



# Assessment of the association between drug disposal practices and drug use and storage behaviors



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## ABSTRACT

**Objective:** Keeping unnecessary drugs at home is a situation showing both causes and consequences of irrational use of medicine. This study aimed to evaluate the approaches of a company's employees regarding drug storage, use, and disposal.

**Method:** This online-based descriptive study was held in a multi-centered private-sector company in a voluntary basis. The survey assessing participants' drug handling and storage behaviors was answered by 1121 employees from across eight provinces of Turkey in 2016. Main outcome measures were storage and disposal of unused/unwanted drugs at home in a rational way.

**Results:** The percentage of participants who declared that they keep unused/unwanted drugs at home was 28.0%. About one-third of participants disposed their unused/unwanted drugs via the "garbage, sink, toilet, etc.". Participants  $\geq 30$  years old and living with  $< 4$  household members significantly tended to bring their unused/unwanted drugs to the company's drug-box. Nearly half of all participants (46.5%) started a recent change in their disposal behavior. The vast majority of participants (94.6%) who previously took drugs back to the company's drug-box stated that they either had, or would, help their contacts adopt such behaviors. These participants were also significantly less likely to dispose of drugs inappropriately, practice self-medication, be unaware of expired drugs at home, or fail to store drugs according to the labelling.

**Conclusion:** While our findings showed that a substantial number of participants still had unused drugs at home and disposed of them inappropriately, it is understood that they started to exhibit more favorable behaviors in recent years.

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## 1. Introduction

The World Health Organization defines rational use of medicine (RUM) as "patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements,

for an adequate period of time, and at the lowest cost to them and their community" (WHO, 2002). In fact, this applies to all phases of drug handling from manufacturing to disposal, hence any non-compliance during these processes could be regarded as irrational use of medicine (IUM). Keeping unnecessary drugs at home is a situation showing both causes and consequences of IUM. This unfavorable behavior predisposes to many IUM practices such as drug wastage, inappropriate treatment, resistance to antibiotics, medication errors, intoxication, drug use of insufficient duration and dose, and unnecessary self-medication (Akici and Oktay 2007; CDC, 2006; Daughton and Ruhoy, 2008; de Bolle et al., 2008; Hazell and Robson, 2015). Besides, inappropriate disposal of used drugs constitutes an additional threat for human health and ecosystems (Daughton and Ruhoy, 2008; Kusturica et al., 2017).

It is well-recognized that people often fail to exhibit proper behavior in keeping medicines at home, which should be confined

**Abbreviations:** CDC, Center for Disease Control; DTB, drug take-back; IUM, irrational use of medicine; RUM, rational use of medicine; TC, Republic of Turkey; TGB, Turkcell Global Bilgi, Inc.; US, United States; WHO, World Health Organization.

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to drugs for ongoing therapies and some over-the-counter drugs (Gracia-Vásquez et al., 2015; Jassim 2010; Kusturica et al., 2012). This confers great responsibilities to many individuals and institutions, where drug-users stay at the top. Meanwhile, several obstacles exist to overcome for proper disposal of unused/unwanted drugs. For instance, many countries including Turkey lack regulations and programs concerning appropriate management of drug waste (Kusturica et al., 2017; TC, 2005; Saygi et al., 2012; Tong et al., 2011). Despite representing the last chance for informing patients just before drug usage and handling, pharmacies in Turkey currently do not accept unused or leftover drugs, possibly due to absence of any obligatory regulation (Toklu, 2015; Saygi et al., 2012). Therefore, any pioneering activities of those companies or institutions that feel responsible, either governmental, non-governmental, or private, may help to reduce this problem. Recently, one such example was run by a private communication company, Turkcell Global Bilgi (TGB), to raise RUM awareness among its employees. This consisted of activities such as RUM training (a symposium, a distant learning course, and informative materials provided to employees), a survey about drug use behaviors, and the “take-back” of unused drugs into the drug-box within the company, where useful ones (regarded as useable by experts) were delivered to animal shelters and others were disposed with least harm to the environment. With collection of more than 14,000 packs and appropriate disposal of 560 kg of drugs, achievements of this RUM awareness-raising campaign were both presented through scientific and public meetings, attracting great attention (Kiroglu et al., 2016).

This study aimed to evaluate the approaches of the company employees regarding drug storage, use, and disposal and to compare these by their “participation to drug waste management activities” status.

## 2. Method

This cross-sectional study consisted of a 14-item questionnaire, which was implemented with voluntary completion of web-based online forms by TGB company employees in late February 2016. TGB is one of Turkey’s leading call center companies, serving in 14 locations in Turkey with over 12,000 employees. Representing almost each geographic region, the survey was carried out in eight locations (five of which were from five different metropolises) of Turkey, where the relevant number of employees in each local office was taken into account.

The questionnaire, delivered to 5200 employees in these 8 locations and completed by 1121 participants (response rate: 21.6%), comprised demographic characteristics followed by questions regarding attitudes and habits of drug use and storage at home, self-medication, and unused drug handling. Survey data was compared by one of the unused drug handling approaches, namely “prior action of drug taking-back to company’s drug-box ever [DTB(+)] or never [DTB(-)]”, and by their demographic characteristics.

Participants were included to the survey on a voluntary basis. Due to the web-based nature of the study and ease of participation, verbal consent was obtained from employers during various sessions of RUM activities. Participants were informed that an online survey was issued as part of RUM activities and its main findings might be published in scientific media. Among all participants, those who replied to the survey were accepted and documented as those who gave consent to the study.

Data were analyzed through Microsoft Excel and SPSS 11.5 Statistics Pack software. Chi-square test was used for detection of any association between demographic or other relevant approaches. Statistical significance was set at a  $p$  value of  $<.05$ .

## 3. Results

There were a total of 1121 participants with a mean age of  $28.5 \pm 5.1$  (range: 18–49), 781 of whom were women (69.7%). Almost half of the participants (49.4%) were living with  $<4$  household members.

Participants declaring “not to keep unused drugs at home” were 31.0%, while those “keeping such drugs” and “failing to remember present condition” were 41.0% and 28.0%, respectively. Handling of unused drugs showed a balanced distribution among participants such that 32.1% declared “to bring them to drug-box of the company”, 34.0% “to give them to a health facility such as pharmacy, family health center, hospital, etc.”, and 33.9% “to dispose them to garbage, sink, toilet, etc.” Nearly half of participants (46.5%) stated a behavioral change in this manner in recent years. While 45.9% of participants stated that they did not keep expired drugs, the rest either had such drugs or failed to remember whether they had or not. Participants who stated a recent change in their self-medication behaviors constituted 39.6%, of which 79.1% declared that they gave up purchasing drugs without prescription.

A total of 320 participants (28.6%) declared that they previously took drugs back to the company’s drug-box during the 2 years of RUM awareness campaign. The vast majority of these participants (94.6%) claimed either to have helped people to develop such attitudes or to affirm to help them when possible (Fig. 1). Comparison of drug take-back status by demographic characteristics showed significantly higher rates of DTB(+) behavior among participants of  $\geq 30$  years old and living with  $<4$  household members, compared to those  $<30$  years old and living with  $\geq 4$  household members. No gender difference was found in this behavior (Table 1).

When keeping unused drugs at home was compared by drug take-back status, more participants among DTB(+) group had this attitude than that in DTB(-) group. Handling of unused drugs also differed significantly according to drug take-back status ( $p < .001$ ). While only 7.3% of DTB(+) participants declared that they disposed unused drugs to garbage, sink, toilet, etc., this was 44.8% for the DTB(-) group. Additionally, significantly more DTB(-) participants (40.2%) did not know whether or not they had expired drugs at home, compared to 24.1% in the DTB(+) group (Table 2).

The presence of a recent change in self-medication behavior was also significantly influenced by drug take-back status, where more participants in DTB(+) group reported a change in last 2 years compared to that of DTB(-) group (47.2% vs 36.6%, respectively;  $p = .001$ ). Among those claiming such behavioral change, 88.7% of DTB(+) participants gave up purchasing drugs without prescription, compared with 74.1% of DTB(-) participants ( $p < .001$ ), (Fig. 2).

Drug take-back status also affected the recent change of participants’ attitudes regarding unused drug handling, where more DTB(+) participants (79.7%) declared the presence of such change compared to those in the DTB(-) group (33.2%). Behavior-changers in these two groups also demonstrated a statistically significant difference ( $p < .001$ ), which was led by more participants in the DTB(+) group who started to bring unused drugs to the company’s drug-box. Similarly, the percentage of those who started to store drugs according to its instructions for use were found to be higher in the DTB(+) group than in the DTB(-) group (40.0% vs 28.0%, respectively,  $p < .001$ ), (Table 3).

Participants’ drug usage habits were also compared by their demographic characteristics. Gender stratification showed that more women kept unused drugs at home compared to men (44.6% vs 32.7%,  $p < .001$ ). In addition, a higher percentage of women declared to change their unused drug handling practice (49.9%) than that among men (38.5%,  $p < .001$ ). Other variables reviewed in the survey showed no gender difference.

When keeping unused drugs at home was compared by age groups, it was found that more participants in  $<30$  years old group

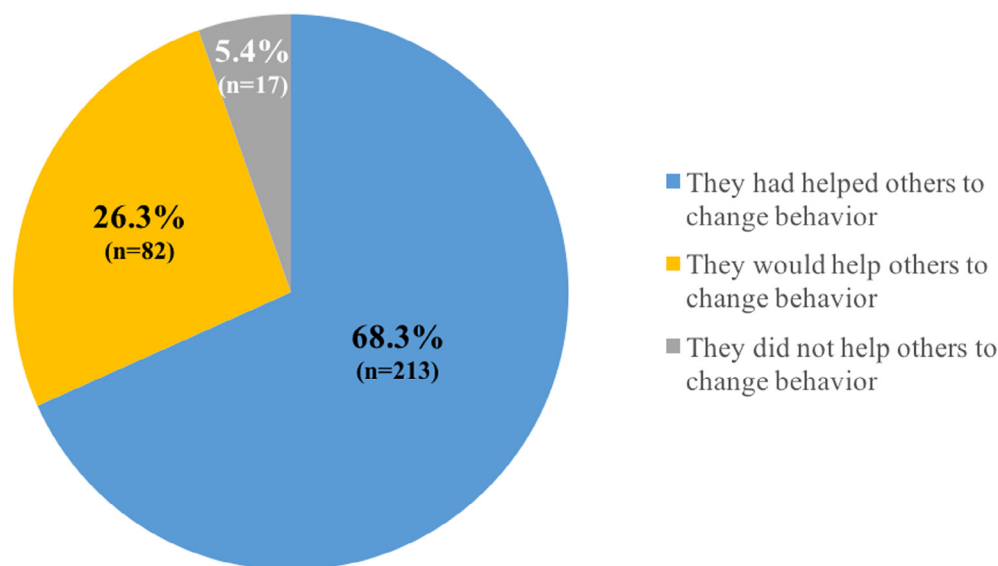


Fig. 1. Behaviors of participants who previously took back drugs to the company regarding encouraging their contacts in favor of such behavior.

**Table 1**  
Comparison of participants' drug taking-back behaviors by their demographic characteristics.

Parameter		Total		Drug take-back (+)		Drug take-back (-)		Statistics
		n	%	n	%	n	%	
Sex	Male	340	30.3	89	27.8	251	31.3	$\chi^2$ : 1.3 P > .05
	Female	781	69.7	231	72.2	550	68.7	
	Total	1121	100.0	320	100.0	801	100.0	
Age group	<30 years	706	63.0	141	44.1	565	70.5	$\chi^2$ : 68.7 P < .001
	≥30 years	415	37.0	179	55.9	236	29.5	
	Total	1121	100.0	320	100.0	801	100.0	
Household members	<4 people	554	49.4	186	58.1	368	45.9	$\chi^2$ : 13.6 P < .001
	≥4 people	567	50.6	134	41.9	433	54.1	
	Total	1121	100.0	320	100.0	801	100.0	

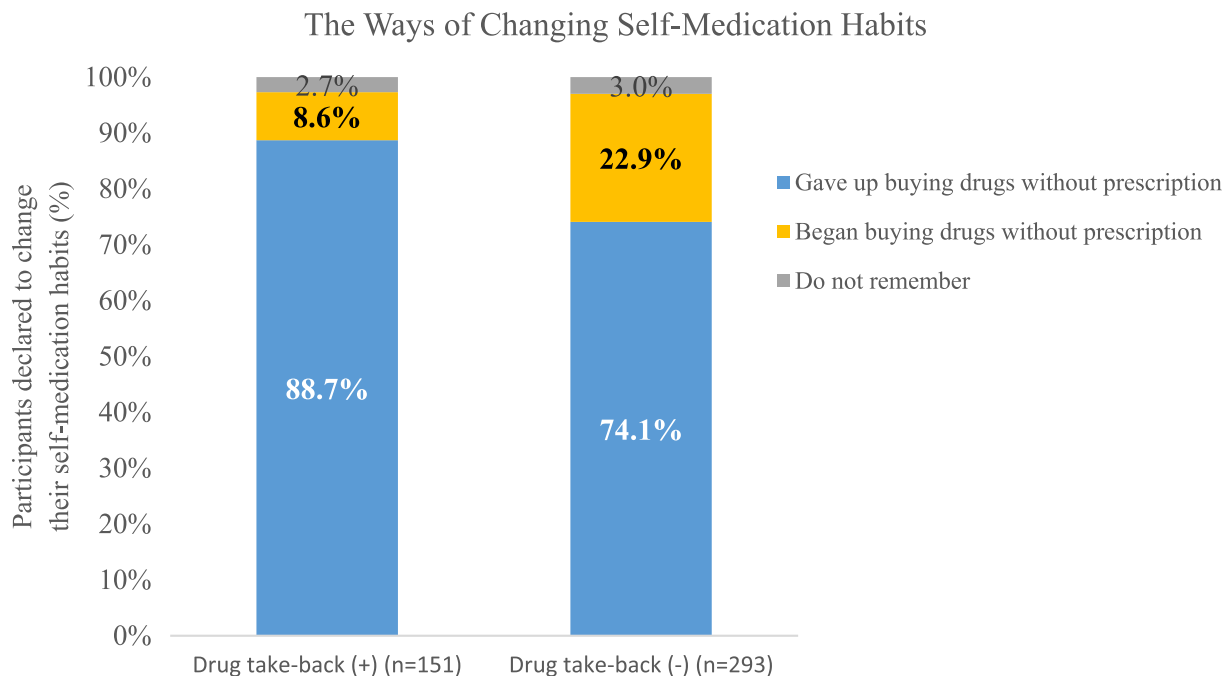
**Table 2**  
Comparison of participants' drug taking-back behaviors by their drug keeping attitudes at home.

Parameter		Total		Drug take-back (+)		Drug take-back (-)		Statistics
		n	%	n	%	n	%	
Do you have unused or unwanted drugs at home?	Yes	459	41.0	174	54.4	285	35.5	$\chi^2$ : 40.3 P < .001
	No	348	31.0	92	28.8	256	32.0	
	Do not know	314	28.0	54	16.8	260	32.5	
	Total	1121	100.0	320	100.0	801	100.0	
How do you handle unused or unwanted drugs? <sup>a</sup>	Return to health facility	398	34.0	42	12.3	356	42.9	$\chi^2$ : 516.8 P < .001
	Throw into garbage, sink, toilet, etc.	397	33.9	25	7.3	372	44.8	
	Bring to company's drug-box	377	32.1	275	80.4	102	12.3	
	Total	1172	100.0	342	100.0	830	100.0	
Do you have expired drugs at home?	Yes	208	18.5	75	23.4	133	16.6	$\chi^2$ : 26.8 P < .001
	No	514	45.9	168	52.5	346	43.2	
	Do not know	399	35.6	77	24.1	322	40.2	
	Total	1121	100.0	320	100.0	801	100.0	

<sup>a</sup> Multiple choices allowed.

“did not know presence of any unused drugs at home” than that among ≥30 years old group (34.5% vs 16.9%,  $p < .001$ ). These groups also differed in their unused drug handling behavior such that participants ≥30 years old were significantly more likely to bring unused drugs to the company's drug-box, compared to those <30 years old (46.2% vs 27.0%,  $p < .001$ ), (Table 4). Age groups examined in the study had no influence on self-medication habits or presence of expired drugs at home.

The number of household members was shown to affect several aspects of the participants' attitudes. Significantly less people living with <4 members were found to be unaware of the presence of any unused drugs at home compared with those living with ≥4 members (16.9% vs 34.5%,  $p < .001$ ). The percentage of those giving unused drugs to the company's drug-box were significantly higher among participants living with <4 members compared to those living with ≥4 members (37.3% vs 27.1%,  $p < .001$ ). Similarly,



**Fig. 2.** Comparison of self-medication habits among participants that declared to change their such habits by drug take-back status;  $p < .001$  ( $\chi^2$ : 14.0) between the groups.

**Table 3**

Comparison of participants' drug taking-back behaviors by their recent change of drug handling and storage attitudes.

Parameter		Total		Drug take-back (+)		Drug take-back (-)		Statistics
		n	%	n	%	n	%	
Have you changed your unused or unwanted drug handling habits in last 2 years?	Yes	521	46.5	255	79.7	266	33.2	$\chi^2$ : 198.6 $P < .001$
	No	600	53.5	65	20.3	535	66.8	
	Total	1121	100.0	320	100.0	801	100.0	
How did you change your way of unused or unwanted drug handling? <sup>a</sup>	Started to bring to company's drug-box	313	47.6	236	81.9	54	19.4	$\chi^2$ : 225.3 $P < .001$
	Started to return to a health facility	185	28.2	25	8.7	130	46.7	
	Gave up throwing into garbage, sink, or toilet, etc.	119	18.1	26	9.0	75	27.0	
	Started to throw into garbage, sink, or toilet, etc.	29	4.4	1	0.4	12	4.3	
	Gave up returning to a health facility	10	1.5	-	-	6	2.2	
	Gave up bringing to company's drug-box	1	0.2	-	-	1	0.4	
	Total	657	100.0	288		278		
Have you changed your habit regarding drug storage per label in last 2 years?	Yes	352	31.4	128	40.0	224	28.0	$\chi^2$ : 15.4 $P < .001$
	No	769	68.6	192	60.0	577	72.0	
	Total	1121	100.0	320	100.0	801	100.0	

<sup>a</sup> Multiple choices allowed.

people living with <4 members were significantly less likely to be unaware of the presence of any expired drugs at home than those living with  $\geq 4$  members (42.5% vs 28.5,  $p < .001$ ), (Table 4). Household member strata did not reveal any statistically significant difference in terms of self-medication, unused drug handling, or drug storage.

#### 4. Discussion

One of the common practices of IUM is use of drugs by any individual other than the prescribed person. Keeping unused and/or expired drugs at home precipitates many IUM practices in this respect. While unused drugs may mainly increase self-medication tendency and the risk for pediatric toxicity due to storing in inappropriate places, expired drugs pose toxicity risk and threaten human and environmental health due to inappropriate drug waste and disposal practices (CDC, 2006; Daughton and Ruhoy, 2008; de Bolle et al., 2008; Hazell and Robson, 2015;

Kusturica et al., 2017). National or local drug take-back programs run in different countries in order to tackle these unfavorable outcomes gained acceptance by the public with important achievements (Coma et al., 2008; Ekedahl, 2006; Lauer et al., 2010; Perry et al., 2014; Persson et al., 2009; Thach et al., 2013). In our study, although a substantial number of participants were seen to keep unused/unwanted drugs at home and dispose them inappropriately, some of them started to exhibit and spread favorable changes in their behaviors.

Presence of unused drugs at home is a widespread entity throughout the world, varying between 15 and 98% (Abuquah et al., 2014; Dias-Ferreira et al., 2016; Jassim, 2010; Kusturica et al., 2012; Persson et al., 2009; Seeheusen and Edwards, 2006; Vellinga et al., 2014). While 41.0% of participants in our study declared to keep unused drugs at home, 28.0% of participants was not aware of unused drug status at home. A nationwide study performed by Turkish Social Security Institution in 2013 reported that participants did not consider using 42.7% of the drugs they were keeping (Dogukan et al., 2015). Another study performed in

**Table 4**

Comparison of participants' drug keeping and handling attitudes by their age group and number of household members.

Parameter	Total		Age Group				Household Members			
			<30 years		≥30 years		<4 people		≥4 people	
	n	%	n	%	n	%	n	%	n	%
<i>Do you have unused or unwanted drugs at home?</i>										
Yes	459	41.0	251	35.6	208	50.1	258	46.6	201	35.5
No	348	31.0	211	29.9	137	33.0	188	33.9	160	28.2
Do not know	314	28.0	244	34.5	70	16.9	108	19.5	206	36.3
Total	1121	100.0	706	100.0	415	100.0	554	100.0	567	100.0
Statistics					$\chi^2: 43.6, P < .001$		$\chi^2: 39.8, P < .001$			
<i>How do you handle unused or unwanted drugs?<sup>a</sup></i>										
Return to health facility	398	34.0	283	36.6	115	26.9	167	29.0	231	38.8
Throw into garbage, sink, toilet, etc.	397	33.9	282	36.4	115	26.9	194	33.7	203	34.1
Bring to company's drug-box	377	32.1	179	27.0	198	46.2	215	37.3	162	27.1
Total	1121	100.0	774	100.0	428	100.0	576	100.0	596	100.0
Statistics					$\chi^2: 61.4, P < .001$		$\chi^2: 17.6, P < .001$			
<i>Do you have expired drugs at home?</i>										
Yes	208	18.5	112	16.0	96	23.1	112	20.2	96	16.9
No	514	45.9	316	44.8	198	47.7	284	51.3	230	40.6
Do not know	399	35.6	178	25.2	121	29.2	158	28.5	241	42.5
Total	1121	100.0	706	100.0	415	100.0	554	100.0	567	100.0
Statistics					$\chi^2: 3.6, P > .05$		$\chi^2: 24.0, P < .001$			

<sup>a</sup> Multiple choices allowed.

the same year reported 72.0% of participants keeping drugs at home (Ozdinc et al., 2015). An earlier study showed that 61.3% of participants had leftover drugs at home (Gocgeldi et al., 2009). Keeping unused drug was also analyzed in terms of demographic characteristics. Since this behavior has been mainly analyzed at household level so far, there's a scarce amount of data focusing on gender differences. Among them, while an Irish study showed no gender differences, another in Uganda reported that women were more likely to keep unused drug at home (Ocan et al., 2014; Vellinga et al., 2014). Our finding that women more commonly exhibited this attitude may contribute to the literature by identifying scope for new research focusing on gender-specific features.

Apart from keeping too many and unnecessary drugs at home, being unaware of the presence of drugs at home could be regarded as an unfavorable attitude due to its potential risks. In our study, 28.0% of participants exhibited such an attitude, being significantly more common in those <30 years old and those living with ≥4 members. This may be explained by a lesser need of young individuals for drug treatment and the reduced probability of an individual's awareness on drugs used by other people in crowded households, with a consequent difficulty of recalling this during the survey.

About one-third of our participants appeared to practice inappropriate drug disposal behavior according to their statement of throwing unused drugs to the garbage waste, sink, toilet, etc. A study in the United States (US) reported that 85.0% of participants threw their drugs to trash, sink, or toilet (Law et al., 2015). A Serbian study in 2010 revealed that 87.9% of participants disposed their unused drugs to garbage or toilet (Kusturica et al., 2012). Another study performed in Ireland reported that 72.0% of participants disposed their unused drugs through inappropriate ways, mainly household waste, sink, or toilet (Vellinga et al., 2014). On the other hand, disposal of unused drugs into waste bin was reduced to 3% after disposal awareness campaigns in Sweden, where a drug take-back policy already existed (Persson et al., 2009). The probability that some participants in our study were affected by the RUM awareness campaign within last two years might explain the lower rates observed in our study compared to mostly published literature. Indeed, those who received information about safe disposal of medications were reported to be >four-fold more likely to return unused drugs or expired drugs to

a pharmacy compared to those who never received such information (Owens and Anand, 2009).

Handling of unused drugs was influenced by some demographic characteristics, where the attitude of drug take-back to company's drug-box was exhibited significantly more in ≥30 age group and those living with <4 members, albeit with no apparent gender difference. A US study reported a higher percentage of women disposing of unused drugs or expired drugs into toilet or sink and a lower tendency to throw such drugs into the garbage with increasing age (Owens and Anand, 2009). A Saudi study in 2015 showed that men exhibited a lower responsibility to find the proper way of disposing drugs and willingness to return these to collection facilities, and that these two habits were significantly more likely to seen with increasing age (Al-Shareef et al., 2016). While these findings partially imply an association between drug disposal management and age, no such association could be established in terms of gender. In fact, an Irish study reported no gender difference with respect to inappropriate disposal of unused drugs (Vellinga et al., 2014). Besides, this was observed to be more commonly adopted by young people, consistent with our findings.

In order to possess appropriate drug waste management behavior, people are expected to be motivated by considering benefits over costs, from receiving relevant information, and developing and maintaining new habits (Pieters, 1991). Particularly, information about hazardous household material and introduction of appropriate occasions for waste collection help people to take action (Cassel, 2008). For instance, drug collection events supported by national awareness campaigns in Sweden were reported to reduce the percentage of people who stated to throw their unused drugs to a waste bin (Persson et al., 2009). In our study, 28.6% of participants declared that they previously took drugs back to the company's drug-box. When drug take-back status was analyzed by demographic characteristics, while gender was not a distinctive factor, this attitude was found to be more common among ≥30 age group and those living with <4 members. Consistently, when current handling of unused drugs was questioned, taking back of unused drugs to a company's drug-box were more commonly adopted by these two groups. In this context, it could be suggested that participants start to convert their previous positive drug take-back experience into a habit. This is further supported by the finding that DTB(+) participants were >six-fold less likely to throw their drugs into waste bin, sink, or toilet, compared to DTB

(–) group. Moreover, it was further evidence that DTB(+) participants who claimed a change in their unused drug handling were about 2.5-fold more than that of DTB(–) group. A difference was also present among these behavior-changers, with a higher tendency of DTB(+) group's behavior towards drug take-back to company's drug-box. Further, participants adopting storage of drugs per instructions for use were significantly more common in DTB(+) group (40.0%) compared to DTB(–) group (28.0%). This may be explained by the reflection of positive action, which is intended to increase awareness about healthy behavior, and towards other indirectly-related positive attitudes.

Wellness programs at worksites were reported to both improve health parameters like physical exercise and body mass index and reduce unfavorable behaviors like smoking and alcohol consumption (Osilla et al., 2012). Various models and methods at individual, interpersonal, and public level may be used for adoption and dissemination of healthy behaviors. Focusing a particular group is one instance of mobilization of the community to a desired modified behavior (Murphy, 2005). For instance, a Senegal study showed that nutritional education intervention given to grandmothers led to positive changes at young mothers' nutrition practices at both family and public level (Aubel et al., 2001). Correspondingly, an awareness-raising activity supported by theoretical knowledge could be disseminated by transfer of the affected one's own experience to people around them. In fact, a great majority of the DTB(+) group (94.6%) declared that they did or would help their contacts adopt such attitudes. This may be regarded as one of the most striking and promising findings of our study. Such an approach of DTB(+) participants suggests that the positive effects of limited-source projects about rational use and appropriate disposal of medicines may be sustainable, due to the dissemination of influence and habit forming behaviors. Raising individual awareness of each person regarding appropriate use of medicines is highly encouraging. In a US study in 2011, 99.4% of respondents who participated a drug-collection program were in favor of continuance of the program (Ma et al., 2014); in another US survey about keeping unused drugs at home, 61% of participants would agree to participate in a future drug take-back program (Lystlund et al., 2014).

Self-medication is a common practice, saving time for physicians for minor symptoms, involving patients in their own treatment, and reducing costs on the health system (Hughes et al., 2001). Nonetheless, it may be associated with unfavorable outcomes like inappropriate drug use, wrong dosage, antibiotic resistance, and adverse drug reactions, and hence should only be preferred for limited conditions (Asseray et al., 2013; Eickhoff et al., 2012; Skliros et al., 2010; WHO, 2010). While studies performed in European countries (Germany, Greece, and Belgium) reported self-medication prevalence as 29.7%, 44.6%, and 56.0%, respectively (de Bolle et al., 2008; Eickhoff et al., 2012; Skliros et al., 2010), it was shown to be 78% and 80.9% in two Asian countries (Ali et al., 2010; Jassim, 2010). Near two-fifths of our participants claimed a recent change in their self-medication habits, of which 79.1% declared that they gave up buying drugs without prescription. Although a substantial number of participants did not change their self-medication habits, ranking between European and Asian countries, it is noticed that an awareness campaign is associated with positive changes in near one-third of participants. This is further supported by the finding that 88.7% of DTB(+) participants gave up purchasing drugs without prescription.

Though unused drugs at home are usually stored for future use, some of them will expire. An Irish study reported 37% of respondents as having leftover unexpired drugs at home and further 23% of them having expired prescription medicines (Wiewzorkiewicz et al., 2013). In a Portugal study, 72% of drugs at home were reported to be unused, of which 8% had expired

(Dias-Ferreira et al., 2016). Another study in US reported prevalence of expired drugs at home as 27% (Asti et al., 2012). While 18.5% of our participants stated having expired drugs at home, more than one-third of them were not aware of that. The latter may contribute to the lower prevalence of expired drugs in our study compared to the literature. Besides, in a simulated study in Turkey, none of the pharmacists counselled their patients about drug storage conditions (Toklu et al., 2010). Therefore, practices encouraging adoption of appropriate drug collection methods may help to raise such awareness. In fact, those unaware of expired drug status at home were less among DTB(+) participants than that in DTB(–) group.

Our study has some limitations. First, since the survey was completed online and based on participants' statements, status of keeping unused drug at home was not confirmed by observation. Apart from that, other household members' approaches about unused drug handling and storage were not examined. Responses to survey, particularly drug take-back status may be influenced by behaviors and attitudes of other individuals at home. Despite being a limitation, this may be investigated in future studies focusing on other household members' attitudes. In addition, there is no regulation regarding over-the-counter drug definition in Turkey. Therefore, we regarded all the medicines that were kept at home and self-medicated as prescribed medicines. However, people could buy most of the drugs from pharmacies without a prescription. This was another limitation of the study. Finally, data was collected in 10 days on late winter, and might therefore have been subject to seasonal variations to keeping drugs at home, which in turn may change recall of individuals' responses regarding drug storage and handling.

In conclusion, our findings show that a substantial number of participants still keep unused drugs at home and dispose of them inappropriately. Nevertheless, it is understood that they started to present more favorable changes in their behaviors in recent years. This may be attributed to the internal campaign within the company, featuring rational management of drug handling, storage, and disposal. In addition, it is remarkable that those exhibiting positive behaviors have a high tendency to extend such behaviors to their contacts. These model behaviors need to be taken as an example and spread across countries, which display less rational behaviors regarding the management of drug disposal.

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### Conflict of interest

The authors declare no competing or conflict of interest.

### Ethical approval

Ethical approval was not obtained since the data were fully anonymized to the authors and the items were asked to gather limited data about questioned behaviors and attitudes without violat-

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