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Association between home-visit nursing use and the occurrence of unfavorable health outcomes among community-dwelling older adults: A prospective cohort study

Sameh Eltaybani[a,b,*], Saori Anezaki[b], Chie Fukui[b], Ayumi Igarashi[b], Mariko Sakka[c], Maiko Noguchi-Watanabe[d], Asa Inagaki-Asano[a,b], Taro Kojima[e], Noriko Yamamoto-Mitani[b]

[a] Global Nursing Research Center, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
[b] Department of Gerontological Homecare and Long-term Care Nursing, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
[c] Faculty of Medicine, University of Tsukuba, Japan
[d] Tokyo Medical and Dental University, Japan
[e] Department of Geriatric Medicine, The University of Tokyo, Japan

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ABSTRACT

This prospective cohort study examined the association between home-visit nursing use and the occurrence of unfavorable health outcomes (UHOs) among community-dwelling older adults (≥75 years) across Japan. An online survey collected data about older people's characteristics (household composition, diagnosis, etc.) and the occurrence of 21 UHOs (e.g., hospitalization, respiratory infection, sleeping disorders, lack of serenity) twice a year apart. The analysis included 835 older adults (58.2% were female, and 39.4% had dementia). Controlling for participants' characteristics and the occurrence of UHOs at the baseline, regression analyses revealed that home-visit nursing use was associated with statistically significant lower occurrence rates of lack of social interaction, social isolation, neglecting the client's desired care, urinary tract infection, and poor family well-being, as well as lower incidence rate of the total number of UHOs. The results demonstrate the favorable contribution of home-visit nursing in minimizing the occurrence of UHOs among older people.

Introduction

Homecare for older people is a key part of the national policy in several countries. It aims to decrease institutionalization (e.g., hospital admission), enable older people to live independently and remain in their own homes, and maintain or enhance their quality of life.[1] In several countries, home-visit nursing constitutes the largest part of homecare services.[2] Home-visit nursing is defined as visiting older people at their homes to provide preventive, promotive, curative, or rehabilitative services by nurses.[2] Evaluating the effectiveness of home-visit nursing is important to inform clinicians, clinical practice guidelines, policy, and future research.

Effectiveness of home-visit nursing

A plethora of research has examined the effectiveness of homecare services, including home-visit nursing, for older people.[3–5] For instance, Elkan et al.[6] evaluated the effectiveness of home visiting programs that offer health promotion and preventive care to older people. The authors synthesized 15 empirical studies and found a favorable effect on mortality and institutionalization (i.e., admission to residential care facilities, such as nursing homes), with no effect of population type, duration of intervention, and age group on these outcomes. The same review found that there was no effect of home visiting programs on hospitalization and health status. Another review of 64 randomized controlled trials[7] concluded that home visiting is not consistently associated with differences in mortality or independent living and that subgroup analyses (e.g., by follow-up interval, age of participants, type of visitors, number of visits, etc.) did not reveal any patterns that were inconsistent with their conclusion. A recent umbrella review[8] concluded that the evidence of the effectiveness of long-term (i.e., ≥ three months) home-visit nursing for older people on mortality, hospitalization, institutionalization, patient satisfaction, and quality of life is minimal.

Whole person care in home-visit nursing

Despite the extensive work to investigate the effectiveness of homecare services, there is a lack of examination of the effectiveness

*Corresponding author at: Global Nursing Research Center, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan.
E-mail address: eltaybanisameh@gmail.com (S. Eltaybani).

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of home-visit nursing in a holistic way. That is, most studies have neglected the holistic philosophy of nursing, which emphasizes treating the whole person rather than just addressing specific symptoms or conditions. The concept of holism is deeply rooted in nursing care[9–11] and is particularly important when caring for older adults.[12,13] Older adults commonly live with multiple morbidities and physical, functional, cognitive, and sensory impairments.[14] Examining the effectiveness of home-visit nursing in a holistic way rather than focusing on a single outcome can provide a more comprehensive understanding of the impact of home-visit nursing on older people's overall health, capture the full scope of how home-visit nursing may contribute to the quality of life of older adults, and uncover nuances that were not apparent in previous studies that focused on single outcomes like mortality, hospitalization, or even quality of life.

Homecare services in Japan

Homecare services for older people in Japan are covered by the national health insurance system and are provided mainly through home-visit nursing agencies and care management offices. Home-visit nursing agencies are staffed with home-visit nurses and provide home-visit nursing, while care management offices include care managers and coordinate homecare services, including home-visit nursing and other services, such as home rehabilitation, home help, and recreation. Home-visit nurses provide health assessment, personal hygiene assistance, guidance about treatment, range of motion exercises, and assessment of the quality of daily life.[15,16] Home-visit nurses also have opportunities to interact and collaborate with their patients' neighbors and friends throughout their daily visits.[16] Home-visit nursing non-users receive other homecare services, such as recreation, assistance with daily activities (e.g., meals, cleaning, bathing, etc.), and rehabilitation. These services are mainly provided by home helpers and physiotherapists. All homecare services, including home-visit nursing, are coordinated by care managers, and recipients typically receive regular home visits by physicians once or twice a month, depending on the patient's medical needs.[17]

The current study

The current study is built on the inherent complexity and holism of nursing care. That is, although outcomes such as fall, pressure ulcers, urinary tract infection, and psychological impairment are recognized as sensitive indicators for home healthcare,[18] changes in any single one of these outcomes may not fully capture the overall effectiveness of nursing care. In contrast, assessing multiple outcomes that reflect the whole person and integrating them into a total score offers a more accurate and holistic evaluation of nursing care quality. This is particularly relevant in the context of homecare, where the content of care is multifaceted, and the primary goal is improving the overall wellbeing, independence, and quality of life.[19] Therefore, the current study sought to examine the effectiveness of home-visit nursing by evaluating a wide range of outcomes covering the home-visit nursing users' physical, psychological, mental, and social conditions, as well as their family well-being. To maximize the robustness and clinical meaningfulness of such evaluation, the current study included older people with various health conditions, followed them for one year, and accounted for a wide range of confounding variables.

The specific aim of the current study was to examine the association between home-visit nursing use and the occurrence of unfavorable health outcomes (UHOs) among community-dwelling older adults. The research hypothesis was that older adults who use home-visit nursing experience fewer UHOs compared with non-users.

Methods

Design

This was a prospective cohort study. The data used in the current paper were derived from a larger project, "Visualizing Effectiveness of NUrSing and long-term care" (VENUS). The VENUS project is a prospective cohort study aiming to develop quality indicators pertaining to the long-term care process and client outcomes. Details about the VENUS project were described elsewhere.[20–23] There is no redundancy or duplication between the current paper and other work published from the same project. The current article was reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement guidelines for reporting observational studies.[24]

Sampling and participants

This study included older people receiving homecare services in Japan. To minimize the coverage error of the current survey, the recruitment of participants started by inviting home-visit nursing agencies and care management offices nationwide through the *National Association for Visiting Nurse Service* and the *Japan Care Manager Association*, with adjunctive use of convenient and snowball sampling to recruit care management offices. Agencies and offices that agreed to participate in the study were requested to invite older people to participate. Older people were eligible for inclusion if they were (i) aged ≥75 years, (ii) recently discharged from a hospital, and (iii) with a primary diagnosis of heart failure, chronic obstructive pulmonary disease, pneumonia, cerebrovascular disease, femoral neck fracture, cancer, nervous system disease, or dementia. Although older people are typically defined as those who are ≥65 years old, the current study included those who are ≥75 years old because this age group constitutes the majority of individuals receiving homecare nursing services in Japan. Furthermore, redefining the term "aged" in Japan has been proposed.[25] For instance, the Japan Gerontological Society and the Japan Geriatrics Society joint committee's proposed classification of people aged ≥65 years defines 65–74 years as pre-old and ≥75 years as old.[26] In the current study, there were no restrictions on the number of participating facilities or participants. Nevertheless, each home-visit nursing agency was requested to invite ≥25 people, and each care management office was requested to invite ≥5 people. There were also no restrictions on the number of clients that a given care provider cared for.

Data collection

Data were collected using online questionnaires completed by home-visit nurses and care managers caring for the participating older adults. The questionnaire was created in the Japanese language using SurveyMonkey®. Paper copies of the questionnaires were also made available on request to enhance the response rate. Data reported in the current article were collected at two timepoints: baseline (September 2019) and 1-year follow-up.

Measurements

Unfavorable Health Outcomes (UHOs). Home-visit nurses and care managers reported about the occurrence of 21 UHOs (Table 1). Guided by Gordon's functional health patterns,[27] these 21 UHOs were developed through a multistage process—literature review, expert panel discussions, pilot study, and longitudinal survey—and intended to comprehensively evaluate the condition of older adults receiving long-term care, including homecare, in Japan.[20–23] The face and content validity of the 21 UHOs were assured by a panel of 20

Table 1
Definition of the 21 unfavorable health outcomes.

Unfavorable health outcomes [a]	Definition [b]
Lack of social interaction in the last 30 days	The client had at least one of the following: (a) no participation in activities of interest, (b) no visits to friends or family members, (c) no interaction with individuals other than family and friends, (d) experiencing conflicts and anger with family and friends, (e) being afraid of families and acquaintances, or (f) being neglected abused, or poorly treated.
Social isolation in the last 30 days	The client always expressed loneliness. [c]
Neglecting the client's desired way of life	The client's desired way of life in the current situation was not realized. [d]
Neglecting the client's desired care	The client's desired way of care, including advanced care planning, was not discussed or shared.
Implementation of activity restriction in the last 30 days	The client was physically restrained.
Occurrence of a new disease or deterioration of an existing disease in the last 30 days	The client either had a new disease or experienced a deterioration of an existing disease.
Hospitalization in the last year [e]	The client was hospitalized at least once. Hospitalization refers to actual hospital admission and does not include visits to outpatient clinics.
Occurrence of urinary tract infection in the last 30 days	The client had a urinary tract infection, whether treated or not.
Occurrence of respiratory infection in the last 30 days	The client had a respiratory tract infection, whether treated or not.
Occurrence of skin breakdown in the last 30 days	The client had a skin laceration, cut, or pressure ulcer of any degree, including redness of the skin, partial loss of skin layer, deep hollow in the skin, muscle and bone exposure, or an ulcer of indeterminable degree.
Poor dyspnea control in the last 30 days	The client had dyspnea that was (a) effectively controlled but not always, (b) partially controlled, or (c) not controlled.
Poor pain control in the last 30 days	The client had pain that was (a) effectively controlled but not always, (b) partially controlled, or (c) not controlled.
Occurrence of weight loss in the last 30 days	The client had a loss of 5% or more of their weight.
Occurrence of dehydration in the last 30 days	The client had dehydration, whether treated or not.
Occurrence of bladder and bowel problems in the last 7 days	The client had diarrhea, defecated less than three times per week, or had difficulty defecating.
Occurrence of traumatic fall since the last survey	The client had a fall with trauma. [f]
Declining activities of daily living	The total score of the client's daily activities (i.e., bathing, mobility, toileting, feeding, personal hygiene, and housework activities) decreased from the previous assessment timepoint. [g]
No activities in the last 7 days	The client did not release their body from the bed even once (i.e., bedridden).
Sleeping disorders in the last 30 days	The client had a sleep disorder that affected—regardless of the degree of effect—their daily life.
Lack of serenity and contentedness in the last 30 days	The client was unable to spend their time, whether partially or wholly, peacefully without having a feeling of urgency or anxiety
Poor family well-being in the last 30 days	The client's family either could not spend time peacefully and calmly or were exhausted by the client's care.

[a] Questions used to assess each outcome are reported elsewhere (blinded for review)
[b] All outcomes are care provider-reported
[c] Expressing only some concerns was not considered an unfavorable health outcome
[d] Partial realization was not considered an unfavorable health outcome
[e] At the baseline, it was "Hospitalization in the last 30 days."
[f] A fall without trauma was not considered an unfavorable health outcome
[g] Since the outcome "*Declining activities of daily living*" is computed as a difference between two timepoints, it was not computed at the baseline. Therefore, for the purpose of the current study, "*Declining activities of daily living*" at 1-month follow-up was considered as the baseline.

experts, including nurses, physicians, and care workers, among others. The reliability was also assured in a separate study.[28] The current study examined the 21 UHOs separately and the total number of UHOs. The latter was computed by summing the number of UHOs (present = 1, otherwise [i.e., absent, I do not know, or missing] = 0; possible range = 0—21) at each timepoint. The rationale for using the total number of UHOs is two-fold. First, as described in the Introduction section above, the total number of UHOs reflects the overall condition of older people and the holistic nature of nursing care better than induvial UHOs. Second, the low occurrence rates of many UHOs may hinder performing a robust statistical analysis (i.e., increase the risk of type 2 error).

Although mortality is a clinically important and patient-relevant outcome,[29] a frequently reported nursing-sensitive indicators,[30] and one of the most frequently examined outcomes of home-visit nursing,[8] it was not included in the current study for two reasons. First, the infeasibility of assessing other UHOs after the participants were lost to follow-up due to death; that is, participants who passed away had missing data in all UHOs examined in the current study. Second, unlike in-hospital care, reducing mortality is not a primary objective of homecare services. Instead, homecare primarily aims to prevent institutionalization (e.g., hospital admission), support older adults in maintaining independent living, and enhance their quality of life.[19,31] The current study considered care outcomes that directly reflect or linked to the quality of the care process.

Home-visit nursing use. The current study participants were divided into two groups based on their home-visit nursing use at the baseline: users and non-users.

Potential confounders. Based on a literature review and extensive discussions among the research team members, data about three types of variables were collected as potential confounders for the association between home-visit nursing use and the occurrence of UHOs: sociodemographic characteristics, health condition, and having long-term care or medical insurance. Sociodemographic characteristics included sex, age, and household composition (living alone vs. living with others). Health condition variables included diagnosis, care provider-perceived medical condition (unstable or terminal vs. stable), use of medical procedure or treatment (no vs. yes), support/care level (from 1 [less disabled] to 7 [more disabled]), dependency in daily activities (from 1 [independent] to 4 [bedridden]), and independency in daily living (from 1 [independent] to 6 [specialized medical care required]). The latter three measures were assessed using nationally standardized tools[32,33]; higher scores indicate higher disability, dependency, and cognitive impairment, respectively. Utilization of long-term care insurance and medical insurance services were also included.

Statistical analysis

The study variables were described using numbers and percentages or mean and standard deviation. The number and percentage of cases with missing data were computed for each variable, and no missing data replacement was performed in the current study. Participants with valid data (i.e., non-missing data) in any of the 21 UHOs at 1-year follow-up were included in the analysis. Attrition analysis was performed to compare the characteristics of those who were included in the analysis and those who dropped out. Among those who were included in the analysis, we compared the characteristics of home-care nursing users and non-users. Comparisons were conducted using either the Chi-square test or the independent sample t-test, and the magnitude of effect was quantified using either Phi-coefficient (0.1: small, 0.3: medium and 0.5: large) or Cohen's d (0.2: small, 0.5: medium and 0.8: large), respectively.[34]

Binary logistic regression analysis was used to examine the association between home-visit nursing use and the occurrence of each UHO at 1-year follow-up, controlling for the clients' characteristics and the occurrence of the respective UHO at the baseline. Poisson regression analysis was used to examine the association between home-visit nursing use and the total number of UHOs at 1-year follow-up, controlling for the clients' characteristics and the total number of UHOs at the baseline. That is, a total of 22 multivariable regression models were built: 21 binary regression models for the 21 UHOs and one Poisson regression model for the total number of UHOs. Before the regression analysis, multicollinearity between predictors was examined and none of the predictors were excluded. In all regression models, all predictors—all measured at the baseline—were entered at once. All analyses were conducted using SPSS (version 28) for Windows, and the statistical significance level was .05 (two-tailed).

Ethical considerations

The study was approved by the Research Ethics Committee of the Graduate School of Medicine, The University of Tokyo, Japan (numbers: 2019087NI-(7)). The cover letter of the questionnaires explained the study purpose, provided assurance regarding the voluntary and confidential nature of the responses, and stated that the completion and submission of the questionnaires would be regarded as consent to participate.

Results

Characteristics of the sample and attrition analysis

Out of 1,450 clients recruited at the baseline, 615 (42.4%) were excluded from the analysis (i.e., dropped out) due to having missing data in all UHOs at 1-year follow-up (Fig. 1). Among those who were included in the analysis (n = 835), 58.2% were female, 25.8% were living alone, 39.4% had dementia, and 70.8% did not use medical procedures or treatment (Table 2). At the baseline, there were no sizable differences between the characteristics of those who dropped out and those who included in the analysis; the biggest effect sizes were for the support/care level (0.129), care provider-perceived medical condition (0.122), and having medical insurance for homecare (0.122). Similarly, comparing the baseline characteristics between home-visit nursing users and non-users (Table 3) revealed that all differences were either small or medium; no large effect size was detected.

Occurrence of UHOs

Table 4 shows that the most frequently reported UHOs at the baseline were lack of social interaction (32.3%), sleeping disorders (24.0%), and neglecting the client's desired care (23.4%). At 1-year

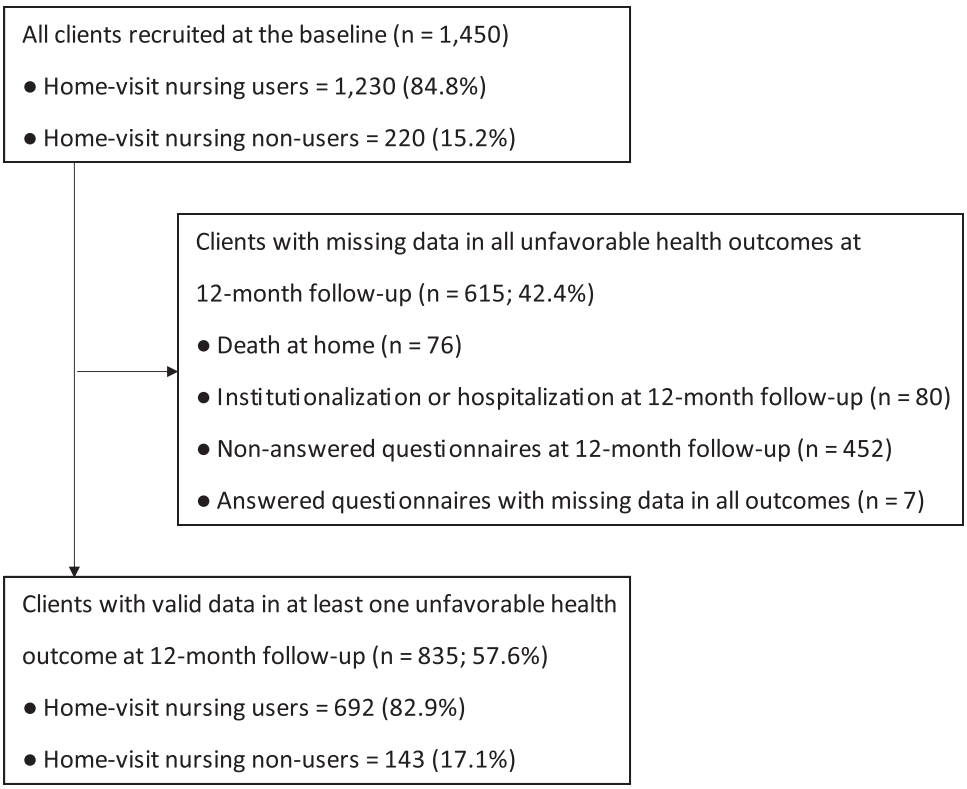

Fig. 1. Sampling flowchart.

Table 2
Attrition analysis comparing those who were included in the analysis with those who dropped out (n = 1450).

	Missing cases		Dropped out (n = 615; 42.4%) †		Study participants (n = 835; 57.6%) ‡		p-value	Effect size
	n (%)		n (%) or mean ± SD		n (%) or mean ± SD			
Home-visit nursing use: Yes	-	-	538	87.48%	692	82.87%	.016	0.063
Socio-demographic characteristics:								
Sex: Female	-	-	374	60.81%	486	58.20%	.317	0.026
Age (in years)	-	-	85.78	± 6.22	85.23	± 6.24	.097	0.090
Household composition: Living alone	-	-	166	26.99%	215	25.75%	.595	0.014
Health condition:								
Diagnosis: Heart failure	-	-	146	23.74%	194	23.23%	.822	0.006
Diagnosis: Pneumonia	-	-	40	6.50%	55	6.59%	.950	0.002
Diagnosis: Dementia	-	-	244	39.67%	329	39.40%	.916	0.003
Care provider-perceived medical condition: unstable or terminal	1	(0.07)	171	27.85%	147	17.60%	<.001	0.122
Support/care level [a]	-	-	4.48	± 1.64	4.26	± 1.71	.020	0.129
Dependency in daily activities of disabled older adults [b]	-	-	2.23	± 0.97	2.15	± 0.97	.100	0.087
Independence in the daily living of people with cognitive impairment	8	(0.55)	2.92	± 1.24	2.89	± 1.22	.660	0.024
Use of medical procedures or treatment: None	-	-	410	66.67%	591	70.78%	.094	0.044
Utilization of long-term care insurance for:								
Homecare	-	-	269	43.74%	305	36.53%	.006	0.073
Home bathing care	-	-	47	7.64%	58	6.95%	.613	0.013
Homecare rehabilitation	-	-	93	15.12%	120	14.37%	.690	0.010
Short-term residential and medical care	-	-	54	8.78%	100	11.98%	.051	0.051
Welfare equipment rental and specified welfare equipment sales	-	-	326	53.01%	460	55.09%	.432	0.021
In-home medical care management guidance	-	-	105	17.07%	152	18.20%	.577	0.015
Utilization of medical insurance for:								
Homecare	-	-	263	42.76%	258	30.90%	<.001	0.122
Visiting dentistry	-	-	28	4.55%	42	5.03%	.675	0.011
Outpatient visits	-	-	314	51.06%	506	60.60%	<.001	0.095
Pharmacist visit	-	-	56	9.11%	53	6.35%	.049	0.052
Home bathing care	-	-	50	8.13%	56	6.71%	.303	0.027

† Out of 1,450 clients recruited at the baseline, subjects with missing data in all unfavorable health outcomes at 1-year follow-up.
‡ Out of 1,450 clients recruited at the baseline, subjects with valid data in at least one unfavorable health outcome at 1-year follow-up.
[a] Based on a need assessment using a nationally standardized tool. The possible score ranges from 1 (less disabled) to 7 (more disabled); higher scores indicate a higher disability level, less dependency, and more care needs.
[b] Based on a nationally standardized tool. The possible score ranges from 1 (independent) to 4 (bedridden); higher scores indicate higher dependency.[c]Based on a nationally standardized tool. The possible score ranges from 1 (independent) to 6 (specialized medical care required); higher scores indicate higher cognitive impairment.Abbreviation: SD, Standard deviation

follow-up, the most frequently reported UHOs were declining activities of daily living (29.7%), lack of social interaction (28.3%), and hospitalization (23.6%). The total number of UHOs ranged from 0 to 10 at the baseline and from 0 to 12 at 1-year follow-up (median [interquartile range]: 2.0 [1.0—3.0] and 2.0 [1.0—4.0], respectively).

Association between home-visit nursing use and the occurrence of UHOs

Table 5 shows that home-visit nursing use was associated with a statistically significant lower occurrence of five UHOs: lack of social interaction (odds ratio [95% confidence interval]: 0.69 [0.392, 0.948]), social isolation (0.098 [0.020, 0.473]), neglecting the client's desired care (0.627 [0.393, 0.999]), urinary tract infection (0.229 [0.055, 0.955]), and poor family well-being (0.440 [0.247, 0.784]). Home-visit nursing use was also associated, yet statistically insignificant, with a lower occurrence of nine UHOs, such as hospitalization (0.777 [0.486, 1.243]), respiratory infection (0.542 [0.131, 2.249]), weight loss (0.808 [0.368, 1.771]), traumatic fall (0.529 [0.26, 1.075]), and lack of serenity and contentedness (0.708 [0.417, 1.200]). Furthermore, the total number of UHOs was statistically significantly lower among home-visit nursing users (incidence rate ratio = 0.839; 95% confidence interval = 0.725, 0.970). There was no statistically significant positive association between home-visit nursing use and any of the outcomes.

Discussion

The current study is among the first to comprehensively examine the effectiveness of home-visit nursing use for older people. The results provide evidence of the long-term (i.e., over one year) favorable effect of home-visit nursing in reducing the occurrence of UHOs among older people and improving the well-being of their families. Despite the observational nature of the current study, using a prospective cohort design and controlling for a wide range of client characteristics, including the occurrence of UHOs at the baseline, add to the rigor of the current research. The absence of sizable differences between the characteristics of those who dropped out and those who were included in the analysis also adds to the robustness of the current results and increases their generalizability. Furthermore, the current study is novel in examining a comprehensive range of theory-based outcomes and using the total number of these outcomes to reflect the overall condition of older people and their family members.

Many of the UHOs examined in the current study were rarely or not examined in previous research on older people receiving home-visit nursing, such as neglecting the client's desired way of life and lack of serenity and contentedness. Some of the current UHOs were prevalent at both the baseline and the one-year follow-up, such as lack of social interaction and neglecting the client's desired care, whereas some UHOs were less prevalent, such as social isolation and the occurrence of urinary tract infection. On one hand, the observed low frequency of many UHOs in the current study, which is consistent with previous research,[35,36] supports the use of the total number of UHOs. On the other hand, the current results provide evidence of the effectiveness of home-visit nursing in reducing the occurrence of both prevalent and less prevalent UHOs. The lack of statistical significance ($p>0.05$) in the observed favorable association between home-visit nursing use and certain UHOs may be attributed to the low prevalence rates of specific outcomes (e.g., neglecting the client's desired way of life, implementation of activity restriction, respiratory

Table 3
Bivariate analysis comparing home-visit nursing users and non-users (n = 835).

	Missing cases		Home-visit nursing users (n = 692; 82.9%)		Home-visit nursing non-users (n = 143; 17.1%)		p-value	Effect size
	n (%)		n (%) or mean ± SD		n (%) or mean ± SD			
Socio-demographic characteristics:								
Sex: Female	-	-	399	57.66%	87	60.84%	.483	0.024
Age (in years)	-	-	85.28	± 6.24	85.01	± 6.26	.637	0.043
Household composition: Living alone	-	-	189	27.31%	26	18.18%	.023	0.079
Health condition:								
Diagnosis: Heart failure	-	-	167	24.13%	27	18.88%	.176	0.047
Diagnosis: Pneumonia	-	-	49	7.08%	6	4.20%	.205	0.044
Diagnosis: Dementia	-	-	255	36.85%	74	51.75%	.001	0.115
Care provider-perceived medical condition: unstable or terminal	-	-	124	17.92%	23	16.08%	.600	0.018
Support/care level [a]	17	(2.04)	4.35	± 1.78	3.85	± 1.24	<.001	0.296
Dependency in daily activities of disabled older adults [b]	-	-	2.20	± 1.01	1.92	± 0.70	<.001	0.285
Independence in the daily living of people with cognitive impairment [c]	3	(0.36)	2.90	± 1.25	2.87	± 1.04	.388	0.023
Use of medical procedures or treatment: None	-	-	462	66.76%	129	90.21%	<.001	0.194
Utilization of long-term care insurance for:								
Homecare	-	-	269	38.87%	36	25.17%	.002	0.107
Home bathing care	-	-	58	8.38%	0	0.00%	<.001	0.124
Homecare rehabilitation	-	-	107	15.46%	13	9.09%	.048	0.068
Short-term residential and medical care	-	-	79	11.42%	21	14.69%	.273	0.038
Welfare equipment rental and specified welfare equipment sales	-	-	380	54.91%	80	55.94%	.822	0.008
In-home medical care management guidance	-	-	139	20.09%	13	9.09%	.002	0.107
Utilization of medical insurance for:								
Homecare	-	-	245	35.40%	13	9.09%	<.001	0.215
Visiting dentistry	-	-	37	5.35%	5	3.50%	.357	0.032
Outpatient visits	-	-	394	56.94%	112	78.32%	<.001	0.165
Pharmacist visit	-	-	46	6.65%	7	4.90%	.434	0.027
Home bathing care	-	-	51	7.37%	5	3.5%	.092	0.058

[a] Based on a need assessment using a nationally standardized tool. The possible score ranges from 1 (less disabled) to 7 (more disabled); higher scores indicate a higher disability level, less dependency, and more care needs.
[b] Based on a nationally standardized tool. The possible score ranges from 1 (independent) to 4 (bedridden); higher scores indicate higher dependency.
[c] Based on a nationally standardized tool. The possible score ranges from 1 (independent) to 6 (specialized medical care required); higher scores indicate higher cognitive impairment.Abbreviation: SD, Standard deviation

Table 4
Descriptive analysis of unfavorable health outcomes in the study sample (n = 835).[†]

Unfavorable health outcomes	Baseline			1-Year follow-up		
	n	%	Missing, n (%)	n	%	Missing, n (%)
Lack of social interaction in the last 30 days	270	32.3	-	236	28.3	-
Social isolation in the last 30 days	29	3.5	–	24	2.9	-
Neglecting the client's desired way of life	18	2.2	-	25	3.0	-
Neglecting the client's desired care	195	23.4	-	167	20.0	-
Implementation of activity restriction in the last 30 days	22	2.6	-	17	2.0	-
Occurrence of a new disease or deterioration of an existing disease in the last 30 days	101	12.1	1 (0.1%)	123	14.7	2 (0.2%)
Hospitalization in the last year [‡]	59	7.1	1 (0.1%)	197	23.6	2 (0.2%)
Occurrence of urinary tract infection in the last 30 days	20	2.4	1 (0.1%)	24	2.9	4 (0.5%)
Occurrence of respiratory infection in the last 30 days	17	2.0	1 (0.1%)	28	3.4	-
Occurrence of skin breakdown in the last 30 days	135	16.2	1 (0.1%)	150	18.0	5 (0.6%)
Poor dyspnea control in the last 30 days	26	3.1	1 (0.1%)	26	3.1	5 (0.6%)
Poor pain control in the last 30 days	61	7.3	1 (0.1%)	57	6.8	6 (0.7%)
Occurrence of weight loss in the last 30 days	44	5.3	-	63	7.5	7 (0.8%)
Occurrence of dehydration in the last 30 days	13	1.6	-	20	2.4	7 (0.8%)
Occurrence of bladder and bowel problems in the last 7 days	163	19.5	1 (0.1%)	147	17.6	8 (1.0%)
Occurrence of traumatic fall since the last survey	65	7.8	2 (0.2%)	51	6.1	8 (1.0%)
Declining activities of daily living	143	17.1	141 (16.9%)	248	29.7	178 (21.3%)
No activities in the last 7 days	65	7.8	3 (0.4%)	114	13.7	8 (1.0%)
Sleeping disorders in the last 30 days	200	24.0	-	166	19.9	8 (1.0%)
Lack of serenity and contentedness in the last 30 days	143	17.1	1 (0.1%)	144	17.2	8 (1.0%)
Poor family well-being in the last 30 days	115	13.8	3 (0.4%)	106	12.7	9 (1.1%)
Total number of unfavorable health outcomes: Mean ± standard deviation (range)	2.3	± 1.8	(range, 0.0 – 10.0)	2.6	2.1	(range, 0.0, 12.0)
Median (Interquartile range)	2.0	(1.0, 3.0)	-	2.0	(1.0, 4.0)	-

[†] : The analysis included only participants with valid data in any unfavorable health outcome at 1-year follow-up (i.e., participants with missing data in all unfavorable health outcomes at 1-year follow-up were excluded from the analysis [see Fig. 1])
[‡] At the baseline, it was "Hospitalization in the last 30 days."

Table 5
Regression coefficients of the effectiveness of homecare nursing use on unfavorable health outcomes[†].

Unfavorable health outcomes	n [‡]	Exp (B) [§]	95% CI of Exp (B)		p-value
			Lower	Upper	
Lack of social interaction in the last 30 days	815	0.609	0.392	0.948	0.028
Social isolation in the last 30 days	815	0.098	0.020	0.473	0.004
Neglecting the client's desired way of life	815	0.631	0.350	1.140	0.127
Neglecting the client's desired care	815	0.627	0.393	0.999	0.050
Implementation of activity restriction in the last 30 days	815	0.650	0.046	9.135	0.750
Occurrence of a new disease or deterioration of an existing disease in the last 30 days	812	1.498	0.794	2.826	0.212
Hospitalization in the last year	813	0.777	0.486	1.243	0.293
Occurrence of urinary tract infection in the last 30 days	810	0.229	0.055	0.955	0.043
Occurrence of respiratory infection in the last 30 days	810	0.542	0.131	2.249	0.399
Occurrence of skin breakdown in the last 30 days	809	1.169	0.642	2.129	0.611
Poor dyspnea control in the last 30 days	809	1.190	0.302	4.698	0.804
Poor pain control in the last 30 days	808	1.177	0.511	2.710	0.701
Occurrence of weight loss in the last 30 days	808	0.808	0.368	1.771	0.594
Occurrence of dehydration in the last 30 days	808	0.757	0.218	2.632	0.662
Occurrence of bladder and bowel problems in the last 7 days	806	1.706	0.879	3.309	0.114
Occurrence of traumatic fall since the last survey	805	0.529	0.260	1.075	0.078
Declining activities of daily living	586	0.693	0.441	1.089	0.112
No activities in the last 7 days	804	1.045	0.467	2.342	0.914
Sleeping disorders in the last 30 days	807	1.040	0.623	1.737	0.880
Lack of serenity and contentedness in the last 30 days	806	0.708	0.417	1.200	0.200
Poor family well-being in the last 30 days	803	0.440	0.247	0.784	0.005
Total number of unfavorable health outcomes	815	0.839	0.725	0.970	0.018

[†] Shown are the regression coefficients of home-visit nursing use—compared with non-use—for each of the listed outcomes. All outcomes were assessed at the 1-year follow-up. A separate regression model was built for each outcome (i.e., a total of 22 regression models for the 22 listed outcomes), and the control variables were consistent across all models. Control variables included all clients' characteristics at the baseline listed in Table 2 (i.e., socio-demographic characteristics, health condition, utilization of long-term care insurance for specific, and utilization of medical insurance for specific services). Furthermore, when the outcome variable was the occurrence of a single unfavorable health outcome at 1-year follow-up, the occurrence of the respective unfavorable health outcome at the baseline was included as a control variable; when the outcome variable was the total number of unfavorable health outcomes at 1-year follow-up, the total number of unfavorable health outcomes at the baseline was included as a control variable.

[‡] The number of cases included in the analysis

[§] For individual unfavorable health outcomes, binary logistic regression analysis was used; Exp (B) is the odds ratio of unfavorable health outcomes among home-visit nursing users. For the total number of unfavorable health outcomes, Poisson regression analysis was used; Exp (B) is the incidence rate ratio of the total number of unfavorable health outcomes among home-visit nursing users.

infection, and dehydration) and the high proportion of cases with missing data (e.g., declining activities of daily living). The importance of considering effect sizes (e.g., odds ratios) and their 95% CIs, rather than relying solely on p-values, is well-documented.[37–39] In the current study, this is particularly relevant for UHOs with the upper limit of the 95% CI slightly above 1.0, as seen in the case of traumatic falls (0.260 – 1.075). The favorable effects shown in the current study are in line with several previous studies whether that were conducted a long time ago[40–42] or the relatively recent ones.[43–45]

Although the exact mechanism by which home-visit nursing helps older people and their families remains unclear, some theoretical and conceptual models may help understand how home-visit nursing is expected to improve outcomes. For instance, as per the Andersen Behavioral Model of Health Services Use,[46,47] home-visit nursing maybe seen as an enabling resource that increases healthcare utilization and addresses unmet needs, thereby improves health outcomes. Similarly, the Chronic Care Model[48,49] can explain the effectiveness of the home-visit nursing through nurses' role in enhancing the use of community resources and empowering self-management support. Furthermore, the holistic, multifaceted nature of home-visit nurses' work may be explained by the biopsychosocial model as home-visit nurses address multidimensional health needs, leading to comprehensive improvements. Each of these models addresses a different part of the pathway from receiving home-visit nursing to better health. Future research may employ advanced statistical models, such as mediation and moderation analyses, to examine potential pathways.

In Japan, home-visit nurses provide a variety of services and types of care,[15,50] and many of the most frequently provided activities may explain the favorable effects observed in the current study. For instance, health assessment is the most frequently practiced nursing care activity provided by home-visit nurses.[15] Health assessment is the foundation of clinical practice, and it helps identify care needs and risks and inform tailored care planning and decision-making. Therefore, home-visit nursing serves as an opportunity for early intervention and preventive measures. Another frequent element of home-visit nursing in Japan that might contribute to the positive effect of home-visit nursing in the current study is the provision of guidance about treatment and caregiving.[15] Friedman et al.[51] reported that education carried out during home visits increases healthy lifestyle behaviors and compliance with treatment. Furthermore, home-visit nursing may also minimize the occurrence of UHOs by promoting the use of health and social services. The current study showed that home-visit nursing had favorable effects on social interaction and social isolation; these favorable effects may, in turn, serve as a potential way to improve older people's overall condition. The literature shows that homecare use was found to increase the use of community care services (e.g., home help),[52] increase utilization of primary healthcare,[40] and improve vaccination coverage.[40,53] Home-visit nursing may also bring a favorable effect on older people's outcomes by empowering their informal caregivers, such as families and neighbors. Home-visit nurses in Japan strive to improve the community involvement of older people to support their home living.[16]

Limitations of the study

The inconsistency of the form, content, and quality of documentation systems across Japan's home-visit nursing agencies and care management offices renders using the current documentation system for assessing the occurrence of UHOs impractical. Therefore, the current study relied on care provider-reported rather than document-extracted data. In the current study, most UHOs employed a time reference of the past 30 days based on the monthly requirement for home-visit nurses to report to the homecare physician. However,

for some UHOs, the time reference has been adjusted. For example, the dates and times of hospitalizations are regularly recorded, enabling homecare providers to report on hospitalizations occurring in the past year. Due to the fluctuating nature of pain, dyspnea, and bowel problems, reporting these UHOs over 30 days may be problematic, necessitating using a shorter time reference (i.e., the last week). Although the variation in the recall period was intended to maximize the feasibility of current UHOs as quality indicators and minimize recall bias,[54] the interpretation of the sum of UHOs, and sequentially the interpretation of the incidence rate ratio of the Poisson regression analysis, may be problematic. Computing the sum of UHOs periodically (e.g., monthly) may address this limitation and provide a comprehensive overview of the client's condition in a clinically feasible way. Future research may need to evaluate the validity and reliability of alternative data collection methods.

Other limitations of self-reporting in the current study include social desirability bias, recall bias, and the inability to verify the occurrence of UHOs. The use of electronic health records may help tackle such biases and facilitate the data collection process. The use of non-probability sampling might hinder the generalization of the results. The current study is also limited by not including some covariates that may shape the effectiveness of home-visit nursing, such as the content and frequency of home visits and the qualifications of home-visit nurses. Furthermore, the attrition rate at the 12-month follow-up exceeded 40%, and the predominant reason for this substantial drop-out was the absence of responses from home-visit nursing agencies and care management offices. Since the timing of the 12-month follow-up survey has coincided with the COVID-19 pandemic, a possible contextual explanation for the elevated dropout rate is the heightened workloads and burdens on homecare service providers.

Recommendations for future research

Consistent with previous research,[51] the current results suggest that future research needs to identify the specific mechanisms through which home-visit nursing reduces the occurrence of UHOs. This can be achieved by adopting theoretical foundations that explain how and why home-visit nursing is expected to cause an effect on the outcome measured. The current cohort included participants aged ≥75 years, and performing sub-group analyses was beyond our scope. Future research is also needed to investigate the effectiveness of home-visit nursing in different subpopulations of older adults. Although the current study examined the effectiveness of home-visit nursing use over 12 months, investigating this effect over a longer interval may provide deeper insights on the sustainability of the observed benefits. Future research needs to evaluate the cost-effectiveness of home-visit nursing use, considering the disparities in healthcare service expenditures and resource allocation both within and between countries.

Implications for policy and practice

The current study suggests that home-visit nursing can help older adults maintain their independence and well-being, and it can also help to prevent the development of more serious health problems. Therefore, policymakers should consider expanding access to home-visit nursing for community-dwelling older adults, and clinicians should consider recommending home-visit nursing to community-dwelling older adults who are at risk of UHOs. A recent study[55] found that early initiation use of home-visit nursing services may contribute to reducing total medical care and long-term care costs in the last 3 months of life for older people living at home as they approach the end of life.

Conclusions

This prospective cohort study provided evidence of the long-term favorable effect of home-visit nursing on the occurrence of UHOs among older adults and their family members. The results suggest that policymakers and clinicians should consider expanding access to and utilization of home-visit nursing for community-dwelling older adults to improve their independence and overall well-being. Future research needs to examine how home-visit nursing causes an effect on the outcome measured and investigate the effectiveness of home-visit nursing over longer intervals (i.e., more than a year).

Declaration of competing interest

The authors have no conflict of interest to declare.

CRediT authorship contribution statement

Sameh Eltaybani: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Formal analysis, Conceptualization. **Saori Anezaki:** Writing – review & editing, Formal analysis. **Chie Fukui:** Writing – review & editing, Methodology. **Ayumi Igarashi:** Writing – review & editing, Writing – original draft, Methodology. **Mariko Sakka:** Writing – review & editing, Methodology, Conceptualization. **Maiko Noguchi-Watanabe:** Conceptualization, Methodology, Writing – review & editing. **Asa Inagaki-Asano:** Writing – review & editing. **Taro Kojima:** Writing – review & editing. **Noriko Yamamoto-Mitani:** Writing – review & editing, Supervision, Resources, Methodology, Funding acquisition, Conceptualization.

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