withdrawal, human assistance, complaint, and redress. Together, these levels define algorithmic inclusion. The concept does not imply removing recommendation systems or treating older adults as incapable decision-makers. It requires platforms to ensure that participation is intelligible, voluntary, reversible, and compatible with users' rights.

3 Universal access in algorithm-driven environments

3.1 Accessibility, capability, and participation

Digital inclusion is not synonymous with digital access. It includes the ability to obtain affordable and understandable technologies, to use services safely and effectively, and to participate in social, cultural, economic, and civic life. A field-based account of digital inequality emphasizes that offline resources and digital resources reinforce one another [14]. Older adults' digital literacy is therefore not a purely personal

attribute; it is shaped by education, health, learning opportunities, household support, and the availability of accessible services [15, 16].

For older adults, three dimensions are especially important. The first is accessibility: services must be perceivable, operable, and available through more than one channel. The second is capability: users need practical support to interpret health information, distinguish content from advertising, understand permissions, and manage recommendations. The third is participation: digital services should expand access to public affairs, culture, health management, and social relations without making citizenship or essential services conditional on high levels of technical competence. Research grounded in activity theory similarly shows that digital inclusion develops within concrete practices and social relationships rather than through isolated skill acquisition [17].

3.2 Profiling, content distribution, and platform power

Algorithm-driven platforms combine data collection, user profiling, content recommendation, traffic allocation, and commercial conversion. Algorithms do not simply connect users with available content; they organize visibility by making some information repeatedly present and other information difficult to encounter. Chinese research on algorithmic visibility describes this as a transformation in the allocation of attention and the production of public visibility [18, 19]. International scholarship likewise emphasizes that algorithms embed institutional choices about relevance, classification, and optimization [20, 21].

For older adults, these systems have a dual effect. Personalization can reduce search costs and provide relevant information, social contact, and convenient services. Yet profiling errors, repetitive recommendations, persuasive interface design, and commercial targeting may also narrow exposure, intensify anxiety, and weaken autonomous choice. Platform companies consequently exercise a form of infrastructural power that cannot be addressed through individual training alone [22, 23]. Digital inclusion must therefore be evaluated not only through adoption but also through the distribution of visibility, the intelligibility of automated decisions, and the availability of procedural safeguards.

4 Results: recurrent barriers to universal access

4.1 Algorithmic filtering and narrowed information exposure

Recommendation systems infer preferences from searches, viewing time, clicks, and other behavioral traces. For older adults, this can improve efficiency, but repeated engagement with health advice, emotional narratives, social news, or commercial live streams may lead to increasingly homogeneous recommendation streams. The process is difficult to observe directly. Users may recognize that a platform repeatedly presents similar content while remaining unable to see how profiles, inferred interests, sponsored rankings, and engagement objectives produce that repetition.

The resulting narrowing is not merely a matter of preference. It is a visibility problem. When engagement-oriented content is privileged, older users may encounter more emotional, experiential, low-threshold, and commercially convertible material while authoritative explanations, risk warnings, and alternative perspectives remain less visible. A narrow conception of inclusion that asks only whether an application can be opened cannot identify this deeper inequality in the organization of attention.

4.2 Health communication, risk amplification, and misplaced trust

Health information is both highly valued by older adults and especially vulnerable to platform risk. The ability to assess social-media health information depends on knowledge, prior experience, digital health literacy, and social support [24, 25]. When platforms continuously recommend wellness advice, disease narratives, supplements, emotionally charged cases, and live-streamed sales, information provision can become intertwined with anxiety production and commercial conversion.

Misplaced trust appears in several forms: popularity is interpreted as expertise; individual experience is treated as general medical evidence; and repeated recommendation is read as an indication of personal need. Studies of online health-information seeking show that older adults often rely on proxy searching, platform content, and experiential accounts [26]. The vulnerability arises not from an inherent inability to reason but from an environment in which authority labels are weak, commercial boundaries are unclear, and correction mechanisms are less visible than persuasive content.

4.3 Targeted consumer inducement and weakened remedies

Mobile payment, live-streaming commerce, community-based marketing, and personalized advertising have lowered transaction costs while expanding the capacity for targeted persuasion. Differences in digital competence influence consumption opportunities and the ability to identify risk [27]. In algorithm-driven markets, the central question is not simply whether older adults can shop online, but whether platforms use health concerns, emotional needs, scarcity prompts, or information asymmetries to sustain attention and purchasing.

Three problems recur. First, the boundary between recommendation and advertising is often difficult to recognize. Second, browsing, viewing, and purchasing records can be used to direct users repeatedly toward supplements, courses, financial products, or live-streamed goods. Third, cancellation, refunds, privacy settings, and complaint procedures may require complex navigation. Even when users identify a problem, the route to exit or redress may be considerably more demanding than the route to purchase. Excessive platform dependence among older adults should therefore be treated as a governance issue rather than attributed exclusively to individual self-control [28].

4.4 Digital-by-default public services and participation exclusion

Digital public services can improve administrative efficiency but may also create a digital default. Medical appointments, social-insurance authentication, transport, government applications, and community services increasingly rely on mobile interfaces and identity verification. For digitally experienced users this arrangement is convenient. For some older, less educated, rural, low-income, or isolated users, it creates an institutional threshold that must be crossed before an essential service can be obtained.

This exclusion is often concealed by the language of convenience. Reduced offline provision, weaker human support, QR-code verification, and smartphone-based authentication can compel older adults to depend on family members or informal intermediaries. When online processing becomes the default, difficulty is easily interpreted as reluctance or deficient ability rather than as a design and service failure. Inclusive governance requires differentiated support, retained offline alternatives, and clear human assistance [29]. The policy challenge is to reconcile efficiency with equal access.

Table 2
Main barriers to universal access on algorithm-driven platforms

Barrier	Typical settings	Access risks	Priority response
Information exposure	Short-video, news, and social platforms	Filtering, repetition, and narrowed exposure	Explain recommendations and increase the visibility of authoritative and diverse information.
Health communication	Health education, teleconsultation, and wellness content	Risk amplification, misplaced trust, and health anxiety	Strengthen source labeling, content review, and risk warnings.
Consumer participation	Live commerce, community marketing, and personalized advertising	Targeted inducement, blurred advertising, and difficult redress	Improve advertising identification, consumer protection, and accessible remedies.
Public services	Government services, health insurance, social security, and transport	Digital default, weak offline provision, and participation exclusion	Retain multiple service channels and strengthen human assistance.

5 Discussion

5.1 Attention-based business models and the commercialization of participation

Platform economies convert viewing time, interaction, search histories, and purchasing paths into measurable resources. When click-through rates, retention, conversion, and user activity become dominant performance criteria, older adults are incorporated into systems of attention capture. Research on older adults' short-video use shows that continuous visual stimulation and social feedback can become embedded in everyday routines and social relations [30, 31]. Recent empirical research further

indicates that perceived algorithmic inducements are associated with digital addiction among older Chinese platform users [38].

This does not imply that older users lack agency. Many use platforms deliberately for companionship, knowledge, entertainment, or social participation. The problem arises when loneliness, health concerns, or emotional needs are treated primarily as opportunities for engagement and monetization. In such settings, inclusion can be redefined by platforms as reachability and convertibility. Deeper participation may then increase exposure to immersive content, commercial pressure, and consumer risk unless public-value constraints are built into system design.

5.2 Reductionist profiling and the compression of diverse needs

Older adults are internally diverse. Age, education, urban or rural residence, health, income, and household support shape distinct needs and forms of platform use. Profiling systems based on past behavior can nevertheless reduce this diversity to simplified categories such as wellness-oriented users, price-sensitive consumers, or users seeking emotional companionship. Once these categories are stabilized through repeated recommendation, the platform-visible world may become narrower than the user's actual interests and social roles.

The problem is not that every imperfect prediction constitutes direct discrimination. Rather, behaviorally inferred profiles can create structural inequality when they are optimized primarily for engagement or conversion and are not constrained by public value [39, 40]. A search for disease information may be interpreted as commercial interest in health products; attention to retirement finance may increase exposure to risky offers; and preference for emotional videos may displace public information and educational content. These effects illustrate why exposure diversity has been proposed as a design principle for recommender systems [41].

5.3 Superficial age-friendly design and the concealment of deeper barriers

Age-friendly transformation has improved font size, button visibility, voice functions, and simplified navigation. These changes matter, but they can become formalistic when accessibility is treated only as an interface issue. Chinese studies have argued that age-friendly digital transformation must be integrated with service processes and governance arrangements [32, 33]. A larger interface does not resolve unclear advertising; simplified navigation does not automatically simplify privacy consent; and an older-adult mode does not guarantee that recommendations, default settings, and complaint routes are controllable.

A universal-access approach therefore distinguishes surface accessibility from institutional accessibility. Institutional accessibility requires understandable recommendations, recognizable commercial communication, manageable permissions, low-threshold withdrawal, and reachable human assistance.

Without these elements, age-friendly modes may improve entry while leaving the deeper allocation of platform power unchanged.

5.4 Digital literacy and uneven support networks

Digital inclusion is also shaped by social support. Children's education, intergenerational assistance, and family communication influence older adults' access and confidence [34, 35]. Intergenerational digital support includes not only operating instructions but also emotional reassurance, interpretation of platform rules, and help in responding to risks. Community and volunteer programmes can further strengthen digital literacy, particularly when assistance is repeated and connected to practical needs [36].

Support, however, is unevenly distributed. Older adults who live alone, have limited income, reside in rural areas, or lack nearby family members may not have continuous assistance. One-off training sessions are also poorly suited to platforms whose functions, advertising practices, and privacy settings change rapidly. When limited literacy and unstable support coincide, users face difficulty not only learning new functions but also recognizing profiling, persuasive design, data permissions, and fraud. Inclusive participation consequently requires institutionalized support rather than an expectation that families or individuals will absorb the costs of digital change.

5.5 Algorithmic inclusion as a universal-access requirement

The findings indicate that algorithmic inclusion is a requirement of universal access. It involves distributive questions about access to information, services, and market opportunities; procedural questions about whether recommendation, consent, withdrawal, and complaint processes are understandable; and recognition questions about whether older adults are treated as heterogeneous citizens rather than as a single vulnerable or commercially exploitable category. It also involves continuity: essential services are not universally accessible when users must repeatedly adapt to opaque and rapidly changing platform systems.

This perspective avoids two common errors. The first is technological solutionism, which assumes that connectivity and interface simplification will automatically produce equal participation. The second is paternalism, which responds to risk by restricting older adults' choices. Algorithmic inclusion instead emphasizes supported autonomy: platforms should make choices intelligible and risks manageable while preserving users' capacity to decide, withdraw, and seek redress. This approach is consistent with broader commitments to reducing inequality and building inclusive institutions [42].

6 Policy and design implications

6.1 Extend age-friendly standards to algorithmic and commercial processes

Age-friendly standards should move beyond visual and operational design to address recommendation, advertising identification, personalized promotion, default authorization, and immersive engagement. Algorithmic fairness does not require identical treatment for every user. It requires proportionate duties of explanation, warning, and protection when platform systems interact with groups exposed to predictable informational or procedural disadvantages. Legal scholarship on platform governance likewise emphasizes the need to clarify the allocation of power and responsibility [37].

Regulators should prioritize high-impact settings, including short-video recommendation, health-information distribution, live-streamed commerce, public-service ranking, and smart-ageing data systems. Age-sensitive algorithmic assessments could examine the frequency and intensity of high-risk recommendations, the clarity of commercial disclosures, and the ease with which personalization can be adjusted. Accessible withdrawal mechanisms should allow users to disable recommendations, limit advertising tracking, revoke permissions, and reach human support without complex navigation.

6.2 Strengthen platform transparency and rights protection

Platforms are central duty bearers because they design the interfaces and optimization processes through which participation occurs. Transparency does not require disclosure of complete source code. It requires explanations that enable users to understand why content is shown, when communication is commercial, what information is being used, and how a recommendation can be changed or stopped. Internal self-regulation should operate under external standards and public accountability [22].

Four measures are especially important. Platforms should clearly identify content sources and commercial relationships in health, finance, supplements, and training products. Privacy interfaces should reduce bundled consent and default selection. High-risk or repeated purchasing patterns should trigger proportionate reminders without removing user autonomy. Finally, human service routes should be easy to locate when users face mistaken purchases, subscriptions, account problems, or personal-data concerns. The objective is not to decide for older users but to provide a digital environment in which decisions are informed and remedies are practicable.

6.3 Establish continuous and scenario-based community support

Communities connect regulatory institutions, platforms, families, and older residents. Platform self-governance cannot address every lived situation, while family assistance is constrained by time, distance, and unequal skills. Digital support should therefore become a routine component of community public services rather than a series of occasional smartphone classes.

Support should be organized around scenarios: medical registration and payment, social-security authentication, transport, government applications, health-information assessment, live-commerce risk, privacy, and fraud prevention. A stable network involving community workers, volunteers, family members, and platform customer services can provide clear points of assistance. Home-based or accompanied support is particularly important for the oldest old, people living alone, persons with

disabilities, and rural residents. This approach distributes the burden of adaptation across institutions rather than leaving it with users.

6.4 Develop intergenerational support and older adults' agency

Protection should be accompanied by capability building. Intergenerational support must move from demonstrating operations to explaining how platforms classify users, rank content, identify advertising, and manage permissions. Older adults should be supported in developing four practical capabilities: recognizing platform mechanisms; evaluating information and evidence; managing privacy and payment permissions; and using complaint, cancellation, refund, and reporting procedures.

Older adults are not passive recipients of digital protection. They are actors whose experience should inform platform testing, standards, and service design. Participatory evaluation can reduce the risk that age-friendly systems are defined exclusively by designers, regulators, or family members. The balance between protection and empowerment is essential: governance should neither stigmatize older users as inherently vulnerable nor transfer platform-generated risks back to individuals.

Table 3
Collaborative framework for algorithmic inclusion and universal access

Actor	Primary responsibility	Priority actions
Government and regulators	Standards and external oversight	Extend age-friendly rules to recommendations, advertising, consent, high-risk content, and redress; conduct age-sensitive algorithmic assessments.
Platform companies	Transparency and rights protection	Explain recommendations, label advertising, simplify control and withdrawal, provide human assistance, and test designs with older users.
Community organizations	Scenario-based assistance and risk education	Provide continuous support for public services, health-information assessment, privacy, consumer protection, and fraud prevention.
Families and intergenerational networks	Practical and emotional support	Move beyond operational help to explain platform rules, risks, and remedy procedures.
Older adults	Agency and informed participation	Develop information evaluation, privacy management, algorithm awareness, and redress capabilities; participate in co-design and evaluation.

7 Conclusion

7.1 Main findings

Digital inclusion for older adults is increasingly a question of universal access, rights, and governance. In algorithm-driven environments, inequality appears through opaque platform rules, repetitive recommendation, difficult-to-recognize commercial persuasion, inaccessible exit routes, and weak remedies. Algorithmic filtering, health-information risk, targeted consumer inducement, and digital-by-default public services are not isolated difficulties; they arise from the interaction of attention-based business models, simplified profiling, superficial age-friendly design, and uneven support networks.

The appropriate objective is algorithmic inclusion. Older adults should be able to understand the practical basis of recommendation, make meaningful choices, withdraw from personalization, and obtain accessible assistance and redress. Progress depends on coordinated public regulation, accountable platform design, community support, intergenerational assistance, and capability building. Age-friendly design should be evaluated by whether it improves actual control and participation, not merely by whether an older-adult mode is available.

7.2 Theoretical and practical contributions

The theoretical contribution is to extend digital-inclusion research from access and skills to the procedural conditions of platform participation. Algorithmic inclusion connects technological accessibility with capability and rights protection, drawing attention to visibility, choice architecture, reversibility, and redress. In practical terms, the framework helps distinguish interface-level adaptations from institutional changes that alter how information, commercial pressure, consent, and service access are organized.

7.3 Limitations and future research

The study is based on literature, policy documents, and publicly documented platform practices. It does not include interviews, surveys, user experiments, digital ethnography, platform audits, or behavioral log data. The analysis therefore identifies plausible and recurrent mechanisms but cannot estimate their prevalence or causal magnitude. Publicly observable functions also cannot represent the individualized intensity of recommendation streams. Future research should compare platform experiences across age groups, urban and rural settings, education levels, health conditions, and household-support arrangements. Account-based audits, user experiments, and longitudinal studies could test how recommendation controls, advertising labels, and accessible remedies influence autonomy, risk recognition, and sustained participation.

Declarations

Competing interests:

The authors declare that they have no competing interests.

Ethics approval:

Not applicable. The study used publicly available literature, policy documents, and documented platform practices and did not involve human participants or animals.

Consent to participate:

Not applicable.

Use of AI-assisted tools

A generative AI tool was used only to assist with translation and language editing. The authors reviewed the complete manuscript, verified the cited sources and arguments, and take full responsibility for the final text.

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Author Contribution

C.L. and Y.Z. conceptualized the study. C.L. designed the methodology, conducted the formal analysis, administered the project, and wrote the original manuscript. C.L. and J.L. collected and examined the research materials. Y.Z., J.L., and X.J. reviewed and edited the manuscript. Y.Z. supervised the study. Y.Z. acquired the funding. All authors reviewed and approved the final manuscript.

Data availability:

No personal or experimental dataset was generated. The materials discussed in the study are publicly available from the sources listed in the references.

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