



# Assessing forgetfulness and polypharmacy and their impact on health-related quality of life among patients with hypertension and dyslipidemia in Greece during the COVID-19 pandemic

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Accepted: 14 June 2021 / Published online: 22 June 2021  
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## Abstract

**Purpose** We estimate the association between forgetfulness to take medications as prescribed and polypharmacy and health-related quality of life (HRQoL) among a cohort of patients with hypertension, dyslipidemia or both in Greece during the COVID-19 pandemic.

**Methods** A telephone survey of 1018 randomly selected adults was conducted in Greece in June 2020. Participants were included in the survey, if they (a) had a diagnosis of hypertension, dyslipidemia or both and (b) were on prescription treatment for these conditions. HRQoL was calculated using the short form (SF) -12 Patient Questionnaire. A multivariable generalized linear regression model (GLM) was used to estimate the association between forgetfulness and polypharmacy and HRQoL, controlling for sociodemographic and health-related covariates.

**Results** Overall, 351 respondents met the inclusion criteria, of whom 28 did not fully complete the questionnaire (response rate: 92%,  $n = 323$ ). Of those, 37% were diagnosed with hypertension only, 28% with dyslipidemia only, and 35% with both. Most reported good to average physical (64.1%) and mental health (48.6%). Overall, 25% indicated that they sometimes forget to take their prescribed medications, and 12% took two or more pills multiple times daily. Total HRQoL score was 68.9% (s.d. = 18.0%). About 10% of participants reported paying less attention to their healthcare condition during the pandemic. Estimates of multivariable analyses indicated a negative association between forgetfulness (− 9%, adjusted  $\beta$ : − 0.047, 95% confidence interval − 0.089 to − 0.005,  $p = 0.029$ ), taking two or more pills multiple times daily compared to one pill once a day (− 16%, adjusted  $\beta$ : − 0.068, 95% confidence interval − 0.129 to − 0.008,  $p = 0.028$ ) and total HRQoL.

**Conclusion** Our results suggest that among adult patients with hypertension, dyslipidemia or both in Greece, those who forget to take their medications and those with more complex treatment regimens had lower HRQoL. Such patients merit special attention and require targeted approaches by healthcare providers to improve treatment compliance and health outcomes.

**Keywords** Polypharmacy · Forgetfulness · Quality of life · Hypertension · Dyslipidemia · Patient reported outcomes

## Introduction

Hypertension and dyslipidemia are among the most common chronic conditions worldwide and approximately one in every three adults has either or both medical conditions [1–3]. Over the past 30 years, the prevalence of hypertension has increased almost two-fold globally, while the number of deaths attributed to elevated cholesterol has increased by around 910,000 from 1990 to 2017, and similar trends have also been observed in Greece [4–6]. High cholesterol and blood pressure impair quality of life and cause more than 10 million deaths worldwide or 17% of total deaths and are equivalent to almost 87 million disability adjusted life years annually [7–10]. They also result in aggravated economic

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burden, due to treatment costs for managing these conditions, lost productivity and other economic costs [11].

There is regional heterogeneity in the prevalence of hypertension and dyslipidemia, attributed to population sociodemographic, clinical, and cultural characteristics [1–3]. For example, the traditional Mediterranean diet which is habitual among the Greek population has been associated with significant reductions in total mortality and incidence of cardiovascular events with improvements in overall health status [12, 13]. Official guidelines and treatment practice, ranging from prescribed medications to lifestyle and dietary instructions, often consider and adjust for local population characteristics to meet diverse needs and to improve health outcomes [14].

Although the efficacy of existing treatments for hypertension and dyslipidemia has long been established in reducing mortality and morbidity and improving quality of life, more than half of patients treated for these conditions in Greece fail to achieve the targeted outcomes [15]. In addition, adherence to prescribed medications for these conditions, particularly when patients are treated with multiple medications, remains poor in everyday practice, thus impacting the real-world effectiveness of treatments [15–20].

Medication adherence refers to the degree of conformity to provider recommendations about day-to-day treatment with respect to timing, dosage, and frequency [21]. Inadequate medication adherence or non-adherence is mostly driven by forgetfulness, limits treatment outcomes and fails to improve or maintain a patient's health status, thus adversely affecting patients' health, productivity, health expenditures, and recourses' use [17, 20–27]. Multiple studies have indicated a positive association between increased medication adherence and quality of life and patient-centered outcomes [22–29]. In contrast, polypharmacy, which refers to the administration of multiple drugs at the same time, has been associated with lower quality of life [30–32]. However, there is some variation in outcomes depending on the disease-type, the population, and the setting analyzed [33].

Adherence is also related to patients' access to medications. Country-level economic and healthcare system capacity critically affect treatment patterns and access and adherence to medications across different settings. In Greece, prescription medications are reimbursed by the National Organization for Health Care Services Provision (EOPYY) and patients shoulder a co-payment (0% for life-threatening diseases, 10% for specific chronic diseases, 25% for all other) plus an out-of-pocket payment of the difference between health insurance contribution (defined according to available generic medications) and the retail price of pharmaceuticals [34]. Such co-payments are overall low, as Greece has among the lowest medication prices across the European Union, calculated as the average of the two lowest

prices in the Euro zone [34]. This, combined with universal health insurance coverage and a high number of community pharmacies (88 per 100,000 individuals; highest across the OECD25 countries) help alleviate access and financial barriers and thus achieve and maintain high rates of medication adherence compared to other countries [35].

Beyond these considerations, the ongoing COVID-19 pandemic has profoundly disrupted healthcare provision and access to medications globally and adversely affected quality-of-life. Evidence in the United States and Latin America suggests that 8% to 16% of patients reported missing one or more doses of a prescription medicine during the pandemic [36, 37]. In contrast, studies conducted in other settings found no particular changes in medication adherence during the pandemic [38, 39].

In Greece, shelter in place orders were supplemented with the universal roll out of electronic prescriptions that substituted the need to visit a physician to renew a prescription for a chronic health condition. Additionally, the job-retention policy adopted by the Greek government during the pandemic, where monthly stimulus checks in the form of cash transfers were provided to workers on the condition of maintaining their employment and the prohibition of layoffs, mitigated large-scale unemployment, and maintained health insurance coverage [40]. To our knowledge, no study has provided evidence on the rates of forgetfulness and polypharmacy and their impact on health-related quality of life (HRQoL) among patients with hypertension and/or dyslipidemia in the era of COVID-19 pandemic in Greece.

This study explores forgetfulness to take medications as prescribed and polypharmacy and estimates their association with HRQoL among adult patients with hypertension and/or dyslipidemia in Greece during the COVID-19 pandemic era. The results of this study expand and update the current evidence on the impact of forgetfulness to take medications and polypharmacy on HRQoL in an era where healthcare has received significant attention from the public. Providing such evidence might be helpful and guide healthcare providers and policymakers to tailor interventions towards enhancing adherence with important societal, economics, and health-related implications.

## Methods

### Data and study sample

We conducted a cross-sectional telephone survey with 1,018 randomly selected individuals in June 2020 in Greece. We included patients who (a) were diagnosed with hypertension, dyslipidemia, or both, (b) received prescribed medication(s) for these conditions, (c) were 18 years of age or older and (d) were fluent in the Greek language. The survey was

designed by the researchers of the study and distributed by a commercial company working in the field of demographic surveys. The process was supported by computer-assisted telephone interviewing (CATI) specialized software. A multistage selection process was used to randomly select participants proportionately among the 13 administrative regions in Greece. De-identified data were collected for all participants after obtaining informed consent for participation in the study.

### Outcome measure

The outcome measure of interest was patient HRQoL. To calculate HRQoL, we used the short form (SF) -12 patient questionnaire in Greek language which is a psychometric, multidimensional, generic measure of HRQoL that has been empirically established across multiple chronic conditions [41–43]. The SF-12 is a reduced form of the SF-36, a standardized questionnaire to assess patient health, which has proven equally reliable and thus more convenient to use and also validated in Greek language [42, 43]. The SF-12 contains 12 questions across 8 dimensions of health and can be used to produce total HRQoL scores, physical component HRQoL scores, and mental health component HRQoL scores. We adjusted the SF-12 to calculate all three HRQoL scores using percentage points, ranging from 0 (lowest) to 100% (highest).

### Main independent variable

The main determinants of HRQoL were self-reported adherence to medications and polypharmacy. There are multiple scales that are currently used to measure medication adherence [44]. Among those, the most common question identifies patients' forgetfulness to take their medication and is considered the major cause of non-adherence. As such, we chose to use only this question, particularly due to the heterogeneity of existing questionnaires. We asked patients the following question as dichotomous "Do you sometimes forget to take your prescribed medication(s)?" In the absence of a unanimous definition of polypharmacy and since we focused on two chronic conditions, we asked patients to report how many different pills they were currently taking daily for each condition to measure disease and treatment complexity (polypharmacy). The measure was categorical and included three mutually exclusive categories, namely use of one pill once a day, one pill multiple times a day or more than one pill multiple times daily.

### Covariates

We obtained sociodemographic characteristics, and health related information, which were used as controls in our

analysis. Sociodemographic characteristics included participants' age, gender, income, area of residence, and education. Health related information included self-reported physical and mental health status, whether the respondent had at least one additional chronic condition, smoking status, regular exercise, alcohol use and dietary habits, which was assessed using a dichotomous question on the consumption of more than five portions of fruits and vegetables weekly. Finally, given the growing evidence on patients' foregoing or postponing healthcare services and necessary treatments during the COVID-19 pandemic, we further obtained information on participants behavior during the pandemic [36, 45]. In particular, we asked patients to report changes in their attention to their healthcare condition during the COVID-19 pandemic, phrased as "How did your attention to your healthcare condition change during the pandemic?" and measured as 'Decreased attention', 'No change', 'Increased attention'.

### Statistical analysis

We initially performed a descriptive analysis to summarize characteristics and information of participants using percentages for categorical and dichotomous variables and means and standard deviations for numeric variables. We similarly analyzed and calculated the HRQoL scores. To estimate the association between forgetfulness and polypharmacy and HRQoL, we used a multivariable generalized linear regression model, controlling for all covariates including the type of diagnosis. Because the outcome variable (HRQoL) was potentially skewed, we initially performed a Shapiro–Wilk test to assess the normality of the distribution. The test indicated a non-normal distribution and we used Tukey's ladder of power for transformations to specify the appropriate adjustment. The test supported the use of squared values for the HRQoL variable, which was used in this form in the multivariable analysis. We included geographic level fixed-effects to control for time-invariant unobserved heterogeneity. We also controlled for the type of chronic condition and standard errors were robust to heteroskedasticity. We further tested for multicollinearity using the variance inflation factor. Finally, we conducted supplemental analyses as robustness checks, with physical and mental health HRQoL scores as outcomes variables separately. All statistical analyses were conducted in Stata (version 16.1; StataCorp, College Station, TX).

## Results

### Descriptive characteristics of study population

A total of 351 respondents met the inclusion criteria. Of those 28 did not fully complete the questionnaire. This

resulted in 323 participants as the final analytic sample (response rate: 92%). Table 1 presents sample characteristics (Table 1). About 37% were diagnosed and currently received prescribed medications for hypertension, 28% for dyslipidemia and about 35% for both conditions. The majority were males (55.1%), 65 years of age or older (40.9%), with average or higher income (65.3%) and resided in urban areas (70.0%). Most had never smoked or were former smokers, while 7.9% reported daily consumption of alcohol. Consumption of more than 5 portions weekly of fruits and vegetables was reported by 57.0%, whereas physical activity (exercise) was balanced.

In terms of self-reported physical and mental health, the majority described their health as good or average across both dimensions (physical: 64.1%; mental: 48.6%). However, 11.5% and 9.9% considered their physical and mental health as bad or very bad, respectively. More than one-third of participants (39.9%) reported having an additional chronic condition.

Most participants (73.7%) indicated that their treatment included one pill once a day, and 12.4% reported using two or more pills multiple times daily (Table 2). About one quarter (25.1%) revealed that they sometimes forget to take their prescribed medications. In terms of respondents' changes in attention to their healthcare condition during the pandemic, the majority reported no change in their behavior (67.8%), while 22.6% reported increased and 9.6% decreased attention.

### Health-related quality of life findings based on the SF-12 patient questionnaire

Table 3 presents the self-reported HRQoL assessment (Table 3). Total score was 68.9% (standard deviation = 18.0%), while results were similar for the physical component (69.3%, s.d. = 22.3%) and mental component (68.7%, s.d. = 19.0%) subscores. Limitations in moderate activities and climbing stairs were reported by 27.2% and 59.1% of patients respectively. Almost one in every four participants revealed that they accomplished less (25.7%) and that they were limited in work or other activities (25.1%) because of their physical health, while 8.7% never or rarely had a lot of energy during the past four weeks. About 40% indicated pain had a small to an extreme impact on their normal work. In terms of emotional health, 26.6% accomplished less and 21.0% were less careful during work or other activities due to emotional problems, 12.7% rarely or never felt calm and peaceful, and 5.3% very often or always felt downhearted and blue during the past 4 weeks. About 8% of patients reported facing issues with social activities very often or constantly due to their physical or mental health.

**Table 1** Descriptive characteristics of participants ( $n = 323$ )

	Participants $n = 323$ Percentage (%)
Hypertension	37.1
Dyslipidemia	27.9
Both	35.0
Gender	
Male	55.1
Female	44.9
Age groups	
25 to 54	29.7
55 to 64	29.4
$\geq 65$	40.9
Area of residence	
Urban	70.0
Rural	30.0
Education	
Lower than high school	19.2
High school	33.1
University	36.5
Masters/doctoral	11.2
Income	
Lower than average	34.7
Average or higher	65.3
Additional comorbidity (at least one)	
No	60.1
Yes	39.9
Smoking status	
Never smoked	32.8
Former smoker	36.2
Current smoker	31.0
Exercise (30 min/day or 3 h/week)	
No	28.8
Yes, but less than 3 h/week	33.4
Yes, 3 h/week or more	37.8
Alcohol consumption	
No	45.6
Occasionally	46.5
Daily	7.9
Fruit and vegetables consumption (more than 5 portions/week)	
No	43.0
Yes	57.0
Self-reported physical health	
Bad/very bad	11.5
Good/average	64.1
Very good/excellent	24.4
Self-reported mental health	
Bad/very bad	9.9
Good/average	48.6
Very good/excellent	41.5

**Table 2** Forgetfulness, polypharmacy, and changes in attention to the healthcare condition during the pandemic

	Participants <i>n</i> = 323 Percentage (%)
Do you sometimes forget to take your prescribed medication(s)?	
No	74.9
Yes	25.1
Number of pills/times/day for each condition	
One pill once a day	73.7
One pill multiple times daily	13.9
More than one pill multiple times daily	12.4
How did your attention to your healthcare condition change during the pandemic?	
Decreased	9.6
Did not change	67.8
Increased	22.6

### Multivariable generalized linear regression findings

Estimates of the multivariable generalized model indicated a statistically significant and negative association between forgetfulness to take prescribed medications and total HRQoL, with patients who forgot to take their medication having 6.1 percentage points lower HRQoL (coefficient =  $-0.047$ , 95% confidence interval—CI  $-0.089$  to  $-0.005$ ,  $p=0.029$ ) (Table 4, Fig. 1). Decreased total HRQoL was also observed in patients who took more than one medication multiple times daily compared to those who took one pill once a day, with an absolute difference of 11.5 percentage points (coefficient =  $-0.068$ , 95% CI  $-0.129$  to  $-0.008$ ,  $p=0.028$ ). Similar results were obtained in the supplemental analyses for the physical and mental health components separately. Behavioral changes in participants attention to their healthcare condition during the pandemic were not statistically significant.

Additional covariates that were positively associated with HRQoL included better self-reported physical and mental health status compared to those who perceived their physical and mental health as bad or very bad ( $p < 0.001$  for all), and regular exercise for more than 3 h/week compared to those who did not exercise (coefficient =  $0.059$ , 95% CI  $0.013$ – $0.104$ ,  $p=0.011$ ). Finally, daily alcohol consumption, and female gender were negatively associated with HRQoL.

### Discussion

The results of our study indicate that forgetfulness to adhere to prescribed medications and taking more than one pill multiple times daily were negatively associated with HRQoL ( $-9\%$  and  $-16\%$  lower respectively) among a nationally representative cohort of patients who were diagnosed and received prescription medication treatment for hypertension, dyslipidemia, or both in Greece. These findings are

supported by previous studies and suggest that, since these conditions can be effectively controlled and treated through medication therapy, increased compliance and less complex treatment regimens result in improved clinical outcomes, and, thus, reduce or eliminate symptoms which in turn improve functioning and HRQoL [22–32, 46–48].

In our study, one in every four patients indicated that they forget to take their medication as prescribed. This finding is encouraging since it is lower than estimates found in other studies, where 36% to 70% of patients reported forgetting to take their medications, while Greek patients were found to be among the least compliant patients across nine European countries [19, 49–51]. We note that this result might be related to the large share of patients who reported paying more attention to their healthcare condition during the COVID-19 pandemic, in the context of affordable medications in Greece, providers' ability to issue prescriptions electronically and updated legislation to subsidize and protect employment and social health insurance during the pandemic. This highlights the positive effects of such policies on population health as well as patients' willingness to improve their quality of life.

However, about 10% of participants reported paying less attention to their health condition during the pandemic. Although we did not observe any significant association between patients' changes in attention to their healthcare condition during the pandemic and HRQoL, HRQoL was relatively lower for those who reported decreasing attention to their condition. There is currently growing literature on patients' foregoing or postponing necessary healthcare services during the pandemic [36, 45]. In Greece, such an impact has been mitigated by effective measures implemented from the breakout of COVID-19, which have sustained affordability, enabled safe access to care and upheld insurance coverage.

The self-reported HRQoL was around 16% lower among patients on treatment with multiple pills daily

**Table 3** Health-related quality of life results using the 12-item Short Form Survey (SF-12) patient questionnaire results using the 12-item Short Form Survey (SF-12) patient questionnaire

	Participants <i>n</i> = 323 Percentage (%)
Total SF-12 score	68.9 (18.0)
Physical component SF-12 score	69.3 (22.3)
Mental component SF-12 score	68.7 (19.0)
In general, would you say your health is:	
Excellent	3.1
Very good	29.1
Good	45.2
Fair	18.0
Poor	4.6
Does your health now limit you in moderate activities (i.e. moving a table, pushing a vacuum cleaner)?	
Not at all	72.8
Yes, a bit	18.2
Yes, a lot	9.0
Does your health now limit you in climbing several flights of stairs?	
Not at all	40.9
Yes, a bit	41.8
Yes, a lot	17.3
During the past 4 weeks, have you as a result of your physical accomplished less than you would like?	
No	74.3
Yes	25.7
During the past 4 weeks, were you as a result of your physical health limited in the kind of work or other activities?	
No	74.9
Yes	25.1
During the past 4 weeks, how much did pain interfere with your normal work?	
Not at all	59.4
A little bit	19.8
Moderately	11.5
Quite a bit	5.9
Extremely	3.4
During the past 4 weeks, did you have a lot of energy?	
Never	1.6
Rarely	7.1
Sometimes	25.1
Often	34.4
Very often	20.1
Always	11.8
During the past 4 weeks, have you as a result of your emotional problems accomplished less than you would like?	
No	73.4
Yes	26.6
During the past 4 weeks, have you as a result of your emotional problems not done work or other activities as carefully as usual?	
No	79.0
Yes	21.0
During the past 4 weeks, have you felt calm and peaceful?	
Never	2.2
Rarely	10.5
Sometimes	26.9
Often	29.4
Very often	18.9

**Table 3** (continued)

	Participants <i>n</i> = 323 Percentage (%)
Always	12.1
During the past 4 weeks, did you feel downhearted and blue?	
Never	37.8
Rarely	19.2
Sometimes	25.4
Often	12.4
Very often	3.7
Always	1.6
During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (visiting friends, relatives etc.)?	
Never	0.0
Rarely	65.6
Sometimes	10.2
Often	16.7
Very often	5.0
Always	2.5

compared to those with one pill once a day, consistent with previous work [30–32]. However, forgetfulness, decreased attention, and complex treatment regimens and polypharmacy are modifiable, through targeted interventions. Multiple studies have explored such interventions and their outcomes on quality-of-life [22, 52, 53]. Most of the initiatives that have positively impacted treatment compliance focus on establishing a good patient-provider relationship, patients' education and counselling tips, shared-decision making and patient input on treatment choices, and adherence feedback [18, 20, 22, 52, 54–56]. Except for patient-provider communication, utilizing novel technological tools such as mobile-phone-based automated medication reminder systems have also proven effective in improving medication adherence [57, 58].

Our results also indicate the importance of lifestyle interventions to improve patients' HRQoL. Regular exercise and decreased alcohol consumption were significantly associated with higher HRQoL, similar to previous work [59]. Other characteristics and factors associated with impaired HRQoL in our study, such as female gender, and worse self-perceived mental and physical health, are in line with findings from several previous studies [60–62]. The association between gender differences and HRQoL could be attributed to the fact that men might be better able to tolerate chronic diseases [60]. Finally, worse physical and mental health status and alcohol use negatively influence daily activities which is reflected in the HRQoL outcomes, as expected.

## Limitations

Our findings are based on self-reported survey data, and may thus be prone to report, recall, and social desirability biases. Second, our estimates regarding the prevalence of both conditions might underestimate the actual prevalence of hypertension and/or dyslipidemia in Greece. However, undiagnosed or asymptomatic patients do not receive treatment for these conditions, which was an inclusion criterion for our study, and, thus, do not affect our results. Third, the question regarding changes in attention to the healthcare condition during the pandemic did not allow us to capture potential changes in the ability to adhere or to access needed medications, which could be additional confounders. Fourth, we highlight that due to the cross-sectional study design, we cannot rule out the possibility of reverse causality between HRQoL and adherence. Despite, multiple studies, which we reference throughout, have examined variations in HRQoL as being driven by changes in adherence. Finally, we note that forgetfulness as a sole measure of adherence is indicative only of unintentional non-adherence and thus might not capture the full spectrum of other factors, such as inability to pay and limited access to providers (intentional non-adherence). Despite, forgetfulness is the most influential and commonly used question in existing and validated medication adherence scales, and thus we believe that it is a robust estimator of both overall adherence and HRQoL [44].

**Table 4** Multivariable generalized linear model estimations on the associations between patient characteristics and health-related quality of life ( $n = 323$ )

	Coefficient	95% CI	<i>p</i> value
Do you sometimes forget to take your prescribed medication(s)?			
No	Ref.		
Yes	− 0.047	− 0.089 to − 0.005	0.029
Number of pills/times/day for each condition			
One pill once a day	Ref.		
One pill multiple times daily	0.001	− 0.045–0.047	0.956
More than one pill multiple times daily	− 0.068	− 0.129 to − 0.008	0.028
How did your attention to your healthcare condition change during the pandemic?			
Decreased	Ref.		
No change	0.041	− 0.014–0.095	0.143
Increased	0.017	− 0.050–0.083	0.624
Physical health			
Bad/very bad	Ref.		
Good/average	0.131	0.070–0.192	<0.001
Very good/excellent	0.201	0.126–0.276	<0.001
Mental health			
Bad/very bad	Ref.		
Good/average	0.181	0.129–0.232	<0.001
Very good/excellent	0.301	0.242–0.359	<0.001
Additional comorbidity (at least one)			
No	Ref.		
Yes	− 0.029	− 0.068–0.010	0.146
Exercise (30 min/day or 3 h/week)			
No	Ref.		
Yes, but less than 3 h/week	− 0.006	− 0.053–0.041	0.801
Yes, 3 h/week or more	0.059	0.013–0.104	0.011
Alcohol consumption			
No	Ref.		
Occasionally	0.008	− 0.031–0.048	0.682
Daily	− 0.069	− 0.137 to − 0.002	0.044
Gender			
Male	Ref.		
Female	− 0.053	− 0.098 to − 0.008	0.022
Age groups			
25 to 54	Ref.		
55 to 64	0.018	− 0.030–0.065	0.469
65+	− 0.021	− 0.137–0.025	0.374
Area of residence			
Urban	Ref.		
Rural	− 0.030	− 0.072–0.004	0.172
Education			
University	Ref.		
Masters/doctoral	0.030	− 0.026–0.086	0.299
High school	0.025	− 0.032–0.083	0.390
Less than high school	0.040	− 0.042–0.122	0.334
Income			
Higher than average	Ref.		
Lower than average	0.024	− 0.016–0.064	0.239



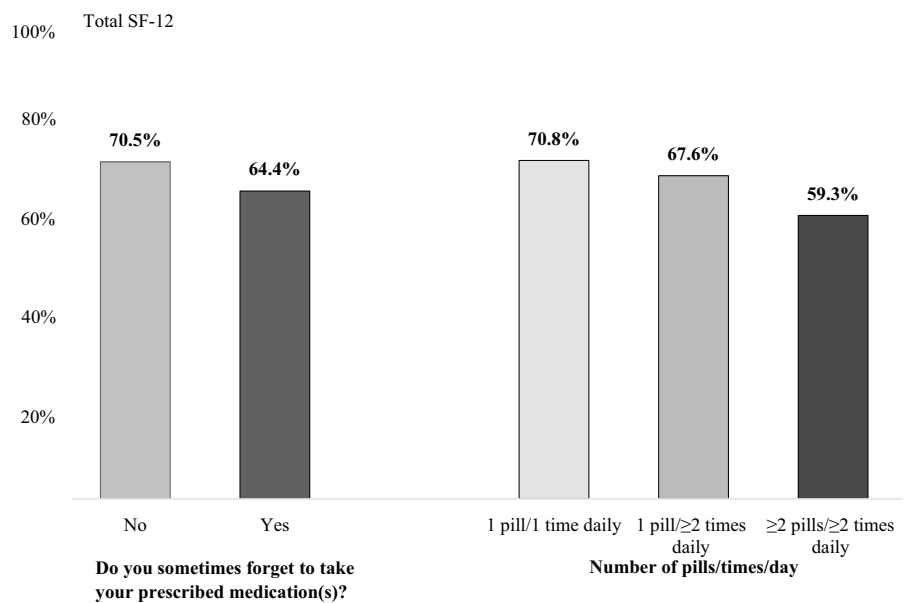
**Table 4** (continued)

	Coefficient	95% CI	<i>p</i> value
Smoking status			
Never smoked	Ref.		
Former smoker	-0.001	- 0.048–0.046	0.961
Current smoker	0.011	- 0.035–0.057	0.641
Fruit and vegetables consumption (more than 5 portions/week)			
No	Ref.		
Yes	0.014	- 0.024–0.052	0.474

The analysis controls for geographic-level fixed effects and type of condition (hypertension, dyslipidemia, both); standard errors were robust to heteroskedasticity

*CI* confidence intervals; *Ref.* reference

**Fig. 1** Association between forgetfulness and polypharmacy and health-related quality of life results using the 12-item Short Form Survey (SF-12) patient questionnaire based on the multivariable analysis. Notes: The figure is based on the estimates (predictive values) of the multivariate generalized linear model



Notes: The figure is based on the estimates (predictive values) of the multivariate generalized linear model

## Conclusion

Forgetfulness to take medications as prescribed and polypharmacy are independent factors associated with HRQoL among patients with hypertension, dyslipidemia or both in Greece. Addressing those is challenging due to the inherent complexity of individual treatment and lifestyle preferences and patient-provider relationships. Effective strategies to improve patients' HRQoL should involve patients in the decision-making processes and promote routine adherence screening and consultation, tailored at individual patient needs.

**Funding** This study was funded by Servier Hellas. The study results were not contingent on the sponsor's approval or censorship of the manuscript.

**Data availability** Data are available upon request.

## Declarations

**Conflict of interest** The authors declares that they have no conflict of interest.

**Ethical approval** All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by an independent research ethics committee of the Health Policy Institute, Athens, Greece.

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