

Changes in Pharmacists' Perceptions of their Roles During Pharmacy Policy Reforms: A Comparative Repeated-Cross-Sectional Study of Patients and Pharmacists

Naohito Takahashi

Josai University

Akira Yoshida

Josai University

Norimitsu Horii

Josai University Pharmacy

Shigeru Ohshima

Josai University Pharmacy

Junya Mikata

Josai University

Daisuke Kobayashi

Josai University

Shinji Oshima

soshima@josai.ac.jp

Josai University

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Abstract

Although the professional role of pharmacists has expanded, the perception of this change by patients and pharmacists remains largely understudied. Therefore, we employed a repeated cross-sectional design to examine changes in the perception of pharmacist roles among patients and pharmacists in Japan. We analyzed pooled data from nationwide online surveys of community pharmacy patients (~ 1,000) and pharmacists (~ 800–900) at each time point using data reported between 2014 and 2017 and newly collected data from 2023. Role perception was assessed across three factors (F1: Communication, F2: Assessment of the patient's condition, and F3: Identity) using two-factor analysis of covariance with age and sex as covariates. A significant year × group interaction was observed for all factors. The pharmacist group maintained consistently high scores across all factors, whereas the patient group scores increased between 2014 and 2023, narrowing the gap between the two groups. This trend was particularly pronounced in F1 and F2. Although the interaction was significant in F3, no significant differences were observed in the individual year-to-year comparisons. These results suggest that changes in pharmacists' duties following pharmacy policy reforms are increasingly reflected in patients' role perceptions. Thus, our findings provide insights for future institutional design and professional education.

Introduction

The population is aging rapidly in many Organization for Economic Co-operation and Development (OECD) member countries, causing significant changes in social structures and disease patterns. The prevalence of multiple comorbidities and vulnerability to mental and psychosocial factors increase as the elderly population grows, resulting in the structural expansion of healthcare and long-term care needs. These changes have increased the complexity of patient care, highlighting the growing importance of patient-centered, collaborative support that transcends the boundaries of a single specialty^[1–4]. To address these challenges, healthcare systems worldwide have increasingly emphasized the importance of inter-professional collaboration. Healthcare professionals are expected not only to apply their own specialized knowledge and skills but also to understand the perspectives of other professions and share relevant information to address the diverse and complex needs of patients. However, the provision of effective care depends not only on the preparedness of healthcare professionals, but also on how patients understand the roles of healthcare providers. If patients do not fully understand the scope and functions of the healthcare professionals' roles, a disconnect may arise between their needs and the services provided, which could hinder the delivery of effective and sustainable care^[5–7].

The specialized roles of pharmacists have expanded in recent years. Internationally, these healthcare professionals are becoming increasingly involved in patient counseling, medication management, and supporting chronic disease care^[8, 9]. This expansion of roles has been driven not only by voluntary changes in professional practice, but also by revisions to healthcare policies and institutional changes. Consequently, the changing roles of pharmacists can be understood as a social process in which these newly defined responsibilities extend beyond the profession itself and involve how they are perceived and understood by patients and other healthcare professionals.

From a sociological perspective, the concept of “role” encompasses both the patterns of behavior expected of an individual in a specific social position and the behavior that is actually performed^[10]. According to role theory, discrepancies between expected roles and actual roles, or differences in role perceptions among various actors, may create tension and lead to inefficiencies in service delivery^[7, 11, 12]. Previous studies applying role theory to pharmacy practice revealed differences in how pharmacists and patients perceive a pharmacist’s role, particularly with regard to medication counseling and the patient–pharmacist relationship^[13]. Such discrepancies may arise from institutional and temporal constraints as well as the characteristics of the broader healthcare system.

Japan offers a unique and useful context in which to examine these issues. Although the country operates a universal health insurance (UHI) system that guarantees broad access to medical services at relatively low out-of-pocket costs, it faces high prevalence rates of chronic diseases and long-term healthcare needs as one of the world’s most rapidly aging societies. Against this backdrop, Japan has been gradually implementing policies that prioritize continuous community-based care. The expansion of the professional roles of healthcare workers, including those of pharmacists, has been institutionally promoted through both legal and reimbursement frameworks^[14–16]. This environment offers an important research opportunity to examine how healthcare providers and patients perceive the expansion of their professional roles in a setting in which universal access to healthcare is ensured.

Despite growing interest in expanding the scope of practice for pharmacists, there remains a limited number of empirical studies that have examined how the discrepancy in role perceptions between pharmacists and patients—particularly in a super-aging society—has evolved against the backdrop of pharmacy policy reforms over time.

The primary objective of this study was to use the framework of role theory to clarify the differences in perceptions between pharmacists and patients regarding the professional role of pharmacists as well as how these perceptions change over time. Within the context of Japan’s UHI system and its highly aged society, we aimed to provide empirical insights into how changes in role perceptions, which occur in tandem with pharmacy policy reforms, relate to the alignment of healthcare needs and professional services.

Results

1. Respondent Characteristics

This study used data from three time points. Data from 2014 and 2017 were obtained from previously published reports (17, 18) (529 patients and 338 pharmacists in 2014; 469 patients and 354 pharmacists in 2017). The 2023 data were collected specifically for this study. Following data cleaning, the respondents with valid responses comprised 583 patients and 366 pharmacists (total, N = 2,639) (Supplementary Table S2). The response rate for the 2023 survey was 58.3% among patients and 45.8% among pharmacists. Chi-square tests revealed significant differences across years in the patient group for age, duration of medication use, and number of comorbidities, and in the pharmacist group for sex, age,

and years of experience. These demographic differences were accounted for by including age and sex as covariates in the ANCOVA model.

2. Factor Structure and Reliability

We verified the three-factor structure (F1: Communication [Q01–Q03]; F2: Assessment of the patient's condition [Q07–Q08]; F3: Identity [Q11–Q12]) across all years and groups using confirmatory factor analysis (CFA) (Supplementary Table S3). Model fit indices fell within the acceptable to good range across all combinations (CFI: 0.975–1.000; TLI: 0.953–1.004; RMSEA: 0.000–0.085; SRMR: 0.013–0.031). The RMSEA for the 2014 patient group slightly exceeded the 0.08 threshold (0.085 [90% CI: 0.063, 0.109]). Contrastingly, other fit indices (CFI = 0.975, TLI = 0.953, SRMR = 0.031) were within acceptable ranges, met Hu and Bentler's composite criteria (CFI $\geq$ 0.95, TLI $\geq$ 0.95, RMSEA $\leq$ 0.06, SRMR $\leq$ 0.08)^[19], and indicated acceptable overall fit.

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The internal consistency was assessed using Cronbach's alpha. For all years and groups, F1 and F2 demonstrated reliability ranging from acceptable to good (α = 0.784–0.886), meeting or exceeding the acceptable threshold of 0.70 for internal consistency. The F3 scale demonstrated acceptable reliability in the patient group (α = 0.700–0.778). In contrast, the pharmacist group had a low α value of 0.520–0.576, which did not meet the general standard of 0.70. However, this factor consists of only two items, and α tends to be underestimated when the number of items is small. Additionally, considering the factor loadings in the CFA, the stable structure observed across patient groups, and the consistency with role theory and previous studies^[17, 18], there is minimal justification for excluding F3 from the analysis. Therefore, we retained F3 as a theoretically important construct and included it in the subsequent analyses in this study.

3. Description Statistics

Table 1 presents the descriptive statistics of the three-factor scores by year and group. Pharmacists consistently scored higher than the patient group across all factors and survey years. In F1 (Communication), the average scores for the patient and pharmacist groups ranged from 3.53 to 3.68, and 3.89 to 4.02, respectively. For F2 (Assessment of the patient's condition), the patient scores ranged from 2.95 to 3.31, whereas the pharmacist scores ranged from 3.88 to 3.93. For F3 (Identity), patient and pharmacist scores ranged from 2.97 to 3.08 and 3.52 to 3.64, respectively. The patient scores showed an upward trend over time. Specifically, the F2 score increased from 2.95 (SD = 1.10) in 2014 to 3.31 (SD = 1.03) in 2023. In contrast, pharmacist scores remained relatively stable across all three factors throughout the study period.

Table 1
Descriptive statistics of factor scores by year and group

Year	Group	N	F1 Mean ± SD	F2 Mean ± SD	F3 Mean ± SD
2014	Patients	529	3.55 ± 0.86	2.95 ± 1.10	2.97 ± 0.90
	Pharmacists	338	4.02 ± 0.63	3.90 ± 0.71	3.56 ± 0.79
2017	Patients	469	3.53 ± 0.90	2.99 ± 1.12	2.99 ± 0.97
	Pharmacists	354	3.92 ± 0.64	3.88 ± 0.75	3.64 ± 0.74
2023	Patients	583	3.68 ± 0.81	3.31 ± 1.03	3.08 ± 0.91
	Pharmacists	366	3.89 ± 0.62	3.93 ± 0.73	3.52 ± 0.73
F1 = Communication (Q01–Q03); F2 = Assessing the patient's condition (Q07–Q08); F3 = Identity (Q11–Q12). The factor scores range from 1 to 5; higher scores indicate more positive perceptions.					

4. Changes in Role Perception Over Time and Between-Group Differences

We conducted a two-way ANCOVA with age and sex as covariates, and the survey year (2014, 2017, 2023) and group (patients, pharmacists) as independent variables. The results are summarized in Table 2.

Table 2
ANCOVA results for factor scores in the patient and pharmacist groups (Type III sum of squares)

Factor	Source	DF	F	p	Partial η^2
F1	Survey year	2	5.20	0.006	0.001
	Group (Patients vs Pharmacists)	1	77.35	< 0.001	0.050
	Year $\times$ group interaction	2	5.73	0.003	0.004
	Sex (female)	1	0.97	0.324	< 0.001
	Age	1	3.29	0.070	0.001
F2	Survey year	2	24.04	< 0.001	0.010
	Group (Patients vs Pharmacists)	1	180.09	< 0.001	0.150
	Year $\times$ group interaction	2	7.24	< 0.001	0.005
	Sex (female)	1	3.27	0.071	0.001
	Age	1	0.76	0.383	< 0.001
F3	Survey year	2	2.45	0.086	0.001
	Group (Patients vs Pharmacists)	1	87.86	< 0.001	0.090
	Year $\times$ group interaction	2	3.39	0.034	0.003
	Sex (female)	1	1.55	0.214	0.001
	Age	1	0.00	0.996	< 0.001
Analysis of covariance (ANCOVA) with year (2014, 2017, and 2023) and group (patients and pharmacists) as independent variables. Age and sex (female = 1; male = 0) were included as covariates.					
F1 = Communication; F2 = Assessing the patient's condition; F3 = Identity. η^2 = partial eta squared.					

The main effects of year were statistically significant for F1 ($F(2,2631) = 5.20$, $p = 0.006$, partial $\eta^2 = 0.001$) and F2 ($F(2,2631) = 24.04$, $p < 0.001$, partial $\eta^2 = 0.011$), whereas those for F3 ($F(2,2631) = 2.45$, $p = 0.086$, partial $\eta^2 = 0.001$) were not significant. The main effect of group was consistently statistically significant across all factors (F1: $F(1,2631) = 77.35$, $p < 0.001$, partial $\eta^2 = 0.050$; F2: $F(1,2631) = 180.09$, $p < 0.001$,

partial $\eta^2 = 0.148$; F3: $F(1,2631) = 87.86$, $p < 0.001$, partial $\eta^2 = 0.092$), with pharmacists scoring higher than patients. Furthermore, a significant Year $\times$ Group interaction was observed for all three factors (F1: $F(2,2631) = 5.73$, $p = 0.003$, partial $\eta^2 = 0.004$; F2: $F(2,2631) = 7.24$, $p < 0.001$, partial $\eta^2 = 0.005$; F3: $F(2,2631) = 3.39$, $p = 0.034$, partial $\eta^2 = 0.003$). This suggests that different temporal patterns exist between the groups, even after adjusting for demographic variables. However, age and sex did not have a significant effect on any of the factors (all $p > 0.05$).

5. Patterns of Change in Role Perception Among Groups

Given the significant year $\times$ group interaction, post hoc multiple comparisons using the Bonferroni correction were conducted separately for each group (Table 3).

Table 3
Pairwise year contrasts within groups (patients and pharmacists)

Factor	Group	Contrast	Estimate	SE	df	t	p	adj. p	Cohen's d
F1	Patients	2014 vs 2017	0.025	0.049	2631	0.52	0.603	1.000	0.033
		2014 vs 2023	-0.117	0.047	2631	-2.51	0.012	0.036	-0.152
		2017 vs 2023	-0.142	0.048	2631	-2.96	0.003	0.009	-0.185
	Pharmacists	2014 vs 2017	0.104	0.059	2631	1.78	0.076	0.228	0.135
		2014 vs 2023	0.129	0.058	2631	2.21	0.027	0.081	0.167
		2017 vs 2023	0.025	0.058	2631	0.43	0.666	1.000	0.032
F2	Patients	2014 vs 2017	-0.041	0.061	2631	-0.68	0.499	1.000	-0.043
		2014 vs 2023	-0.367	0.058	2631	-6.33	< 0.001	< 0.001	-0.383
		2017 vs 2023	-0.326	0.060	2631	-5.45	< 0.001	< 0.001	-0.340
	Pharmacists	2014 vs 2017	0.019	0.073	2631	0.26	0.796	1.000	0.020
		2014 vs 2023	-0.038	0.072	2631	-0.53	0.600	1.000	-0.040
		2017 vs 2023	-0.057	0.071	2631	-0.79	0.427	1.000	-0.059
F3	Patients	2014 vs 2017	-0.016	0.055	2631	-0.30	0.764	1.000	-0.019
		2014 vs 2023	-0.107	0.052	2631	-2.06	0.040	0.119	-0.124
		2017 vs 2023	-0.091	0.054	2631	-1.69	0.092	0.275	-0.105
	Pharmacists	2014 vs 2017	-0.082	0.065	2631	-1.26	0.208	0.625	-0.096

Post-hoc pairwise comparisons with Bonferroni correction. Estimated marginal means adjusted for age and sex. Estimate = difference in means; SE = standard error; df = degrees of freedom; t = t-ratio; p = unadjusted p-value; adj. p = Bonferroni-adjusted p-value; d = Cohen's d effect size.

Factor	Group	Contrast	Estimate	SE	df	t	p	adj. p	Cohen's d
		2014 vs 2023	0.039	0.065	2631	0.60	0.551	1.000	0.045
		2017 vs 2023	0.121	0.064	2631	1.89	0.059	0.178	0.141
Post-hoc pairwise comparisons with Bonferroni correction. Estimated marginal means adjusted for age and sex. Estimate = difference in means; SE = standard error; df = degrees of freedom; t = t-ratio; p = unadjusted p-value; adj. p = Bonferroni-adjusted p-value; d = Cohen's d effect size.									

F1 (Communication)

A significant increase was observed from 2014 to 2023 ($t(2631) = -2.51, p = 0.036, d = -0.152$) and from 2017 to 2023 ($t(2631) = -2.96, p = 0.009, d = -0.185$) in the patient group, indicating a change in perceptions of communication over time. In contrast, no significant changes between years were observed in the pharmacist group (all $p > 0.05$). As shown in Fig. 1, patient perceptions improved between 2014 and 2023, whereas pharmacist perceptions remained consistently stable at a high level.

F2 (Assessment of Patient Condition)

The patient group showed a statistically significant difference from 2014 to 2023 ($t(2631) = -6.33, p < 0.001, d = -0.383$), and from 2017 to 2023 ($t(2631) = -5.45, p < 0.001, d = -0.340$), although the effect size was small. No significant changes were observed in the pharmacist group (all $p > 0.05$). As shown in Fig. 2, the gap between patient and pharmacist perceptions was significantly narrowed over time, particularly between 2017 and 2023. This was primarily driven by improvements in patient perception.

F3 (Identity)

Although a significant Year $\times$ Group interaction was observed in the ANCOVA, no significant pairwise differences were found in any of the groups (all $p > 0.05$). Figure 3 shows a slight upward trend in patient scores and a relatively stable trend in pharmacist scores. However, no statistically significant differences were observed in these changes after Bonferroni correction (Table 3).

6. Overall Trends

For all three factors, pharmacists consistently reported a higher perception of their role than did patients at every time point (Figures. 1–3). The significant year $\times$ group interaction was primarily due to improvements in patients' perceptions from 2014 to 2023, whereas pharmacists' perceptions remained consistent. This trend was most pronounced for F2 (understanding the patient's condition), where patient scores increased over the study period, significantly narrowing the gap in perception between patients and

pharmacists. These findings suggest that role perceptions between the two groups gradually converged, particularly in areas related to the monitoring responsibilities of pharmacists.

Discussion

In this study, pharmacists consistently scored higher than the patient group on all three factors, indicating that they maintained a strong sense of their professional role. These findings are consistent with the results of previous studies indicating that pharmacists have a stronger sense of their professional roles than non-healthcare professionals^[22]. The scores of the patient group increased throughout the study period, with this trend becoming particularly pronounced in 2023. This resulted in the gradual narrowing of the gap in role perception between the two groups. This trend was particularly evident in F1 and F2. Both factors corresponded to specific professional practices mandated or strengthened by the amendment to the Pharmacists Act.

The study period (2014–2023) coincided with several pharmacy policy reforms that directly affected the scope of pharmacists' duties. Following the 2014 amendment to the Pharmacists Act, pharmacists are legally required to provide medication counseling and drug information to patients based on their professional expertise. The scope of pharmacy has expanded beyond simply providing information on medications; it also includes guidance that supports appropriate use tailored to each patient's individual condition and helps optimize drug therapy. Furthermore, following regulatory changes in 2019, pharmacists are required to continuously monitor patients' medication adherence. In 2015, the Ministry of Health, Labour and Welfare announced a policy to redefine pharmacies from facilities primarily serving specific medical institutions by filling their prescriptions to facilities that serve as hubs supporting the entire regional healthcare system. Since then, reforms aimed at promoting patient-centered and community-oriented pharmacy services have been implemented in stages through the biennial revisions to the pharmacy reimbursement system—a review of the public system under which reimbursements are determined based on the scope of a pharmacy's operations^[14, 23–26].

F1 (communication) evaluates specific communication behaviors during routine medication counseling, such as whether pharmacists are approachable to patients, provide clear explanations, and respond appropriately to patient concerns.

F2 (assessment of the patient's condition) reflects perceptions regarding monitoring practices. Specifically, it reflects whether pharmacists continuously assess the effects of medications and changes in the patient's health status. These roles align with the scope of pharmacist duties directly mandated by the aforementioned regulatory reforms. Furthermore, the increase in scores among the patient group in 2023 suggests that changes in practice resulting from the reforms may have been reflected in patient perceptions. In contrast, the scores for the pharmacist group remained high throughout the study period, with no significant changes. These results suggest that there was relatively minimal room for further change following these reforms because the professional self-identity of pharmacists was already high before the regulatory reforms. Conversely, patient perceptions of their own roles have considerable room for change and are thought to reflect regulatory reforms and changes in service delivery more sensitively.

Schommer and Gaither^[13] conducted a 15-year longitudinal study in the United States and reported that the discrepancy between pharmacist and patient perceptions of their respective roles persisted without significant changes.

In the present study, patient perceptions improved regarding the behavioral factors F1 and F2. This discrepancy may reflect changes that occurred concurrently with successive revisions to Japan's Pharmacist Act and adjustments to dispensing fees. Thus, the improvement in patients' understanding of their roles must be viewed not as the result of a single institutional measure but as part of the comprehensive changes in pharmacy functions brought about by a series of pharmacy policy reforms.

F3 (Identity) consists of items such as "Patients are more likely to consult pharmacists than physicians about medications" and "Pharmacists are greater experts on medications than physicians". This factor assesses the social status of pharmacy as a profession and the perception of the expertise of pharmacists relative to physicians. Unlike F1 and F2, F3 measures professional identity—a highly abstract concept—rather than behavior. This difference in characteristics is also important when considering their relationship to pharmacy policy reforms. Revisions to the Pharmacists Act and changes to dispensing fees mandate and promote specific professional practices, such as providing information and monitoring medication adherence, which may have a direct impact on the understanding of F1 and F2. Meanwhile, professional identity—specifically, how pharmacists are perceived as professionals compared to physicians—has not changed rapidly because of changes in the legal system. In this study, although an interaction between year and group was observed in F3, no significant differences were detected in the post-hoc comparisons after Bonferroni correction. These results indicate a lack of sufficient evidence to clearly identify differences between specific time points.

These results indicate that changes in pharmacist roles facilitated by pharmacy policy reforms may be reflected, to some extent, in shifts in patient perceptions of these roles. Specifically, the convergence of perceptions observed in behavioral aspects, such as communication and assessment of patients' conditions, suggests that the involvement of pharmacists is becoming more visible to patients and is being recognized as a healthcare service. This shift in perception could enhance the alignment between patients' healthcare needs and professional services. In other words, a clearer understanding of the pharmacist's role by patients may encourage behavioral changes that lead to the appropriate utilization of the pharmacists' expertise. This, in turn, could improve the effectiveness of healthcare delivery. On the other hand, the unaltered perceptions regarding professional identity (F3) suggest that pharmacy policy reforms alone have limitations in transforming patients' overall cognitive structures. Therefore, a higher degree of alignment between healthcare needs and professional services can be achieved through long-term initiatives, such as patient education and shaping social perceptions, in addition to institutional interventions.

The results of this study suggest that the changes in role perception observed during periods of pharmacy policy reform vary depending on their nature. Pharmacy policy reforms related to specific work practices may be associated with behavior-based role perception through the services experienced by patients, whereas perceptions regarding professional identity may depend on long-term and multifaceted factors.

This study demonstrates the importance of distinguishing between behavioral and identity-based aspects of role perception and offers insights for future institutional design and professional education.

Limitations

This study had several limitations. First, this was a repeated cross-sectional study, not a longitudinal study that tracked the same individuals over time. Therefore, changes over time reflect population-level trends, and it is not possible to draw direct inferences regarding changes in individual perceptions or causal relationships. Furthermore, the uneven intervals between surveys (2014, 2017, and 2023) require caution when interpreting the patterns of change over time.

Second, due to the instability of the factor structure, we excluded the “family or regular pharmacist” item (Q10) used in previous studies^[17, 18]. Consequently, this study did not assess this specific role dimension directly. However, the refined measurement model allowed for more stable tracking of changes over time. Communication (F1) and Understanding the Patient’s Condition (F2) are fundamental elements of the primary care pharmacist’s function, and improvements in these areas may reflect an enhancement of the “primary care function” in a broader sense.

Third, we applied the factor structure established based on data from the patient group as a reference model for the entire sample. Although using the cognitive structure of patients—recipients of medication counseling—as a reference has theoretical validity, it may not fully capture the cognitive structure specific to pharmacists.

Fourth, although the analysis was adjusted for age and sex as covariates, other potentially influential factors such as educational background, work history, health status, and frequency of pharmacy visits were not controlled for. Furthermore, self-report questionnaires may be subject to social desirability bias and response-pattern effects.

Fifth, this study employed an online survey using a web-based platform for both patients and pharmacists. Patient participants were screened to ensure that they regularly picked up medications at community pharmacies, whereas pharmacist participants were screened to ensure that they were currently engaged in dispensing duties at community pharmacies. Both groups were recruited to match the Japanese population distribution and ensure geographic representativeness. However, this methodology has several limitations common to both groups. Because the sample was limited to individuals with internet access and digital literacy, certain population segments, such as low-income individuals or those unfamiliar with technology, may have been systematically excluded. In addition, although the respondents were actual pharmacy users and practicing pharmacists, the online panel recruitment method differed from in-person or site-based recruitment methods. Online panel participants who voluntarily participated in the survey may have different characteristics from those recruited through traditional methods, such as higher health literacy (patients), stronger professional engagement (pharmacists), and greater interest in healthcare topics. Furthermore, online self-administered questionnaires completed at home or outside the workplace may elicit different response patterns than face-to-face surveys conducted in pharmacy settings, where

service experiences and professional contexts are more pronounced. For pharmacists, online panel recruitment may not fully represent the diversity of practice settings, workplace environments, or professional attitudes of the broader pharmacist population. These methodological differences may limit the comparability of the results with those of studies using pharmacy- or workplace-based recruitment and face-to-face data collection.

Despite these limitations, this study makes a significant contribution by systematically examining changes in the perceptions of the roles of patients and pharmacists using a large sample with confirmed measurement stability across three time points.

Methods

Study Design and Data Collection

This repeated cross-sectional study was designed to examine changes in the perceptions of the roles of patients and pharmacists around the time of the amendment to the Pharmacists Act. We conducted an online survey with the same content at three different points in time: 2014 (just before the legal amendment), 2017 (approximately three years after the 2014 amendment came into effect), and 2023 (approximately three years after the 2019 amendment came into effect)^[17, 18]. Although similar surveys were conducted in 2021 and 2022, this study excluded those data from the analysis to isolate the effects of the COVID-19 pandemic—a unique social circumstance—and evaluate the medium- to long-term impacts of pharmacy policy reforms. Furthermore, both 2017 and 2023 were surveyed approximately three years after the revised law came into effect, ensuring temporal symmetry for comparisons before and after the reform. The survey methodology and questionnaire items were identical to those described previously^[17, 18]. This analysis utilized data from previous reports^[17, 18] and added new data from 2019 following the institutional reform.

Survey Participants and Methodology

The study population comprised patients and pharmacists registered as panelists at an online research firm (Rakuten Insight Inc., Tokyo, Japan). Patients were defined as individuals aged 20 years or older who regularly visited pharmacies, whereas pharmacists were defined as individuals aged 24 years or older who worked in community pharmacies and dispensed medications.

The survey recruited 1,000 patients and 800 pharmacists and was conducted from September 8 to 15, 2023. The sex ratio was set at 1:1, and Japan was divided into eight regions, with respondents allocated based on the population ratio from the Basic Resident Register.

Survey Items

We used a 12-item questionnaire based on role theory, as described in previous reports^[17, 18] (Supplementary Table S1). Responses were rated on a 5-point Likert scale (1: strongly disagree to 5: strongly agree).

Data Selection and Cleaning

Patients and pharmacists who selected the same answer for every item were excluded because they provided insincere responses. For pharmacists, we further verified the year of license acquisition and the name of the Minister of Health, Labour and Welfare at the time of acquisition; respondents for whom there was a discrepancy were excluded.

Statistical Analysis

We adopted the factor structure model of patient perceptions of the pharmacist's role (F1: Q01–Q03; F2: Q07, Q08; F3: Q11, Q12) obtained from previous studies^[17, 18] as a reference. We verified the model fit using confirmatory factor analysis across all years and groups. We calculated the following fit indices: Comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Good model fit was defined as $CFI \geq 0.95$, $TLI \geq 0.95$, $RMSEA \leq 0.06$, and $SRMR \leq 0.08$ ^[19].

The internal consistency of each factor was assessed using Cronbach's alpha.

Factor scores were calculated as a simple average (mean item score) of the items comprising each factor, as shown below:

- - F1 (Communication) = $(Q01 + Q02 + Q03) / 3$
- - F2 (Assessment of the patient's condition) = $(Q07 + Q08) / 2$
- - F3 (Identity) = $(Q11 + Q12) / 2$

We conducted a two-factor analysis of covariance (ANCOVA) for each factor to examine the effects of year and group, adjusting for age and sex. We examined the main effect of group using ANCOVA to assess the overall difference in perceptions between the pharmacist and patient groups and the main effect of Survey Year to assess changes in perceptions over time. Additionally, we used the Survey Year $\times$ Group interaction to determine whether the discrepancy between the two groups changed over the course of the survey period. When the interactions were significant, we conducted pairwise comparisons based on the estimated marginal means to examine the differences between survey years within each group. We applied Bonferroni correction to control for Type I errors associated with multiple comparisons. The effect size was calculated using partial η^2 (partial eta squared). As no directly comparable effect sizes were available from previous research in this field, we adopted Cohen's η^2 criteria (0.01 = small, 0.06 = moderate, 0.14 = large) in accordance with Richardson^[20, 21]. We used Cohen's d as the effect size for pairwise comparisons and interpreted it according to established criteria (0.2 = small, 0.5 = medium, 0.8 = large)^[21].

All statistical analyses were performed using R version 4.2.0 (R Foundation for Statistical Computing, Vienna, Austria) with a two-sided significance level of 5%. The lavaan and car packages were used for confirmatory factor analysis and ANCOVA, respectively.

Ethical considerations

All participants voluntarily participated in this study and provided consent after reviewing the information provided online. Informed consent was obtained online. However, written informed consent was not obtained. We explained to the respondents that their responses would be handled in accordance with Rakuten Insight's privacy protection guidelines, and that the collected data would be anonymized in accordance with Rakuten Insight's privacy policy, ensuring that it could not be linked to any personal information. This study was conducted in accordance with the "Ethical Guidelines for Life Science and Medical Research Involving Human Subjects" of the Ministry of Education, Culture, Sports, Science and Technology. This study was approved by the Human Medical Ethics Committee of Josai University (Approval No. 2023-06).

Declarations

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Competing interests

The authors declare no competing interests.

Author Contribution

NT and SO conceptualized and designed the study. NT was responsible for data acquisition. NT and AY performed statistical analyses. NT, AY, NH, SO, JM, DK, and SO assisted in the interpretation of the results and drafted the manuscript. NT prepared the first draft of the manuscript. All authors contributed to the interpretation of the data and revision of the manuscript and approved the final draft.

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Data availability statement

The research datasets generated during and analyzed during the current study are not publicly available due of contractual and ethical restrictions. Permission from the data provider and the corresponding author may be required to use the data.

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Figures

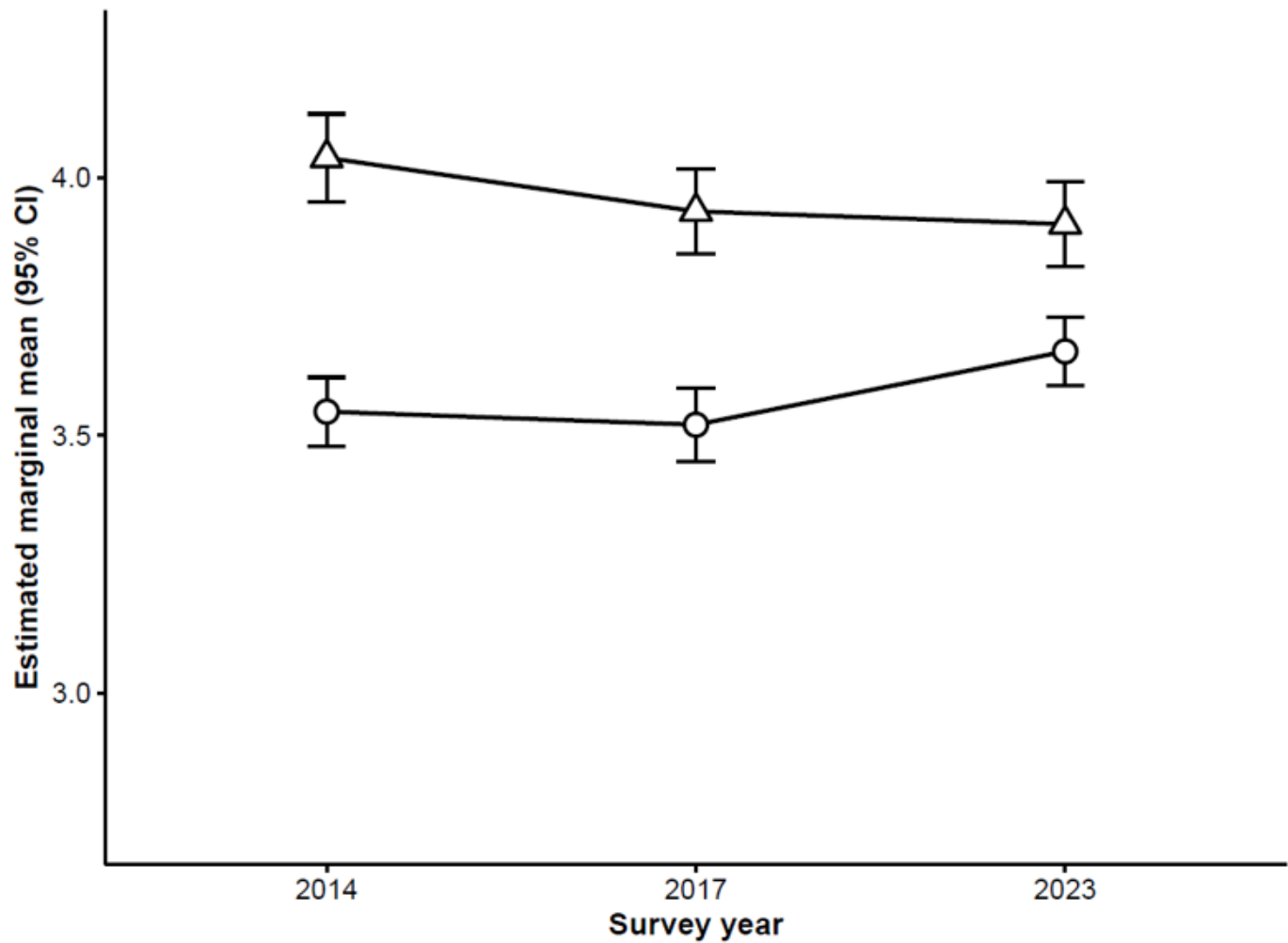


Figure 1

Estimated marginal means of F1 (Communication) scores for patients and pharmacists across survey years, adjusted for age and sex.

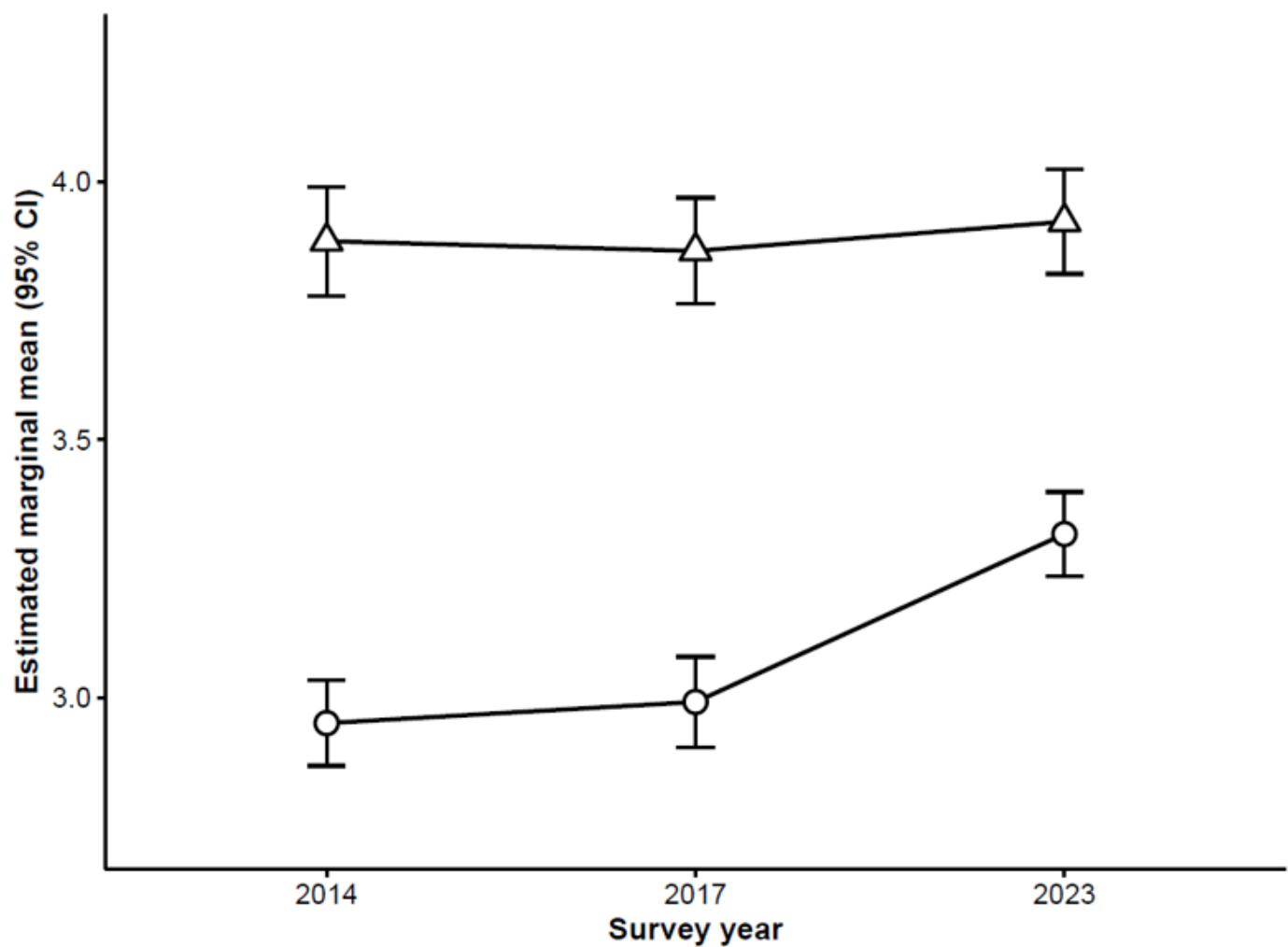


Figure 2

Estimated marginal means of F2 (Assessing the patient's condition) scores for patients and pharmacists across survey years, adjusted for age and sex.

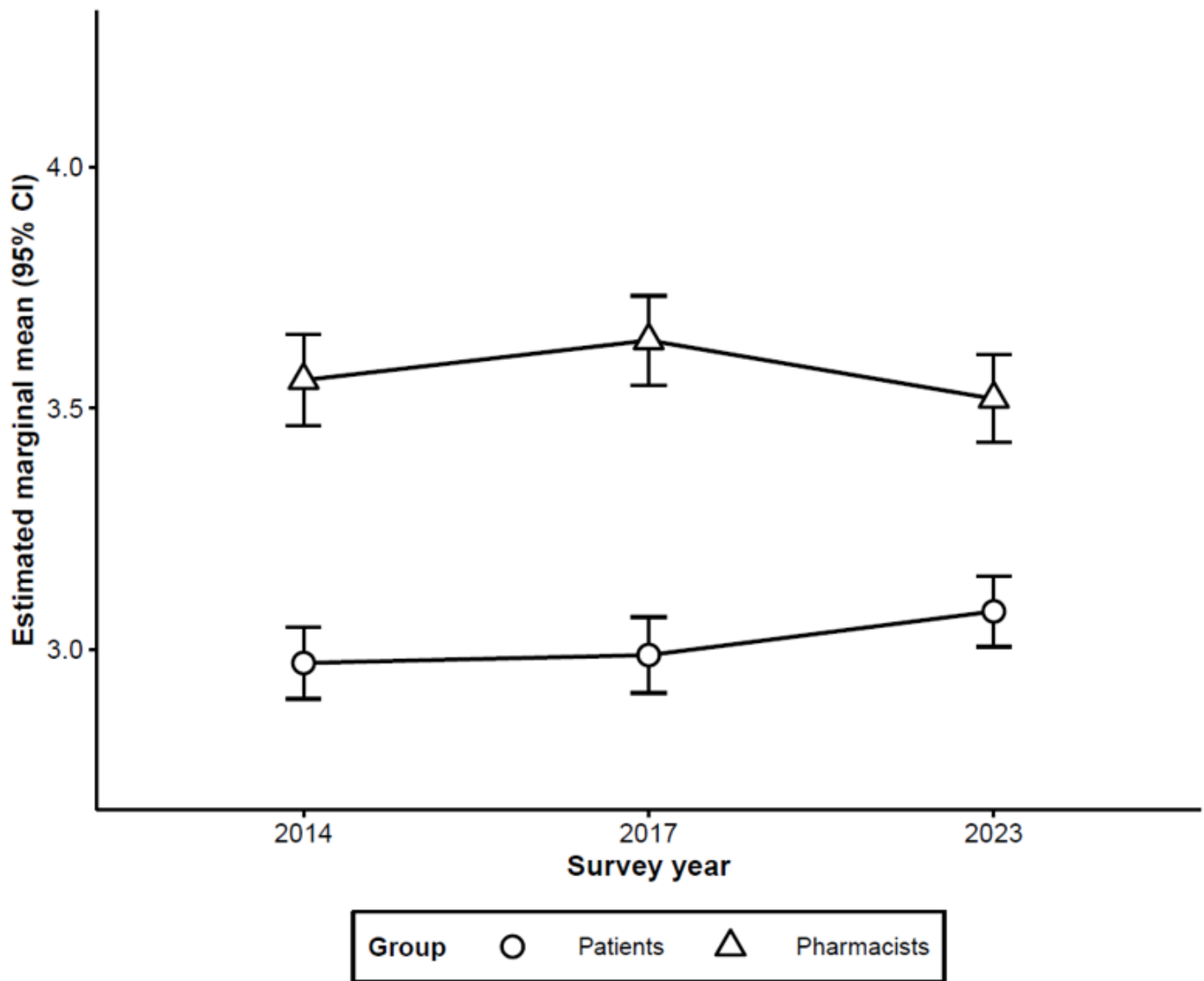


Figure 3

Estimated marginal means of F3 (Identity) scores for patients and pharmacists across survey years, adjusted for age and sex.

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