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Patient characteristics associated with retention in an asthma self-management trial for older adults

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ABSTRACT

Objective: New self-management interventions are being developed for older adults who suffer from worse asthma morbidity than their younger counterparts, but high rates of study drop out have hampered these efforts and there is limited literature on what factors may influence retention in behavioral intervention studies with older adults. This study analyzed illness beliefs and patient characteristics that may contribute to retention in an asthma self-management trial for older adults.

Methods: This is a secondary analysis of data from a randomized controlled trial of a self-management support intervention for adults 60 years and older with persistent, uncontrolled asthma. Multivariable logistic regression was used to evaluate the association of medication and illness beliefs, and other subject characteristics with study retention, which was defined as completion of the research study interview at 6 and 12 months.

Results: The randomized trial enrolled 388 individuals; 261 (67.3%) completed the 12-month interview. Higher perceived threat of chronic diseases relative to asthma was associated with higher study retention (OR = 1.11, 95% CI = 1.00–1.24) at 12 months. Other variables including asthma beliefs, age, cognitive function, health literacy, and asthma symptoms were not significantly associated with retention.

Conclusions: Concern about non-asthma chronic conditions, but no other illness beliefs, or patient characteristics, were associated with retention in an asthma self-management support intervention. Further research, including qualitative studies, is needed to better understand why patients drop out of asthma behavioral intervention studies.

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Introduction

Over 7% of Americans ages 65 and older have asthma and they experience worse asthma morbidity than younger adults with the disease (1,2). Challenges in self-management, such as low levels of medication adherence and poor medication inhaler technique, may contribute to the higher morbidity (3). New self-management interventions for older adults with asthma have emerged in recent years (4–6), but have faced dropout rates as high as 40% (6), significantly higher than in other health behavior change trials (7). Drop out is a major concern because of the attendant risk of bias (7,8) and diminished statistical power (9). Black and Latino patients, and those with lower

incomes, have lower research participation rates (10,11). Among the individuals from these groups who do participate, there are gaps in understanding the factors that may determine why they may remain through completion of the study, as prior work has been largely focused on study enrollment and may not directly relate. These groups are known to face challenges with access to or distrust in the healthcare system and experience poorer material and psychosocial circumstances (12), significant factors in their worse disease outcomes (13). Therefore, factors that affect research engagement may also be important in the clinical context and new strategies may offer promise for both issues.

Understanding the conditions that reduce retention is a key step in addressing the problem, but there have been few and inconsistent findings on the particular factors associated with retention in asthma behavioral intervention studies among older adults. In longitudinal studies of older adults with other (non-asthma) chronic medical conditions, increasing age, cognitive impairment, comorbidities, worse overall health (14–17), and lower self-efficacy (18,19), have been associated with lower study completion. Qualitative evaluations of self-management support programs for chronic respiratory diseases have documented social support, comorbidities, less severe disease, and improved disease-specific knowledge as factors tied to increased study retention rates (20–22). These studies varied by populations, design, disease conditions, and definitions of retention, and a consistent pattern of factors associated with study retention remains absent.

One set of patient characteristics that may be an important indicator of study retention but that has yet to be studied is beliefs about illness. Among older adults with asthma, illness-related beliefs have been shown to be powerful drivers of self-management behaviors. For example, 53% of older adults with asthma have a ‘no symptoms, no asthma’ belief, wherein they believe they do not have the disease when symptoms are absent (23) and have lower adherence to medications and other self-management tasks (24). In a prior study, a lower percentage of completers of the 12-month study held similar beliefs compared to the overall enrolled population (25). An individual’s psychosocial and emotional conception of disease includes illness beliefs and prioritization, which can potentially influence both the decision to participate and remain in studies to completion. If illness-related beliefs were established to have a significant association with study retention, messaging could be crafted around these beliefs to help individuals understand the risks associated with asthma and the utility of the new interventions being tested. This could subsequently promote adherence to treatment as well as retention in clinical trials.

This study sought to investigate the factors associated with participant retention in an asthma self-management intervention trial for older adults. We specifically assessed if illness-related beliefs are associated with retention as well as other patient characteristics. Understanding predictors of study retention can help guide researchers of future asthma intervention trials to account for key factors and develop strategies to improve retention and protect against bias.

Methods

Subject and settings

Data for this study are from the Supporting Asthma Self-Management Behaviors in Older Adults (SAMBA) trial, conducted between 2014 and 2017. Details of the study methods and outcomes are reported elsewhere (6,26). English and Spanish-speaking adults ages 60 years and older with uncontrolled, moderate to severe, persistent asthma were recruited from nine New York City primary care offices. Individuals with other chronic pulmonary diseases or a smoking history greater than 15 pack-years, as well as those who were unable to speak English or Spanish, or who were not responsible for their medication administration were excluded. Study interviews were conducted in person at baseline, over the phone at 3 and 6 months, and in person at 12 months by trained bilingual research coordinators. The study was approved by the Institutional Review Board of the Icahn School of Medicine at Mount Sinai.

Participants randomized to the intervention were assigned to a care coach or community health worker (CHW) over a 12-month period. The SAMBA intervention was delivered in the primary care clinic or at one’s home and participants were not blinded to their study arm. In-person encounters between coaches and patients were scheduled at baseline, 2, 3, 8, 12, and 24 weeks with weekly telephone call follow-up every week for the first 8 weeks and monthly after until 12 months. However, each coach had flexibility in timing and number of visits to cater to each participant’s availability and wishes. The coaches were employed by the health coaching organizations and participating institutions prior to the start of the study and underwent extensive training on intervention procedures and asthma prior to working directly with patients. They used a standardized screening tool to identify barriers to patients’ self-management of asthma, for example, poor controller medication adherence due to cost concerns, then worked with the patient to address the specific barriers identified. Research coordinators and care coaches collaborated and shared patient contact information, gave patients reminders of upcoming appointments, and made repeated outreach calls to all available numbers at different time points for those who were not responsive.

Dependent variable

The primary outcome was study retention, defined as completion of the final research interview at 12 months.

Independent variables

All subject characteristics and assessment scales were collected at the initial baseline interview. The perceived seriousness of, or threat posed by the illness, may be a key factor in influencing decisions to participate and remain in a chronic illness self-management study. We assessed individuals' cognitive and emotional views of asthma with the Brief Illness Perception Questionnaire (BIPQ) (27), and higher scores represent a more threatening perception of asthma. We used four items of the illness priority domain of the Multimorbidity Illness Perceptions Scale (MULTIPLeS) that were adapted to determine how patients view the threat of asthma relative to their other chronic illnesses (28). Response options ranged from strongly disagree to strongly agree on a 4-point scale, and responses were added to calculate a total score (range 0–12), with higher scores indicating that other illnesses were of greater concern than asthma for the participant.

Other candidate factors that might predispose subjects to remain in the study include sociodemographic factors, cognition and health literacy, social support, measures of asthma control and severity, and overall health status and physical function. Cognitive ability was assessed with the Montreal Cognitive Assessment (MoCA) (29). Cognitive impairment was defined as MoCA score <26. Health literacy was measured with the Newest Vital Sign (NVS) (30). We defined low health literacy as NVS score <4. Social support and isolation were measured using the Patient-Reported Outcome Measurement Information System (PROMIS) Social Support Short Form 4a (31). Higher scores indicate greater social support. Isolation was quantified with the PROMIS Social Isolation Short Form 4a (31), with higher scores indicating greater social isolation. All PROMIS instruments are reported as standardized *T* scores with a mean of 50 and standard deviation of 10 as compared to the general US population.

Quality of life was assessed with the Mini Asthma Quality of Life Questionnaire (mAQLQ), which covers the domains of asthma symptoms, activity restrictions, emotional function, and environmental stimuli (32). Scores <4.7 indicate low quality of life. Asthma symptoms were measured with the Asthma Control Test (ACT) (33). ACT scores ≤19 indicate uncontrolled asthma. The number of ER visits and overnight hospitalizations for asthma in the previous 12 months reflect severity of asthma symptoms. Overall patient health was assessed *via* PROMIS Global Health 10 scale (34), in which higher scores indicate better

overall health. Physical function was determined by the PROMIS Physical Function Short Form 4a (35), with lower scores indicating physical impairment.

Statistical analysis

Study participant characteristics were described with counts and percentages for categorical variables and means and standard deviations for continuous variables with normal distribution or median and inter-quartile range (IQR) for non-normal distribution. The values were compared for unadjusted associations between the retention and attrition groups by Pearson's chi-square statistic for categorical variables and independent *t*-tests or Wilcoxon rank-sum test as indicated. Within the attrition group, demographic characteristics of those that actively dropped out of the study were compared to those who were lost to follow-up.

For multivariable models, we included variables with $p < .25$ for their association with retention in the univariate analyses. The multivariable logistic regression modeling assessed retention at 12 months (primary model) and 6 months (secondary models) between all study participants and in subgroups with individuals split by control and combined intervention study arms. In exploratory analyses, we modeled retention in the clinic-based and home-based intervention arm subgroups. For each variable included in the model, we reported odds ratios and 95% confidence intervals. All analyses were conducted with SAS version 9.4 (SAS Institute Inc., Cary, NC).

Results

There were 1346 patients assessed for eligibility: 403 met eligibility criteria and were randomized to a study arm, and 388 individuals received the specified intervention (control, home-based, or clinic-based). There were 184 subjects who met eligibility criteria but declined. The mean and standard deviation of age was 67.6 (SD ± 7.4) and 17.8% were 75 or older (Table 1). Males constituted 15% of study participants, 23.7% were married or had a life partner and most identified as Black (30.7%) or Hispanic (55.9%); 42% had low health literacy. Most participants (87.6%) had uncontrolled asthma.

Overall, 261 of 388 individuals (67.3%) completed the 12-month study. The retention rate at 12 months was 72.5% for the control group and 64.5% for the combined intervention group (58.9% for the clinic-based intervention arm, 70.3% for the

Table 1. Characteristics of study participants, by study retention and attrition.

Characteristic	Total (n=388)	Retention (n=261)	Attrition (n=127)	p
Age, mean (SD)	67.6 (7.4)	67.4 (7.5)	68.1 (7.0)	.37
Age, n (%)				.20
60–64	175 (45.1)	126 (48.3)	49 (38.6)	
65–74	144 (37.1)	91 (34.9)	53 (41.7)	
≥75	69 (17.8)	44 (16.9)	25 (19.7)	
Male sex, n (%)	58 (15.0)	44 (16.9)	14 (11.0)	.13
Married or partner, n (%)	92 (23.7)	61 (23.4)	31 (24.4)	.82
MoCA score < 26, n (%)	334 (86.1)	222 (85.1)	112 (88.2)	.40
NVS score < 4, n (%)	163 (42.0)	115 (44.1)	48 (37.8)	.24
BIPQ, mean (SD) ^a	39.8 (12.0)	39.5 (11.6)	40.5 (12.8)	.47
MULTIPLEs – prioritization scale, median [IQR] ^b	7.0 [3.0]	7.0 [3.0]	6.0 [4.0]	.05
Race/ethnicity, n (%)				.38
White, non-Hispanic	29 (7.5)	16 (6.1)	13 (10.2)	
Black, non-Hispanic	119 (30.7)	77 (29.5)	42 (33.1)	
Hispanic	217 (55.9)	152 (58.2)	65 (51.2)	
Other	23 (5.9)	16 (6.1)	7 (5.5)	
Education level, n (%)				.13
Less than high school	161 (41.5)	113 (43.3)	48 (37.8)	
High school graduate	81 (20.9)	54 (20.7)	27 (21.3)	
Some college	84 (21.7)	60 (23.0)	24 (18.9)	
College graduate	62 (16.0)	34 (13.0)	28 (22.1)	
Limited English Proficiency, n (%)	141 (36.3)	98 (37.6)	43 (33.9)	.48
Monthly household income < \$1350, n (%)	259 (66.8)	180 (69.0)	79 (62.2)	.19
PROMIS social support, mean (SD)				
Informational ^c	52.7 (11.9)	52.8 (11.9)	52.4 (11.7)	.73
Emotional ^d	53.2 (9.7)	53.5 (10.0)	52.7 (9.0)	.49
Social isolation ^e	44.7 (10.7)	44.3 (10.8)	45.4 (10.4)	.37
mAQLQ score < 4.7, n (%)	243 (52.8)	161 (61.9)	82 (64.6)	.61
ACT score ≤ 19, n (%)	339 (87.6)	223 (85.4)	116 (92.1)	.07
ED visit past 12 months, n (%)	146 (37.6)	95 (36.4)	51 (40.2)	.48
Hospitalization past 12 months, n (%)	52 (13.4)	38 (14.6)	14 (11.0)	.34
PROMIS global physical health, mean (SD)	40.6 (6.4)	40.7 (6.5)	40.4 (6.1)	.64
PROMIS global mental health, mean (SD)	43.8 (8.6)	43.8 (8.5)	43.6 (8.8)	.78
PROMIS physical function, mean (SD) ^f	38.3 (8.3)	38.5 (8.5)	38.0 (7.7)	.63

MoCA, Montreal Cognitive Assessment; NVS, Newest Vital Sign; BIPQ, Brief Illness Perception Questionnaire; MULTIPLEs, Multimorbidity Illness Perceptions Scale; PROMIS, Patient-Reported Outcomes Measurement Information System; mAQLQ, Mini Asthma Quality of Life Questionnaire; ACT, Asthma Control Test; ED, Emergency Department.

^aData missing for 25 patients.

^bData missing for six patients.

^cData missing for 35 patients.

^dData missing for 36 patients.

^eData missing for 42 patients.

^fData missing for 14 patients.

home-based arm). There were 355 (91.5%) participants remaining in the study at 3 months, 337 (86.9%) at 6 months, and 261 (67.3%) at 12 months. Among the study non-completers, 33 (26.0%) participants actively dropped out, while 91 (71.6%) were lost to follow-up, designated when staff were unable to participant reach over multiple calls (and an additional 3 were deceased). While the vast majority were lost to follow-up, among those who actively chose to drop out the most frequently mentioned reasons were no longer interested in study participation, burden of time commitment, and other priorities, with 20 (60.6%) leaving before 3 months. The active drop-out rate was higher among the intervention group (11.7%) than the control (2.3%), with similar rates of loss to follow-up in the two groups.

In bivariate analysis, none of the variables was significantly associated with retention, although considering other chronic illness as a greater threat than asthma closely approached statistical significance in

its association with retention (MULTIPLEs prioritization score (median, [IQR]: retention, 7.0 [3.0] vs. attrition, 6.0 [4.0]; $p = .05$) (Table 1). In multivariable logistic regression, higher perceived relative threat of other chronic diseases over asthma (MULTIPLEs) was associated with higher odds for study retention at 12 months (OR = 1.11, 95% CI = 1.00–1.24) (Table 2). Among those who did not complete the study, the only variable with a statistically significant difference between those who explicitly reached out to leave the study and those who were lost to follow-up was mean age ((mean ± SD): Drop Out: (70.3 ± 7.7) vs. Lost to Follow-Up ((67.3 ± 6.7); $p = .04$) (Table 3).

Subgroup and exploratory analyses

In subgroup analyses of the intervention and control groups, neither prioritization of asthma nor asthma beliefs, nor other variables, were significantly associated with retention. There were no significant

Table 2. Multivariable model of study retention.

	OR (95% CI)	<i>p</i>
<i>Age categories, %</i>		
60–64 (reference)		
65–74	0.63 (0.38–1.03)	.07
≥75	0.62 (0.33–1.16)	.13
<i>Sex, %</i>		
Female (reference)		
Male	1.54 (0.78–3.03)	.21
<i>Health literacy, %</i>		
Adequate health literacy, NVS > 4 (reference)		
Low health literacy, NVS < 4	1.22 (0.77–1.93)	.39
<i>MULTIPLeS prioritization Scale, mean</i>	1.11 (1.00–1.24)	.04
<i>Education, %</i>		
High school or less (reference)		
High school graduate	0.77 (0.43–1.40)	.39
Some college	1.06 (0.57–1.96)	.85
College graduate	0.52 (0.27–1.03)	.06
<i>Monthly household income</i>		
<\$1350, %		
Income >\$1350 (reference)		
Income <\$1350	1.25 (0.76–2.04)	.38
<i>Asthma uncontrolled, %</i>		
No, ACT >19 (reference)		
Uncontrolled, ACT ≤19	0.50 (0.23–1.08)	.08

NVS, Newest Vital Sign; MULTIPLeS, Multimorbidity Illness Perceptions Scale; ACT, Asthma Control Test.

associations for any of the study variables for retention at 6 months in univariate analyses involving all study participants, and in the intervention and control arm subgroups.

Discussion

We examined potential predictors of study retention in an asthma self-management intervention trial for older adults, with a focus on beliefs about asthma and prioritization of the disease. Contrary to our expectations, patients who considered asthma a lesser threat to their health than their other chronic illnesses were more likely to remain in the study than those in whom the perceived threat was greater. Specific asthma-related beliefs pertaining to the threat of asthma were not significantly associated with retention. Moreover, other variables, including older age, low health literacy, cognitive dysfunction, and poorer asthma control were not significantly associated with retention.

Table 3. Characteristics of attrition group, by drop out and lost to follow-up.

Characteristic	Drop out (<i>n</i> = 33)	Lost to follow up (<i>n</i> = 91)	<i>p</i>
Age, mean (SD)	70.3 (7.7)	67.3 (6.7)	.04
Age, years, <i>n</i> (%)			.45
60–64	21 (63.6)	61 (67.0)	
65–74	7 (21.2)	23 (25.3)	
≥75	5 (15.2)	7 (7.7)	
Male sex, <i>n</i> (%)	2 (6.0)	12 (13.2)	.27
Married or partner, <i>n</i> (%)	7 (21.2)	24 (26.4)	.56
MoCA score < 26, <i>n</i> (%)	30 (90.9)	80 (87.9)	.64
NVS score < 4, <i>n</i> (%)	15 (45.5)	31 (34.1)	.25
BIPQ, mean (SD) ^a	41.9 (11.5)	39.9 (12.2)	.45
MULTIPLeS – prioritization scale, median [IQR]	6.0 [3.0]	6.0 [4.0]	.25
<i>Race/ethnicity, n (%)</i>			.76
White, non-Hispanic	3 (9.1)	9 (9.9)	
Black, non-Hispanic	13 (39.4)	27 (29.7)	
Hispanic	15 (45.5)	50 (55.0)	
Other	2 (6.1)	5 (5.5)	
<i>Education level, n (%)</i>			.30
Less than high school	12 (36.4)	36 (39.6)	
High school graduate	10 (30.3)	16 (17.6)	
Some college	7 (21.2)	17 (18.7)	
College graduate	4 (12.1)	22 (24.2)	
Limited English proficiency, <i>n</i> (%)	9 (27.3)	34 (37.4)	.30
Monthly household income <\$1350, <i>n</i> (%)	23 (69.7)	54 (59.3)	.30
<i>PROMIS social support, mean (SD)</i>			
Informational ^b	50.7 (10.0)	53.1 (12.4)	.34
Emotional ^c	51.8 (7.7)	53.1 (9.5)	.51
Social isolation ^d	44.2 (9.1)	46.0 (11.0)	.41
mAQLQ score < 4.7, <i>n</i> (%)	24 (72.7)	56 (61.5)	.25
ACT score ≤ 19, <i>n</i> (%)	32 (97.0)	81 (90.0)	.21
ED visit past 12 months, <i>n</i> (%)	14 (42.4)	37 (40.7)	.86
Hospitalization past 12 months, <i>n</i> (%)	4 (12.12)	10 (11.0)	.86
PROMIS global physical health, mean (SD)	40.1 (4.4)	40.5 (6.7)	.78
PROMIS global mental health, mean (SD)	42.7 (7.1)	43.9 (9.5)	.52
PROMIS physical function, mean (SD) ^e	37.0 (6.5)	38.2 (7.9)	.40

MoCA, Montreal Cognitive Assessment; NVS, Newest Vital Sign; BIPQ, Brief Illness Perception Questionnaire; MULTIPLeS, Multimorbidity Illness Perceptions Scale; PROMIS, Patient-Reported Outcomes Measurement Information System; mAQLQ, Mini-Asthma Quality of Life Questionnaire; ACT, Asthma Control Test; ED, Emergency Department.

^aData missing for 14 patients.

^bData missing for seven patients.

^cData missing for six patients.

^dData missing for six patients.

^eData missing for one patient.

The association of lower perceived relative threat of asthma with retention is in contrast to theories of health behavior and prior observations in the literature. The MULTIPLeS measure encompasses the cognitive conceptualization of disease as well as accompanying emotional and psychological effects and fits within the consequences domain of the Common Sense Model, which evaluates an individual's perception of illness severity (36). Previous work with this model among cancer survivors has shown negative illness perceptions, including a greater concern for consequences are associated with higher healthcare follow-up (37). Relatedly, patients who have less concern about the threat of their asthma or hypertension tend to have poorer medication adherence (24,38). In qualitative studies, those who have a lower concern for the consequences of their diabetes or chronic lower respiratory disease are less motivated to participate in self-management programs (17,39). Findings from our analyses suggest that the association of illness perceptions with self-management behaviors does not directly extrapolate to extended participation in self-management support intervention studies. The impact of illness beliefs like these may also be in determining who declines participation as 184 eligible individuals did in this study and is an area to explore in future work.

Overall, we did not find a consistent picture for the association of other variables with study retention. Prior research has reported associations of advanced age (e.g. >75 years) (14,16), worse symptoms and poor disease control with lower rates of study retention (14,17). Those and the other variables were not associated with retention in our analyses, whether patients were in the treatment or usual care arms of the study. These observations, in combination with the inconsistent findings of illness beliefs and perception of relative illness threat, indicate that more research is needed to understand patients' motivations for remaining in, or dropping out of behavioral intervention studies. Such research may need to involve qualitative methods applied to both study completers and drop-outs to draw new information to improve retention in behavioral intervention studies. This work could be informative as well for supporting retention in clinical programs outside of the research context.

Two asthma self-management intervention studies for older adults reported higher study retention rates. Goeman et al. reported over 90% remained in a personalized educational intervention study at 12 months (4) and the Baptist et al. (5) trial of a self-regulation intervention had retention rates of 93% at 6 months and 90% at 12 months. Heterogeneity of patient

characteristics across studies may have accounted for the differences in retention between these studies and the SAMBA trial, with the former including higher income, better educated, largely White and less ill patients with asthma in comparison to the generally low-income, predominantly Black and Latino subjects with poorly controlled asthma included in the SAMBA trial. Previous research has found lower rates of research engagement among individuals who identify as Black and Latino (10,40) as well as those who have less formal education (18) or lower health literacy (41).

Furthermore, the homogeneity of the study population within the SAMBA trial is important to note. Among the total study population, many of the characteristics including female sex (82% vs. 89%), presence of cognitive deficits (85% vs. 88%), and uncontrolled asthma (85% vs. 92%) had very high prevalence and little variation between those who did complete or did not complete the study. The lack of variance may explain why we were unable to observe statistically significant differences in our analysis of these characteristics between groups.

While low-income and ethnic minority populations have higher rates of asthma and worse outcomes, they have traditionally been underrepresented in research studies in part due to challenges with recruitment and retention (42). The lack of representation of these groups may be a hindrance in translating research findings into effective interventions tailored to those who are most affected and mitigating disparities in asthma. In the SAMBA study, patient stakeholder groups and advisory boards provided significant feedback for the development of the intervention and SAMBA study protocol, materials, and trainings. In addition, community health workers and care coaches worked at the respective institutions patients were referred from, were bilingual and from the representative communities they served in. Similarly, research staff were bilingual and trained in culturally competent engagement strategies (26). These steps are commonly suggested in the literature as processes to better engage these harder to reach populations (42,43). Yet, there was still low retention rates within the SAMBA study, suggesting that other factors may play a significant role in mediating this process and other innovative practices are necessary for improving participant retention.

Limitations

This study has several limitations. First, individuals that explicitly reached out to end their study

participation may differ from those who were lost to follow-up, but we did not have data to evaluate them independently. We also did not have data on the specific reasons for study drop out or loss to follow-up for most patients and could not directly assess how an individual's experience may have impacted their research participation. Second, the study sample was drawn from low-income, inner-city communities with primarily older Hispanic and Black adults and the findings may not be generalizable to non-urban areas and other populations. Third, 184 patients that were deemed eligible and recruited for the study refused and an additional 12 were no-shows at the initial interview, which may have introduced possible recruitment bias into our findings. We did not have data on their reasons for refusal to participate in the study or their characteristics, and it is unknown whether any bias would have changed the association of certain factors and study retention.

Conclusion

We found no consistent associations between a comprehensive set of candidate predictor variables and retention in an asthma self-management support intervention study for older adults. Most notably, illness perceptions were not associated with retention. With a better understanding of patient barriers to retention, researchers can implement novel strategies to keep patients engaged in behavioral intervention studies for the intended duration and improve the value of their studies. Qualitative research with study completers and non-completers is one strategy that may shed light on this problem.

Declaration of interest

No conflicts of interest exist for the following authors: Dustin Kee, Rachel O'Connor, Alex D. Federman. Juan P. Wisnivesky has received consulting honorarium from Atea, Sanofi, Banook, and grants from Sanofi and Arnold Consulting, outside the submitted work. Michael S. Wolf reports personal fees from Sanofi, grants from Amgen, grants and personal fees from Merck, Sharpe, & Dohme, grants from Eli Lilly, grants and personal fees from Pfizer, personal fees from Luto UK, personal fees from GlaxoSmithKline, outside the submitted work.

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