JUNIPER
Your Health. Your Community.

Cost Savings Associated with Preventing Falls in Older Minnesotans

BY INNOVATIONS FOR AGING, LLC
RESEARCH AND ANALYSIS BY SOLID RESEARCH GROUP, LLC
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Innovations for Aging, LLC (IFA) is a not-for-profit, limited liability corporation (LLC) and manages Juniper and its network partners. IFA is wholly owned by the Metropolitan Area Agency on Aging, Inc. (MAAA) and strives to meet the challenge of delivering better health outcomes through innovative programs that enable community-dwelling older adults to maintain their independence.

EXECUTIVE SUMMARY

FALL RATES AND ASSOCIATED COSTS

There is extensive literature demonstrating that falls are common among older adults and that efforts to reduce falls and fall risk produce significant cost savings. Functional decline and social isolation, common in older adults and exacerbated by COVID-19, can increase the risk of falls and fall-related costs. In addition to the immediate costs that falls incur to treat fall-related injuries, falls can impose long-term costs by impeding mobility and cognitive function.

Estimates for the percentage of adults ages 65 and older who fall each year ranges from 24-49%, with an average of 35%;[1,2,3,4,5,6,7,8] as many as 3.1-11% of falls result in a hospitalization[5,9] and 14-18% result in an ED/OP physician visit.[10]

The direct costs associated with falling in this population varies by type of fall (e.g., injurious, non-injurious, fatal, non-fatal, overall, etc.), setting (e.g., community, while hospitalized, while in assisted living, etc.), and type of care provided (e.g., any medical attention, hospitalization, emergency department [ED], nursing home, outpatient/physician office, overall, etc.). In 2022 USD, estimates for the cost per fall ranged from $1,670-$32,426.[1,5,11,12] Estimates for fall-related hospitalizations go as high as $60,417 in 2022 USD.[12]

The indirect costs for falls are also substantial. Given that experiencing a fall significantly increases the chances of a subsequent fall,[13,14,15] each fall increases the risk of future fall-related costs, especially if future falls are injurious or occur in specific care settings. Those who fall while in the hospital have longer lengths of stay and incur higher hospital costs.[16,17,18] Further, falls are associated with an increased risk of a nursing home or long-term care placement after hospital discharge.[19,20,21] This finding is notable given that the most recent estimates for the annual cost of long-term care in Minnesota range from $45,600 for assisted living to $132,448 for a nursing home.[22] Falls among older adults are the leading cause of head injuries and hip fractures (in fact, 95% of hip fractures result from a fall), impeding mobility and cognitive function, leading to restrictions in daily activities.[7]

FALL PREVENTION AND IMPROVED HEALTH OUTCOMES FROM JUNIPER-SUPPORTED FALL PREVENTION PROGRAMS

Fall prevention programs can improve strength and balance, while reducing the fear of falling. Additionally, they can help maintain physical functioning and provide socialization, which further reduce fall risk and generally improve patient health and well-being.

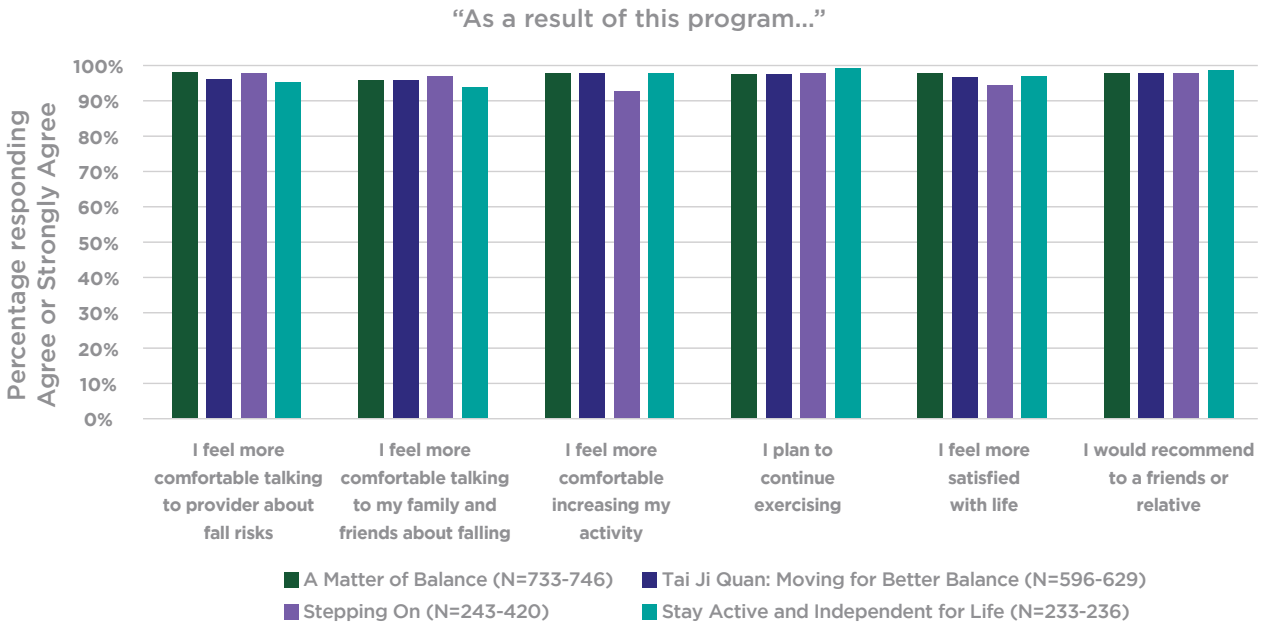
Participant-reported data from Juniper-supported fall prevention programs illustrates the impact on fall prevention, patient activation, healthy behaviors, and mental and emotional well-being. The Juniper data set includes adults (ages 18+) who live in Minnesota and participated in an evidence-based fall prevention class from a Juniper network provider. This analysis uses data from January 2019 through January 2020. Participants of A Matter of Balance (MOB), Tai Ji Quan: Moving for Better Balance (TJQMBB), Stepping On (SO), and Stay Active and Independent for Life (SAIL) experienced absolute reductions in fall rates of 19.9%, 8.8%, 18.5%, and 6.4%, respectively (see Table 1).

Table 1. Fall reduction rates after participation in Juniper-supported fall prevention programs.

Class	% Who Fell Before Class	% Who Fell After Class	Difference
A Matter of Balance	37.1%	17.1%	19.9%
Tai Ji Quan Moving For Better Balance	23.5%	14.7%	8.8%
Stepping On	34.7%	16.2%	18.5%
Stay Active and Independent for Life	27.0%	20.6%	6.4%

Additionally, participants consistently reported improvements in their fear of falling, their level of physical activity, satisfaction with life, stress level, ability to perform daily activities, and general well-being. As shown in Figures 1 and 2, participants' responses regarding each fall prevention program's impact were overwhelmingly positive.

Figure 1. Juniper-supported fall prevention programs' impact on falls-efficacy.



FOLLOW-UP ANALYSIS

- A follow-up survey given an average of 207 days after the end of the class demonstrated that reductions in falls were maintained over time, with respondents reporting a **69% reduction in fall rate since the end of class**, as compared to prior to the start of class. *See addendum, page 60-61.*

Figure 2. Juniper-supported falls prevention programs' impact on healthy behaviors.

ESTIMATED COST SAVINGS AMONG JUNIPER PARTICIPANTS

The cost savings through avoided expenditures from reducing falls were evaluated using Juniper participant data by using fall incidence and estimates of fall-related healthcare costs. Depending on the inputs chosen, the aggregated savings across these programs range from several hundred thousand dollars to several million dollars.

A Matter of Balance (MOB)

A total of 978 participants in the MOB program during the study period provided self-reported data. Approximately 37% (*n*=239/645) reported falling three months before the pre-survey questionnaire, completed at the first session of the program (Time 1); at the last session (Time 2), 17% (*n*=81/473) indicated a fall, a reduction of 19.9 percentage points, and a relative risk rate of 0.46. The total number of falls was reduced from 408 to 111, a decrease of 297 falls. When the 111 falls reported at Time 2 are extrapolated to the number of anticipated falls for a sample size equal to that at Time 1, it would equal 151 falls, which would still have resulted in a reduction of 257 falls. When limiting the analysis to 418 participants who had falls data at both time points, the reduction in total falls was 134, with 28% of participants reporting fewer falls at Time 2 than at Time 1. Using these data and fall-related cost estimates calculated from previously published studies, the estimated cost savings for MOB range from $223,780 to $3,960,495. This methodology produces $75-$956 of savings per session attended and $546-$7,227 of savings per participant who completed the program (defined as attending at least 66% of total sessions) (see Table 2).

Table 2. MOB cost savings for Juniper participants.

Class					Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total Completers	Savings Per Fall Avoided	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
645	297	4,143	548	$13,335	$3,960,495	$6,140	$7,227	$956
645	257	4,143	548	$13,335	$3,427,095	$5,313	$6,254	$827
645	257	4,143	548	$1,670	$429,190	$665	$783	$104
418	134	2,983	410	$13,335	$1,786,890	$4,275	$4,358	$599
418	134	2,983	410	1,670	$223,780	$535	$546	$75

Other Juniper-Supported Fall Prevention Programs

The same methods were applied to the other Juniper-supported fall prevention programs to obtain estimated total cost savings, savings per session attended, and savings per completer.

Table 3. Total cost savings, savings per completer, and savings per session attended for other Juniper-supported falls-prevention programs.

Program Name	Total Savings	Savings Per Session Attended	Savings Per Completer
Tai Ji Quan: Moving for Better Balance	$70,140-$1,933,575	$11-$212	$249-$5,075
Stepping On	$111,890-$2,200,275	$74-$1,079	$486-$7,359
Stay Active and Independent for Life	$8,350-$213,360	$3-$83	$94-$2,425

These estimates include only direct costs associated with falls and ignore indirect cost savings that stem from the reduced likelihood of future falls, increased physical activity and mobility, reduced fear of falling, and the long-term effects of falls on physical and cognitive functioning. Further, greater patient activation is associated with less healthcare utilization and costs and a greater likelihood of making healthy choices and/or preventive health measures (e.g., getting check-ups and screenings, better diet, increased exercise, and avoiding smoking and/or drugs). In addition, each program addresses multiple components of the star-rating system created by the Centers for Medicare and Medicaid Services (CMS), which adds value for health plans and health systems in value-based program arrangements.

CONCLUSION AND RECOMMENDATIONS

Evidence from Juniper participants suggests that these fall prevention programs produce significant cost savings, even when conservative estimates are used. These results are consistent with previous research and economic studies that have consistently concluded that fall prevention results in healthcare cost savings for older adults. While evidence of the effectiveness of these programs is clear, they have rarely been widely scaled. Juniper is the nation's largest network of these kinds of evidence-based health promotion programs, and a health plan or other risk-bearing entity who maximizes this opportunity will likely be a leader in this field. Given the increased focus on fall-prevention and wellness programs from The Joint Commission, NCQA, and CMS, these programs may fill a significant need for care delivery systems and health plans alike. Additionally, self-reported data from Juniper course participants provides insights into patient perspectives and perceptions, and yields information unavailable in claims data. There is potentially significant value to be gained from Juniper fall-prevention programs and associated data.

KEY FACTS

- Over 25,000 Minnesotans have participated in Juniper programming since 2018
- More than half of participants are from rural areas
- Four evidence-based fall prevention classes offered: A Matter of Balance, Staying Active and Independent for Life (SAIL), Stepping On, Tai Ji Quan
- There are 85 partner provider organizations across the state who help facilitate the programs

JUNIPER PROGRAMS DELIVER RESULTS

Participants in Juniper classes report up to 20% fewer falls (the reduction was maintained 6 months after class ended)

More than 90% of Juniper class participants report feeling less afraid of falling and more confident in increasing their physical activity

9 out of 10

9 out of 10 Juniper class participants would recommend the class to friends and family

Over 90% of Juniper participants report the program helped them to prevent falls and continue performing their daily activities

Participants report that Juniper programs helped them socialize more with others

Participants in Juniper classes report up to 20% fewer falls, with significant cost saving per participant*

$7,227

A Matter of Balance Class Savings Per Participant

$7,359

Stepping On Class Savings Per Participant

$5,075

Tai Ji Quan Class Savings Per Participant

$2,425

Stay Active and Independent for Life (SAIL) Class Savings Per Participant

* *Data from January 2019 through January 2020, based on self-reported falls; assumes program completion, and using an estimate of cost-savings per fall avoided. Values represent the upper limit of a range of estimates produced by an internal analysis.*

INTRODUCTION

Falls in older adults are a source of significant morbidity and healthcare-related costs. In addition to the significant costs associated with treating fall-related injuries, falls have been linked to decreased health outcomes over time, including long-term mobility and cognitive functioning decline. Many older adults limit their physical activity and social involvement out of a fear of falling, which can have psychological and emotional implications, especially for community-dwelling individuals. Physical activity and social interactions both decreased for this population during the COVID-19 pandemic, potentially exacerbating current trends in falls and fall-related injuries.

Evidence-based fall prevention programs were developed to reduce the likelihood of falling among older adults by increasing strength and balance, improving communication with healthcare providers, and raising awareness of an individual's physical environment. These strategies have been shown to successfully reduce fall risk and the fear of falling while increasing physical activity, self-efficacy, and patient activation. These programs can also help improve physical functioning more generally and reduce social isolation and physical inactivity, both of which were exacerbated by the COVID-19 pandemic. Additionally, steps to assess and reduce fall-risk are components of national reimbursement and quality initiatives, including from CMS. This paper summarizes the results of a literature review on falls and fall prevention programs and estimates direct cost avoidance using data from Juniper program participants in Minnesota.

The current version was updated in 2023 to include new literature since the original publication of this analysis. Additionally, monetary inputs pulled from literature to estimate cost-savings were updated to 2022 USD. Finally, given the timing of the update, it was also prudent to add information related to the impacts of COVID and to describe a recent claims analysis performed on Juniper's behalf.

ABOUT JUNIPER

The Juniper Programs are administered by Trellis,® a nonprofit organization that creates access to social care services to help older adults live healthy and connected lives in their communities. Trellis® is the federally designated area agency on aging for the Twin Cities metro area and awards Federal Older Americans Act funding to community-based organizations that deliver older adult services.

Juniper® is a program of Trellis and delivers evidence-based health promotion classes in partnership with a network of community-based healthcare organizations across Minnesota. Juniper classes effectively engage older individuals with chronic conditions or those at risk for falls, providing them with essential tools and knowledge to proactively manage their health.

These evidence-based classes not only build participants' capacity to make informed health decisions but also serve as a strong source of motivation and socialization, empowering them to take actionable steps towards improving their overall well-being. Classes are available to people across Minnesota with in-person, online and phone options.

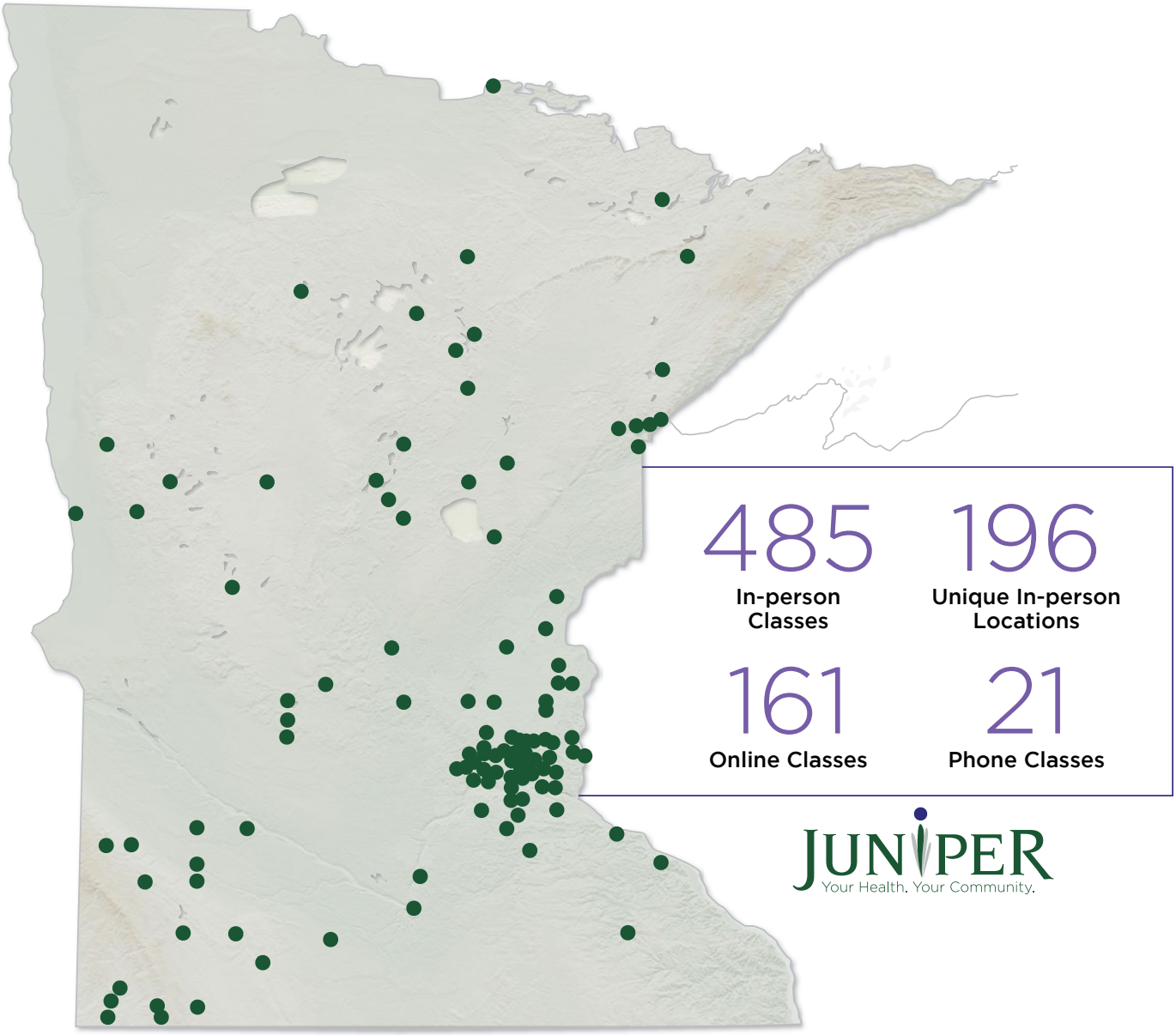
Since 2018, over 25,000 Minnesotans have participated in Juniper programming, with more than half of those participants joining from rural areas of the state.

Provider Partners Delivering Juniper Classes in Every County in Minnesota

Juniper classes are offered through a network of community organizations, local healthcare organizations, class leaders, and funding partners. The best health outcomes come from an integration of clinical care and social care, and Juniper is at the forefront of this growing movement.

We are committed to building partnerships that allow us to provide services targeted to people who will benefit from them most. Our well-known partner providers imbed Juniper in local communities to better serve Minnesotans and create increased access to Juniper programs.

Class Locations



Dots reflect physical locations of classes offered in 2022

METHODS

LITERATURE REVIEW

This analysis focuses on the following fall prevention programs: A Matter of Balance (MOB), Tai Ji Quan: Moving for Better Balance (TJQMBB), Stepping On, and Stay Active and Independent for Life (SAIL).

The goal of the literature review was to gather information on the rate, outcomes, and cost of falls among older adults, and determine the impact the identified evidence-based fall prevention programs have on those variables.

This impact includes estimates that quantify the amount of risk reduction and/or cost avoidance associated with these fall prevention programs. The literature review included the names of the fall prevention programs listed above and more generic search terms such as “falls," “falling,” “fall prevention,” “fall reduction,” “fall rate,” “fall risk,” “fear of falling,” “costs of falls.” No limitations were put on the date of publications, although preference was given to more recent studies. Reviews and meta-analyses were included, but, when possible, the relevant original articles in the reviews were used. After reviewing titles and abstracts, full-text articles were either omitted or abstracted. The search was not limited to studies based in the United States, although it was a criterion for deciding the study’s relevance (and therefore, inclusion) in this summary. The search was originally performed in 2020 and updated in 2023.

COST-SAVINGS ANALYSIS

To estimate the cost savings associated with each fall prevention program, self-reported fall rates from Juniper’s data set were used. The Juniper data set includes adults (ages 18+) who live in Minnesota and participated in an evidence-based fall prevention class from a Juniper network provider. This analysis includes Juniper data between January 2019 and January 2020. Participants completed pre- and post-survey questionnaires during the first and last sessions of each class, respectively. Thus, fall rates can be compared before and after program participation.

In addition to reporting falls over the past three months, participants rate their own general health, well-being, and fear of falling. They also provide feedback on the effectiveness of the program in promoting healthy behavior and choices related to falls, such as their comfort level in discussing falls with family and healthcare providers, increasing physical activity, managing stress, and socializing with others. Using the change in fall rates and estimated costs associated with fall-related healthcare utilization, several scenarios for each program were calculated to estimate the direct cost savings among program participants. These scenarios are calculated as total cost savings, per session attended, and per “completer” (someone who attends at least 66% of the total sessions).

RESULTS

LITERATURE REVIEW AND SUMMARY

Over 100 studies, publications, and public websites that contained information directly relevant to falls and fall prevention were identified. The findings of these sources are summarized here.

The Risk of Falls and Fall Prevention

From the information gathered, falls are common among older adults and they can have both immediate and long-lasting impacts of an individual's health. The National Council on Aging (NCOA) and the Centers for Disease Control and Prevention (CDC) state that **one in four older Americans fall each year**. The CDC goes on to claim that falling once doubles the chances of falling again;[13,15] another study suggests fall risk more than triples after an initial fall.[14]

A 2018 study of 2011 Medicare Current Beneficiary Study (MCBS) data indicated that 24% of respondents self-reported falling in 2011; of those, 49% fell two or more times.[2] In their 2007 "Global Report on Falls Prevention in Older Age," The World Health Organization (WHO) reported 28-35% of individuals ages 65+ fall each year; for individuals ages 70+, the rate was 32-42%.[7] They go on to claim that falls lead to 20-30% of all mild to severe injuries, and after a fall, individuals can experience a "post-fall syndrome" that can include "dependence, loss of autonomy, confusion, immobilization and depression."[7]

COVID-19, Physical Activity, Functional Decline/Frailty, and Social Isolation

During the height of the COVID-19 pandemic, activity levels dropped substantially in older populations, as reported by multiple studies.[23,24] As such, reductions in physical activity and increases of sedentary lifestyles during this period resulted in decreased mobility[25] and increased depression and anxiety.[26] A 2023 review indicated that the **most frequent recommendation for improving mobility was to increase physical activity** to prevent "the occurrence of adverse results, such as falls, fractures, and functional decline."

Functional decline is a significant issue within the older adult population. It has been estimated that 16% of Medicare patients are frail.[27,28] While that represents a relatively small portion of the entire population, the same data suggest that an additional 47.2% may be classified as "pre-frail," namely that they demonstrate some of the commonly cited frail characteristics.[27] This suggests that individuals who are currently mobile and able to participate in physical activities may exhibit one or more signs that their physical functioning may be in the early stages of decline. For these individuals, the risk of functional decline can have major implications if it is not addressed. Those with a reduced functional status have a higher risk of falls,[29] and once individuals become frail, fall prevalence may be *five times* that of non-frail patients.[28] Frail patients also have significantly higher hazards for cardiovascular events like AMI (HR = 1.95), stroke (HR = 1.71), and peripheral vascular disease (HR = 1.80),[27] and experience increased healthcare utilization[30] and costs.[31,32] Community-dwelling older adults with a fear of falling are at an increased risk of becoming frail.[33] **Additionally, physical frailty may be linked to cognitive decline,**[34] which can also increase fall risk. Among community-dwelling adults considered to be at a high risk of falls, Li et al. reported *that those with cognitive impairment were 2.6 times more likely to have a fall* than those with healthy cognition.[35] For these reasons, it is critical to acknowledge and assess physical decline early and take steps to reduce or avoid declines in physical function in those who are currently fully functioning.

Fortunately, physical exercise can slow and may even be able to reduce frailty. Two separate reviews reported studies that reduced or reversed frailty in patients receiving physical activity interventions.[36,37] Some of the reviewed studies also demonstrated increases in muscle mass, strength, and physical performance, as well as reductions in the number and fear of falls.[36,37] This suggests that **in addition to immediate benefits of fall risk reduction, physical activity interventions may help slow functional decline and frailty,** potentially reducing the risk of major cardiac events, depression/anxiety, and cognitive decline. The need for such interventions has never been greater, given the aging population and decreasing mobility. As one global review suggests, "functional loss will have a role in the burden of disease among older adults."[38]

Most fall-prevention programs, including Juniper's, are provided in a social, group setting. Group activity programs help reduce social isolation and loneliness that were exacerbated by COVID. Studies have shown that persistent isolation and loneliness results in the release of stress hormones that cause long-term damage through increases in cardiovascular stress and inflammation. This increases the risk of heart disease and other chronic diseases, and changes gene expression in white blood cells resulting in a reduction in the ability to fight disease.[39] A national survey demonstrated how social interaction and exercise measurably reduces loneliness,[40] suggesting that regular group physical activities may help to combat the debilitating effects of social isolation and loneliness.

Health Equity, HEDIS, and Star Ratings

Social determinants and health disparities are now generally accepted to have significant impacts on patient outcomes, care utilization, and overall medical expenditures. It should be no surprise that disparities can impact the risk of falling.

A 2019 study of over 26,000 Medicare Advantage members reported that members with food insecurity had a 69% higher odds of a fall in the previous year.[41] Additionally, at least one study has linked socioeconomic status (SES) to fall risk through the impacts SES has on health and functioning.[42] Said another way, without the financial means to maintain good health, proper weight, and treat chronic conditions, patients increase their risk of falls. The fear of falling, which was noted above to decrease physical activity and social interaction, is predictive of future falls independent of balance,[43] and may differ by race/ethnicity."[44,45,46] This suggests that interventions to reduce fall risk need to be sensitive to and relevant for a variety of populations, and involve multifaceted components to address barriers, including those related to social determinants.

Therefore, **fall prevention programs offer a unique avenue to address health equity in the older population**. This is particularly relevant given national initiatives to address these socially-based disparities. The Joint Commission has new standards for hospital accreditation that require facilities to screen patients for "health-related social needs" and provide information about services and resources that are available to them.[47,48]

Similarly, NCQA has called health equity the "future of HEDIS"[49] and has announced the development of measures related to social needs screening and intervention, as well as for "social connection." Considering that managing fall risk is already a part of HEDIS,CAHPS[50,51] and CMS's Star Ratings programs,[52] programs that simultaneous reduce fall-risk and address social needs would provide additional benefit. CMS recently announced a Health Equity Index reward that will start measuring performance in 2024. And, such programs are needed, as CMS reported a drop in the average star rating for the measure "reducing the risk for falling" from 2022 to 2023.[53]

Fall Rates

Observed fall rates are reported in a variety of ways (Table 4), including the percentage of individuals who fell and/or were injured,[16] per time at risk,[54] and per 100,000 population.[2] A variety of research studies and economic analyses have reported fall rates and fall-related events to determine their calculations. Table 4 contains pre-and post-intervention fall rates used in each research study and economic analysis included in the literature review. Studies reporting **the percentage of individuals who fall per year typically report or assume values between 20–60%.**[1,3,5,6,8,43,55,56] Within these studies, the percentage of individuals who fall and seek medical care is between 33.4–47%,[1,6] of these, 3.1–4.7% require hospitalization.[5] An economic study from the United Kingdom assumed 14.4–47.3% of individuals fall in a given year, depending on age.[57] Shumway-Cook et al. observed 27% of individuals fell over a 3-month period;[58] several studies by Li et al. found 31–51% of individuals fell over 3- to 6-month periods of time, with 17–19% experiencing injurious falls.[4,59,60,61] Rikkonen (2023) reported 59.7% falling (mean age 76.6) or a rate of 804.0 per 1000 person years; 52.9% of these falls were at least "moderately" injurious and 13.3% required medical attention.[56]

Reported fall rates presented as the number of events per time at risk or the average number of falls per person include, 6 to 13 per 100 person months,[4,60] 2.83 per person year[57], and an average of 0.7 to 2.6 over a 6-month period.[10,62,63]

Also reported are fall-related hospitalization rates, average time until the next fall (for individuals with a history of falls), and one-year emergency department (ED)readmission rates. While estimates vary by study, age, and subject characteristics, the take-away is that falls are common and frequent among older adults.

Table 4. Observed or assumed (baseline) rates of falls and related events reported by studies or used in economic analyses.

Study	Group	Event	Estimated / Reported Fall Rate
Li (2005)[59]	Ages 70+	Falls	31-42% per 3 months
		Injurious falls	17-19% per 3 months
		Received medical attention for falls	12-13% per 3 months
WHO (2007)[7]	Ages 65+	Falls	28-35% per year
	Ages 70+	Falls	32-42% per year
Shumway-Cook (2007)[58]	Ages 65+	Falls	27% per 3 months
Voukelatos (2007)[6]	Ages 60+ (Australia)	Falls	41-49% per year
		Falls requiring medical treatment	40-47% of falls
Zijlstra (2009)[64]	Ages 70+ (Netherlands)	Falls	55% per 6 months
		More than 1 fall	34-37% per 6 months
Smith (2010)[65]	"Older" females	Falls	22.2% per 30 days
		Number of falls	0.35 per 30 days
Wu (2010)[8]	Ages 65-74	Falls	30% per year
	Ages 75+	Falls	37.5% per year

Study	Group	Event	Estimated / Reported Fall Rate
Miller (2011)[5]	Ages 50-64	Falls	20% per year
	Ages 65+	Falls	33% per year
		Falls that result in hospital stay	3.1-4.7% of falls
Laing (2011)[3]	Ages 65+	Self-reported falls	48% in previous 12 months
Li (2013)[60]	Ages 65+	Falls	41.2% per 3 months
Smith (2014)[66]	"Older" females	Falls	21% per 30 days
		Number of Falls	0.34 per 30 days
Li (2014)[61]	Ages 65+	Falls	51% per 3 months
Carande-Kulis (2015)[1]	Ages 65+	Falls	30% per year
	Ages 80+	Falls	50% per year
	Ages 65+	Seek medical care after a fall	33.4%
Spetz (2015)[67]	Hospitalized patients	Fall rate	0.67-4.37 per 1000 patient days (preintervention)
		Falls that result in an injury	10-30% of falls
Howland (2015)[68]	Adults treated at the ED for injurious falls	1-year ED recidivism	18%
		Admitted to hospital	33%
Chen (2015)[69]	Ages 60+	Falls	29-33% per 2 months
		Ave Number of falls	0.42 per 2 months
		% with 2+ falls	9% per 2 months
Basic (2015)[16]	Hospitalized patients	Falls	8.7% of patients (median LOS = 11 days)
		Falls that result in an injury	25.7%
		Falls that result in serious injury (fracture)	1.9%
		Percent who fell	34% over 48 weeks
		Ave time to first fall	1.4 months
Ford (2017)[62]	Rural community-dwelling adults ages 60+	Falls (self-report)	0.87 per 6 months
		ED visit for a fall (self-report)	0.07 per 6 months
		ED visit for a fall (medical record)	0.028 per 6 months
Isaranuwatchal (2017)[63]	Ages 75-84	Fall rate	1.0-1.1 per 6 months
	Ages 85-95	Fall rate	2.3-2.6 per 6 months
Florence (2018)[2]	Ages 65+	Fall rate	24% per year
		Fell again	49% per year
Hopewell (2018)[70]	"Older people living in the community" (mean ages 62 to 85 yrs)	Fall rate, 3-24 months	2,317 per 1,000 pts
		Percent with a fall, 3-48 months	47.2%
		Percent with fall-related injuries, 3-48 months	6% overall, 12.7% of those who fell
		Falls requiring hospital admission, 3-36 months	267 per 1000 pts
		Falls requiring medical attention, 12-24 months	126 per 1000 pts

Study	Group	Event	Estimated / Reported Fall Rate
Franklin (2019) (UK Study)[57]	Ages 65-69	Fall rate	14.4% per year
	Ages 70-74	Fall rate	18.4% per year
	Ages 75-89	Fall rate	47.3% per year
	Ages 65+	Those with at least one fall	2.83 falls per person year
	Ages 65-69	Probability of longterm care after major fall	0
	Ages 70-74	Probability of longterm care after major fall	0.086
	Ages 75-89	Probability of longterm care after major fall	0.274
Li (2019)[71]	Ages 70+ who had fallen at least once in previous 12 months and clinician indicating they were a fall risk	Fall rate	72-73% per 6 months
Liu-Ambrose (2019)[54]	Ages 70+ with a nonsyncopal fall in previous 12 months	Falls resulting in injury	70-73% of falls
Mahoney (2020)[10]	Ages 65+	Fall rate	0.7-1.2 per 6 months
Rikkonen (2023)[56]	Ages 75+	Percent with a fall	59.7%
		Fall rate	804 per 1000 pt yrs (546 individuals over 1716.4 person-yrs)
		Percent of falls with at least "moderate" injury	52.9%
		Percent of falls that required medical attention	13.3%
Choi (2023)[55]	Age 70+	Percent with a fall	• 2019: 19.8% 1 fall; 12.7% 2+ falls • 2020: 17.7% 1 fall; 11.9% 2+ falls • 2021: 19.2% 1 fall; 14.9% 2+ falls • 2019-2021: 43.0% 0 falls; 23.1% 1 fall; 33.9% 2+ falls (59.5% of those with any fall)
		Recurrent falls	• 68.5% of those with a fall in 2019 also had a fall in 2020-2021 • 11.7% had 2+ falls in each of 3 years • 75.0% had 2+ falls in any one of three years
Garbin (2023)[43]	Aged 65+	Falls	32.7% over 1-year period

Unsteadiness and low levels of activity are among the significant predictors of falls and/or fractures in older women.[14] This unsteadiness may increase an individual's fear of falling, resulting in restricting their activity, further exacerbating their risk of falling.[7] Among individuals who experience a fear of falling, 50-75% limit their social and/or physical activities as a result.[3,13]

Evaluations of previous fall prevention programs and cost-effectiveness studies have consistently demonstrated that it is possible to significantly reduce fall risk[1,5,8,54,,73] by as much as 40%, by reducing the fear of falling,[74-76] and increasing physical activity.

The Cost of Falls

The evidence regarding the economic impact of falls in older adults is clear: falls and related injuries are **expensive to treat and have long-lasting impacts on healthcare utilization, future adverse events (including subsequent falls), and overall functioning and well-being.**

Both the NCOA and the CDC cite several statistics regarding falls, including that falls in older adults are the leading cause of head injuries and hip fractures; they result in more than 2.8 million ED visits, 800,000 hospitalizations, and 27,000 deaths per year.[13,15] Both agencies consider the average cost for treating a fall as high as $30,000 per fall. In 2015, private payers paid approximately $12.0 billion for non-fatal falls.[2]

The evidence linking falls with higher healthcare costs has a lengthy history. Over 20 years ago, Rizzo et al. (1998) reported that an injurious fall was associated with additional hospital costs of $11,042, nursing home costs of $5,325, and total healthcare costs of $19,440 per year in 1996 dollars.[77] Those values are significantly higher when converted to 2022 USD (Table 5). Roudsari et al. (2005) used medical claims data from 1998 to estimate that the average cost of a hospitalization for a fall-related injury was $17,483 (2004 USD).[78]

More recently, in a 2010 review of 32 studies, Heinrich et al. performed a systemic review of the cost of falls and reported a total cost per fall of $10,913 (2006 USD) and fall-related hospitalization costs that range from $10,052- $42,840 (2006 USD) in the United States depending on fall severity.[12] In estimating the potential return of fall reduction, a 2011 analysis by Miller et al. estimated fall-related hospitalizations to cost $25,500 in 2009 USD and further assumed that non-hospital costs add an additional 37%, putting the total fall-associated cost at $40,227 (2009 USD).[5] Burns et al. (2016) estimates the cost of a fatal fall to be $25,487 (2012 USD). For non-fatal falls, they estimated the average cost of a fall-related hospitalization, ED visit, and outpatient (OP) visit to be $29,562, $4,673, and $5,625, respectively (2012 USD).[11]

Table 5. Summary of Estimates of Fall-related Costs.

Study	Type of Fall	Cost Type (Year)	Estimate	Cost in 2022 USD*
Rizzo (1998)[77]	Injurious	Hospital (1996)	$11,042	$19,209
		Nursing Home (1996)	$5,325	$9,264
		Total (1996)	$19,440	$33,819
Roudsari (2005)[78]	Injurious	Hospital (2004)	$17,483	$26,217
Heinrich (2010)[12]	All	Total (2006)	$10,913	$15,390
		Hospital (2006)	$10,052-$42,840	$14,176-$60,417
		ED visit (2006)	$251-$873	$354-$1,231
		OP visit (2006)	$439	$619
Bohl (2010)[9]	All	Quarterly total (2006)	$30,038	$42,362
		Quarterly fall-related (2006)	$27,745	$39,128
Wu (2010)[8]	Recurrent falls	Incremental vs those with no falls for age 65-74 (2008)	$10,582	$14,262
		Incremental vs those with no falls for age 75+ (2008)	$13,228	$17,828
Miller (2011)[5]	All	Hospital (2009)	$25,500	$34,143
		Total (2009)	$40,227	$53,862
Wong (2011)[17]	In-hospital falls	Incremental (2006)	$13,316	$18,779
Howland (2015)[68]	Injurious	ED visit (2013)	$2,823	$3,529
		Hospital (2013)	$25,465	$31,835
Carande-Kulis (2015)[1]	All	Direct medical (2012)	$11,502	$14,633
Spetz (2015)[67]	In-hospital, non-injurious	Hospital (2012)	$1,130-$2,033	1,438-$2,586 (midpoint = $2,012)
	In-hospital, injurious	Hospital (2012)	$7,136-$15,444	$9,079-$19,649 (midpoint = $14,364)
	In-hospital, serious injury	Hospital (2012)	$17,567-$30,931	$22,350-$39,352 (midpoint = $30,851)
Burns (2016)[11]	Fatal	Total (2012)	$25,487	$32,426
	Non-fatal	Total (2012)	$9,463	$12,039
		Hospital (2012)	$29,562	$37,610
		ED visit (2012)	$4,673	$5,945
		OP visit (2012)	$5,625	$7,156

*Using the GDP Price Index

Table 5 shows that the average cost of fall-related hospitalizations typically hovers between $20,000-$30,000, and **total costs may reach as high as $60,000 (2022 USD) or more per fall.**

Additionally, although patients who fall may have other medical conditions, at least one study has shown that most cost increases after a fall are a direct result from falling. Bohl et al. (2010) estimated the total cost of falling during the quarter in which a fall occurred to be $30,038; of this total cost, 92% ($27,745 in 2006 USD) of these costs were attributed to the fall.[9] In 2022 USD, those values are $42,362 and $39,128, respectively.

In addition to the direct medical costs associated with an acute falling event, falls have long-lasting effects. The most basic of these is a significantly increased chance of a subsequent fall,[13-15] which leads to additional costs whether the falls happen at home or in a care setting. Individuals who fall while in the hospital have longer lengths of stay (LOS), resulting in higher hospital costs.[16-18] Further, falls are associated with an increased risk of nursing home or long-term care placement after hospital discharge.[19-21] Falls among older adults are the leading cause of head injuries and hip fractures (in fact, 95% of hip fractures result from a fall), and can impede mobility and cognitive function, leading to restrictions in daily activities.[7]

There are published studies on the effectiveness of evidence-based, fall-prevention programs, which we now explore.

Interventions to Reduce Fall Risk

The literature on reducing fall risk is extensive. A report from WHO entitled "Step safety, strategies for preventing and managing falls across the life-course" made technical recommendations for different settings and aged individuals. **The "Strongly recommended" strategies for reducing falls of older adults in the home included "gait, balance, and functional training, Tai Chi, and home assessment and modifications."**[79] A recent study of over 5,100 community-dwelling Medicare beneficiaries concluded that "balance training is appropriate to reduce falls in older adults with a fear of falling."[43] Several studies or reviews of studies also demonstrated specific evidence.

Dautzenberg et al. report a reduction in falls and fall-related fractures from exercise interventions and falls assessments.[80] A controlled study of an exercise program (gym sessions and Tai Chi) with 24-month follow-up produced a 14.3% fall rate reduction, and a 38% lower fracture rate.[56]

A meta-analysis of 5 systematic reviews that included 32 RCTs produced pooled risk ratios demonstrating reductions in fall risk (vs a control group): strength/resistance (RR = 0.6, p=0.046), three dimensional (constant movement through all three spatial planes, like Tai Chi; RR = 0.51, p=0.004). There were also benefits from "mixed exercises" or "multicomponent."[81] Another systematic review and meta-analysis of 66 RCTs reported that "postural control training" (which includes balance and coordination) was the most effective strategy for reducing fall risk.[82]

Multiple studies also suggest that **fall-prevention interventions are often cost-effective,** including a tailored exercise program (strength, balance, cardiovascular exercise, stretching, functional training).[83] Additionally, a review of interventions concluded that fall-prevention exercise programs "are likely to be cost-effective."[84] These studies explore physical activity interventions generally; research specific to the four programs offered by Juniper provide more insight into specific benefits.

The Effectiveness of Matter Of Balance (MOB)

A report by CMS states that "MOB participation was associated with total medical savings"[73] and cites a study by Ghimire et al. (2015) where MOB participation was associated with a $938 decrease in total medical costs per person per year for Medicare patients, a $517 decrease in costs for unplanned hospitalizations, and $234 in reduced skilled nursing facility (SNF) costs (2012 USD).[85] Their analysis of 2006-2013 Medicare data linked with 2007-2011 MOB program data found that one unplanned hospitalization was prevented per year for every 20 MOB participants. However, results were closely linked with class attendance; total medical costs of those who attended fewer than five sessions increased by over $2,000, while total medical costs for those who attended five or more sessions decreased by more than $1,300.

A 2013 study of community-dwelling older adults in Florida observed that MOB participants were 84% less likely to report a fall at follow-up, despite being older and having more chronic conditions, more functional limitations, worse global cognitive function, a greater fear of falling, and lower falls efficacy at baseline than the comparison group.[69] The MOB group who experienced a fall dropped from 33% to 11% (while in the comparison group it increased from 29% to 30%); individuals experiencing multiple falls dropped from 9% to 3% (the comparison group increased from 9% to 10%). Smith et al. studied older women (mean age = 76 years) who participated in MOB and observed the average number of falls per 30 days decrease from 0.34 at baseline to 0.22 post-intervention; this was also true among women ages 75+ (0.32 to 0.20). A study in North Carolina of MOB reported a drop in the total number of falls (self-reported) among the 4,296 participants from 1178 (pre-survey) to 669 (post-survey), a reduction of 62%; the number of falls with injury dropped 47%, from 432 to 112.[86]

Howland et al. (2013) estimate that among community-dwelling older adults treated at EDs for injurious falls in Massachusetts, a referral to a MOB program to reduce repeat falls could produce a return on investment (ROI) of 144%, saving the state between $2.8 million-$8.4 million, depending on the participation rate.[68] The authors used inputs from a Dutch study on MOB by Zijlstra et al. (2009), which observed recurrent fall odds were reduced by 62% (odds ratio = 0.38).[64] Miller et al. (2011) explored potential cost savings of MOB. It determined that if applied to 140 hypothetical participants with a "normal" fall risk (100 of whom would complete the program), the program would produce a positive ROI if it averted 6.6 falls in the first year of the program (averting 8.2 falls would produce an ROI of 25% and averting 9.9 falls would produce an ROI of 50%). When applied to participants at a "high" risk of falling, a positive ROI would occur after averting 4.4 falls (averting 5.5 and 6.6 falls would produce 25% and 50% ROIs, respectively).[5]

One of the reasons this program is effective is that it reduces the fear of falling and improves overall strength and balance. Alexander et al. (2015) observed that **"Participation in the MOB program significantly improved balance confidence among community-dwelling older adults."**[87] The authors reported quantitative improvements in the total score of the Activities-specific Balance Confidence (ABC) Scale and in the functional activities of reaching for a small can on a shelf at eye level, walking outside to a car parked in the driveway, and walking outside on icy sidewalks. **Falls efficacy,** a measure frequently associated with the scale, developed by the original MOB developer,[74] reflects an individual's beliefs about their ability to prevent and manage falls. Falls efficacy has frequently improved as a result of MOB,[88-92] even among individuals ages 85+.[93] Improving falls efficacy can reduce the fear of falling and increase physical activity, boosting falls efficacy even more.[93]

It is also encouraging to note that MOB appears to be feasible and effective for those with multiple chronic conditions;[94] positive effects have been observed regardless of urban or rural location,[89,92] or ethnicity.[88]

The Effectiveness of Tai Ji Quan: Moving for Better Balance (TJQMBB)

Tai Ji Quan: Moving for Better Balance (TJQMBB), a balance training program based on adapted Tai Chi, has also been shown to be effective for reducing falls, improving health,[6,95,96] and reducing healthcare costs.[1,21] Much of the relevant literature on the effectiveness of TJQMBB (formerly referred to "Tai Chi: Moving for Better Balance") stems from research by Dr. Fuzhong Li, who developed the program.). As described in a 2014 review article by Dr. Li, TJQMBB is well suited for improving balance and reducing fall risk. It "emphasizes movements performed with 'rooted' feet, centered body mass, bilateral weight-shifting initiated from the waist…and smooth and rhythmic movement."[97] Therefore, TJQMBB helps postural control and promotes stability,[61] which is important for performing activities of daily living. It is also safe and effective for those with chronic conditions or physical limitations, such as Parkinson's disease.[98,99]

Dr. Li summarizes his earlier research specific to TJQMBB in a 2014 literature review. This research include a 24-week randomized controlled trial (RCT) where **individuals practicing TJQMBB showed significant improvements in four clinical physical performance measures when compared to those in a low-impact exercise group,** and a 12-week, pre-post study where TJQMBB participants demonstrated significant improvements in functional reach, the Timed Up and Go (TUG) test, chair stands, and 50-foot walk speed. In a subsequent 24-week study, individuals who were referred by healthcare providers showed significant improvements in stability, measures of gait and strength, walking velocity, functional reach, TUG, and the time it takes to rise from a chair.[97]

Other research by Dr. Li includes an RCT published in 2005, where, after 6 months, participants of the TJQMBB program reported significantly fewer falls, fewer injurious falls, and fewer medical care visits for injurious falls. In fact, the relative risk for moderate injurious falls for TJQMBB participants was 0.31 and for severe falls requiring medical attention it was 0.28, which reflects relative improvement of 69% and 72%, respectively. After 12 months, the fall rate for TJQMBB participants was less than half that of controls: 3.16 falls vs 8.96 falls per 100 patient months. There were also significant improvements in functional balance measures attributable to the treatment group.[59] Other studies have demonstrated reductions in falls when TJQMBB was implemented in senior centers[4] and in the outpatient clinic setting.[60] The program also appears to be feasible and effective when implemented among non-English speaking community residents, as demonstrated by Fink et al. (2014).[100]

More recently, Dr. Li and colleagues performed another RCT from 2015-2018 on community-dwelling adults ages 70+ who had fallen in the previous 12 months. **At 6 months, TJQMBB participants had significantly fewer falls and a lower fall rate than the comparison group, who participated in basic stretching exercises.**[71,101,102] In addition, the treatment group had significantly better health state utility scores and less total healthcare utilization cost per individual,[101] making it the economically dominant strategy over stretching alone or multimodal exercise. At 12 months, the TJQMBB group had less moderate injurious falls than stretching alone and less serious injurious falls than the multimodal exercise intervention.[71]

In a review by Stevens et al. (2014), the authors discuss benefits of TJQMBB on bone density, cardio-pulmonary outcomes, physical functioning, psychological symptoms, quality of life, and immune system functioning, in addition to its ability to reduce falls. The authors note the program's effectiveness is due to its focus on improving balance, increasing physical difficulty, and the participants' commitment to invest at least 50 hours of practice throughout the duration of the program.[103]

The Effectiveness of Stepping On

The Stepping On program is aimed at individuals ages 60+ who live independently. Individuals who live in a congregate care setting, use an assistive device for ambulation, or have cognitive impairment are screened by the program facilitator for appropriateness of the program. Although not required, Stepping On is suggested as follow-up program for someone who has completed the MOB program. The original RCT on Stepping On was performed in Australia and published in 2004 by Clemson et al. This study demonstrated a 31% reduction in falls (relative risk = 0.69, p=0.025).[104] Using this result, Carande-Kulis (2015) estimated in an **economic analysis that the program would produce a net benefit of approximately $130 per participant and a ROI of about 60%.**[1]

In community-based studies, Stepping On has demonstrated smaller, but still significant, effects. In a study of 2,219 community-dwelling adults in Wisconsin from 2008-2011, Mahoney et al. (2020) observed a 38% reduction in fall rate during the first 6 months after program completion compared to baseline (rate ratio = 0.62). Six to twelve months after program completion, the improvement was attenuated, but still significant: a 28% reduction versus baseline.[10] In a community-level study across 20 communities, the program resulted in an 8-9% reduction in fall-related hospitalizations and ED visits.[105] In a study of rural communities, Ford et al. (2017) observed self-reported fall rates drop by almost half (0.87 per six months to 0.45, $p < 0.001$) and self-reported fall-related ED visit rates drop by more than two-thirds (0.07 per six months to 0.02, $p < 0.01$).[62]

In addition to fall-related outcomes, **there is evidence that the Stepping On program improves balance, self-reported health status, and quality of life.** After the 7-week program was administered to community-dwelling adults ages 60+ in Oregon, Colorado, and New York, participants not only significantly improved on the TUG test, but they also self-reported improvements in several other areas. Significant improvements were seen in the percentage of participants who reported excellent or very good health status, very/mostly satisfied with activity levels, confidence in not falling, no difficulty walking one block, no difficulty getting out of a straight back chair, and no difficulty in climbing one flight of stairs.[106]

The Effectiveness of Stay Active and Independent for Life (SAIL)

Like the other fall prevention programs, SAIL is intended for community-dwelling older adults ages 65+ with a fear of falling or a history of falls. It is especially good for those who need accountability and structure for staying active.

The original study on the benefits of the program occurred from 2003-2005 and was published in 2007, before the program had been officially named. When compared with the control group, those receiving the intervention **had significantly greater improvements in measures of balance, leg strength, and mobility.** The intervention group also had a 25% lower fall rate, but since the study was powered to detect a 29% decrease in fall rate, the result was not statistically significant. The authors note that in the study population, 75% had no history of falls in the previous 3 months and 50% were considered to have a low fall risk based on Berg Balance Scores. It is unknown if the low-risk nature of study participants contributed to the lack of a statistically significant difference. in the change in fall rates is unknown. However, attendance was linked to decreases in the likelihood for falling; those who attended more sessions tended to have lower fall rates. Additionally, those in the intervention group were more likely to have increased their exercise (65% vs 33%) and more likely to have discussed falls with their health care provider (19% vs 11%) compared with those in the control group.[58]

A few years later, a study of 331 adults who participated in the SAIL program found **significant improvements in measures related to performing activities of daily living, strength, balance, fitness, and flexibility.** As with the first study, higher attendance was associated with larger improvements. Additionally, when asked, 80% of participants found the educational component of the program helpful.[107]

The Effectiveness of Higher Patient Activation

Teaching individuals how to manage their own health and arming them with the appropriate knowledge, often referred to as “patient activation," has been associated with lower healthcare costs, and is a key component of the fall prevention programs presented above. Multiple studies have shown direct financial benefits from increased patient activation. **Higher levels of patient activation have been associated with fewer hospitalizations and ED visits,**[108,109] **more preventive care (e.g., check-ups, screenings, immunizations) and healthier behaviors,**[109] **and lower healthcare costs.**[110] Specifically, a pair of Minnesota-based studies reported that individuals with higher levels of patient activation had within-normal clinical indicators, fewer ED visits (16% vs 24.1%, $p<0.001$) and fewer hospital stays (7.8% vs 13.1%, $p<0.001$).[108] Higher patient activation was associated with lower annual healthcare costs per patient, including individuals with hyperlipidemia, $6,089 vs $5,454, hypertension, $7,687 vs 6,750, asthma, $6,581 vs 5,442, and diabetes, $8,474 vs $7,901.[110] A 2013 literature review found evidence that individuals with higher patient activation were more likely to get regular check-ups, screenings, and immunizations, made healthier choices regarding diet and exercise, and avoided smoking and drug use. Higher patient activation among study participants was also associated with normal BMI, HbA1c, blood pressure and cholesterol, and fewer hospitalizations and ED visits. High patient activation among individuals with chronic conditions was associated with higher treatment adherence and self-monitoring.[109]

COST-SAVINGS ANALYSIS

Estimating Direct Fall-Related Costs

Previous studies and economic analyses provide ample evidence of the healthcare costs associated with falls in older adults. Estimates vary by type of fall (e.g., injurious, non-injurious, fatal, non-fatal, overall, etc.), setting (e.g., community, while hospitalized, while in assisted living, etc.), and type of care provided (e.g., any medical attention, hospitalization, ED visit, nursing home, OP visit, overall, etc.). Appendix A highlights these articles.

To determine estimates for the total cost per fall, information was combined from several articles (Table 6).

Table 6. Cost per fall estimates from literature review.

Study	Description	Estimate of Cost Per Fall*
Heinrich (2010)[12]	A review of studies from several countries; the estimate from cost per fall comes from a US study (studies from Finland and Sweden had significantly lower cost per fall)	$15,390
Miller (2011)[5]	Estimated fall-related costs	$1,670 for low-risk individuals to $3,852 for high-risk individuals
Carande-Kulis (2015)[1]	An economic analysis; used national data from 2000 on the total direct medical costs for "fatal and non-fatal" falls and the number of falls to arrive at an average	$14,633 per fall
Burns (2016)[11]	Used 2012 claims data to determine the overall cost and number of fatal and non-fatal falls	$32,426 for fatal falls $12,039 for non-fatal falls

*All dollar values have been converted to 2022 USD

The average of these values is $13,335. The lowest estimate among these is $1,670. Note that both of these values are significantly lower than what the NCOA and the CDC report for the cost of falls, $30,000 per fall. Additionally, these values exclude several higher estimates, including one from Rizzo et al. (1998) who estimated that the annual increase in total costs for those who experience an injurious fall is $33,819 (USD 2022),[77] Bohl et al. (2010) who estimated a quarterly total cost of $42,362 (USD 2022) per fall that required medical care,[9] and Miller et al. (2011) who estimated that falls requiring a hospitalization have direct costs of $34,143 (USD 2022) and indirect costs of $19,719 (USD 2022).[5] These papers are not directly applicable to estimates on the "cost per any fall" due to focusing only on injurious falls. Therefore, it is notable that they are all significantly higher than the average used for this paper, $13,335, suggesting that the estimates for this analysis are conservative.

Estimates of the cost per hospitalization, ED visit, and OP visit were developed through a similar process. For the cost per fall-related hospitalization, the average of seven estimates (low = $19,209; high = $60,417; mean = $31,944, all USD 2022) from six different publications were calculated.[5,11,12,68,77,78] Costs for fall-related ED visits ranged from $354-$5,945[11,12,68] (USD 2022); two of these articles also estimated costs for OP visits, estimated at $619- $7,156 (USD 2022).[11,12] Based on these studies, the estimated fall-related ED/OP visit is $3,139.

Indirect Costs

In addition to the direct medical costs associated with an acute falling event, falls have long-lasting effects. Specifically, experiencing a fall significantly increases the chances of a subsequent fall,[13-15] which leads to additional costs, whether the falls happen at home or in a care setting. Those who fall while in the hospital have longer lengths of stay and incur higher hospital costs.[16-18] Further, falls are associated with an increased risk of nursing home or long-term care placement after hospital discharge.[19-21] Falls among older adults are the leading cause of head injuries and hip fractures (in fact, 95% of hip fractures are the result of a fall), and can impede mobility and cognitive function, leading to restrictions in activities of daily living.[7]

This analysis excludes indirect costs and those associated with the long-term detriments to falls, indicating these results are conservative.

Cost Savings of MOB

Pre- and post-survey questionnaire responses from Juniper participants between 01/01/2019-01/17/2020 were used to find the cost savings of the MOB program. A total of 978 MOB participants completed at least some of the pre-survey questionnaire at session 1 (Time 1); of those, 645 participants reported fall-related information. Fewer participants (*n*=473) provided post-survey, fall-related information at session 8 (Time 2), eight weeks later. Even fewer individuals (*n*=418) provided fall information at both time points (Table 7).

Table 7. Self-reported falls of Juniper MOB participants.

	Participants with Data at Either Time 1 or 2			**Participants with Data at Both Time 1 and 2**		
	Time 1	**Time 2**	**Difference**	**Time 1**	**Time 2**	**Difference**
N	645	473		418	418	
1+ falls	239 (37.1%)	81 (17.1%)	-19.9% p<0.0001*	137 (33%)	63 (15%)	-18% p<0.0001**
Total Falls	408	111	-297	222	88	-134
Average Falls	0.633	0.235	-0.398	0.531	0.211	-0.321

*Chi-squared test

**Paired t-test on mean change in number of falls

The difference in total falls, (*n*=297) may be influenced by the smaller sample size at Time 2 (*n*=473) vs. Time 1 (*n*=645). Therefore, the number of falls that would have been at Time 2 if the sample size had equaled that of Time 1 was imputed (*n*=257), and used to calculate the reduced falls from that value (Table 8).

Inputs for the Cost-Savings Analysis

Table 8 includes the inputs used to calculate the cost savings associated with MOB.

Table 8. Inputs for MOB cost-savings analysis.

Input Type	Input	Source	Description
Total Sample Size	645	Juniper data	The total who reported # of falls at Time 1 (4143 total classes, 548 "completers")
	418	Juniper data	The total who reported # of falls at both Time 1 and Time 2 (2983 total classes, 410 "completers")
# of falls avoided	297	Juniper data	The observed decrease from Time 1 (n=408) to Time 2 (n=111) among participants who reported falls at EITHER time
	257	Juniper data	The imputed decrease from the observed falls at Time 1 (n=408) to the calculated falls at Time 2 using the Time 1 sample size and the average falls per person at Time 2 (645 x .235 = 151)
	134	Juniper data	The observed decrease from Time 1 (222) to Time 2 (88) among all who reported falls at BOTH times
% of falls needing hospitalization	3.1-11%	Miller (2011), Bohl (2010)	The range from these studies
% of falls needing ED/Outpatient visit	14-18%	Mahoney (2020)	This study's observations over two samples
Savings per fall avoided (all falls)	$13,335	Heinrich (2010), Miller (2011), Carande-Kulis (2015), Burns (2016)	The average of values from these studies adjusted to 2022 USD
	$1,670	Miller (2011)	The lowest value found in the literature adjusted to 2022 USD
Savings per fall-related hospitalization avoided	$31,944	Rizzo (1998), Roudsari (2005), Heinrick (2010), Miller (2011), Howland (2015), Burns (2016)	The average of values from these studies adjusted to 2022 USD
Savings per fall-related ED/ Outpatient visit avoided	$3,139	Howland (2015), Burns (2016)	The average of fall-related ED and OP visits from these studies adjusted to 2022 USD

Depending on the sample and value for savings per fall avoided, the overall savings for MOB ranged from $223,780-$3.96M (Table 9). Regardless of the sample, when using a savings per fall avoided of $13,335, the savings per session attended is at least $599 and per completer is at least $4,358. When using the conservative savings per fall avoided of $1,670, the estimated savings per session attended and per completer are at least $75 and $546, respectively.

Table 9. Estimated cost savings for MOB.

Inputs					Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	Savings Per Fall Avoided	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
645	297	4,143	548	$13,335	$3,960,495	$6,140	$7,227	$956
645	257	4,143	548	$13,335	$3,427,095	$5,313	$6,254	$827
645	257	4,143	548	$1,670	$429,190	$665	$783	$104
418	134	2,983	410	$13,335	$1,786,890	$4,275	$4,358	$599
418	134	2,983	410	$1,670	$223,780	$535	$546	$75

Scenarios using savings per hospitalization and ED visit avoided were explored, instead of a total savings per fall avoided. In these scenarios, the only savings calculated comes solely from avoiding those events, and therefore only involve a fraction of the sample. The cost savings of $0 was assumed for avoiding non-injurious falls, indicating conservative results for this analysis (Table 10).

Table 10. Estimated cost savings for MOB related to hospitalizations and ED visits.

Inputs								Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	% of Falls Needing Hosp	% of Falls Needing PhysEd	Savings Per Hosp Avoided	Savings Per Phys/ Ed Visit	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
645	297	4,143	548	3.1%	14%	$31,944	$3,139	$424,628	$658	$775	$102
645	257	4,143	548	3.1%	14%	$31,944	$3,139	$367,439	$570	$671	$89
418	134	2,983	410	3.1%	14%	$31,944	$3,139	$191,583	$458	$467	$64
645	297	4,143	548	11.0%	18%	$31,944	$3,139	$1,211,421	$1,878	$2,211	$292
645	257	4,143	548	11.0%	18%	$31,944	$3,139	$1,048,267	$1,625	$1,913	$253
418	134	2,983	410	11.0%	18%	$31,944	$3,139	$546,567	$1,308	$1,333	$183

If savings from cost avoidance of indirect outcomes associated with falls and improved self-reported outcomes (e.g., well-being, fear of falling, etc.) were included in this analysis, the return would be even higher. These results suggest significant cost savings from the MOB program.

Cost Savings of TJQMBB

Pre- and post-survey questionnaire responses from Juniper participants between 01/01/2019- 01/17/2020 were used to find the cost savings of the TJQMBB program. A total of 952 individuals who started the TJQMBB program and completed at least some of the pre-survey questionnaire at Time 1. As before, available sample sizes varied depending on the completion of the survey questionnaire. (Table 11).

Table 11. Self-reported falls of Juniper TJQMBB participants.

	Participants with Data at Either Time 1 or 2			Participants with Data at Both Time 1 and 2		
	Time 1	**Time 2**	**Difference**	**Time 1**	**Time 2**	**Difference**
N	582	373		321	321	
1+ falls	137 (23.5%)	55 (14.7%)	-8.8% p=0.0013*	66 (20.6%)	47 (14.6%)	-5.9% p=0.0026**
Total Falls	223	78	-145	110	68	-42
Average Falls	0.383	0.209	-0.174	0.343	0.211	-0.131

*Chi-squared test

**Paired t-test on mean change in number of falls

Because the difference in total falls (*n*=145) may be influenced by the smaller sample size at Time 2 (*n*=373) vs Time 1 (*n*=582), the number of falls that would have been at Time 2 if the sample size had equaled that of Time 1 (*n*=101), was imputed, and used to calculate the reduced number of falls from that value (Table 12).

Inputs for the Cost-Savings Analysis for TJQMBB

The inputs to figure out fall-related costs using the percentage of falls requiring hospitalization and/or ED/OP physician visits used the same methodology as the MOB analysis (Table 12).

Table 12. Inputs for TJQMBB cost-savings analysis.

Input Type	Input	Source	Description
Total Sample Size	582	Juniper data	The total who reported # of falls at Time 1 (9129 total classes, 381 "completers")
	321	Juniper data	The total who reported # of falls at both Time 1 and Time 2 (6132 total classes, 282 "completers")
# of falls avoided	145	Juniper data	The observed decrease from Time 1 (223) to Time 2 (78) among all who reported falls at EITHER time (cell H67)
	101	Juniper data	The decrease from the observed falls at Time 1 (223) to the calculated falls at Time 2 using the Time 1 Sample size and the Time 2 average falls per person (582 x .209 = 101)
	42	Juniper data	The observed decrease from Time 1 (110) to Time 2 (68) among all who reported falls at BOTH times (cell U66)

Depending on the sample and value for savings per fall avoided, the overall savings ranged from $70,140-$1.9M. Regardless of the sample, when using a savings per fall avoided of $13,335, the savings per session attended is at least $91 and savings per completer is at least $1,745. When using the conservative savings per fall avoided of $1,670, the estimated savings per session attended and per completer are at least $11 and $249, respectively (Table 13).

Table 13. Estimated cost savings for TJQMBB.

Inputs					Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	Savings Per Fall Avoided	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
582	145	9,129	381	$13,335	$1,933,575	$3,322	$5,075	$212
582	101	9,129	381	$13,335	$1,346,835	$2,314	$3,535	$148
582	101	9,129	381	$1,670	$168,670	$290	$443	$18
321	42	6,132	282	$13,335	$560,070	$1,745	$1,986	$91
321	42	6,132	282	$1,670	$70,140	$219	$249	$11

Like the MOB analysis, scenarios using savings per hospitalization and ED visit avoided were calculated. The cost savings of $0 was assumed for avoiding non-injurious falls, indicating conservative results for this analysis. The results are similar, in that, the savings per session attended ranges from $10-$65 and per completer ranges from $213-$1,552 (Table 14).

Table 14. Estimated cost savings for TJQMBB related to hospitalizations and ED visits.

Inputs								Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	% of Falls Needing Hosp	% of Falls Needing PhysEd	Savings Per Hosp Avoided	Savings Per Phys/ Ed Visit	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
582	145	9,129	381	3.1%	14%	$31,944	$3,139	$207,310	$356	$554	$23
582	101	9,129	381	3.1%	14%	$31,944	$3,139	$144,402	$248	$379	$16
321	42	6,132	282	3.1%	14%	$31,944	$3,139	$60,048	$187	$213	$10
582	145	9,129	381	11.0%	18%	$31,944	$3,139	$591,435	$1,016	$1,552	$65
582	101	9,129	381	11.0%	18%	$31,944	$3,139	$411,965	$708	$1,081	$45
321	42	6,132	282	11.0%	18%	$31,944	$3,139	$171,312	$534	$607	$28

The savings per session attended is less for this class because the TJQMBB program involves more sessions than the other Juniper-supported fall prevention programs.

Cost Savings of Stepping On

The analysis of Stepping On included 559 participants. As before, the number of falls that would have been at Time 2 if the sample size had equaled that of Time 1, was imputed (*n*=152), and used to calculate the reduced number of falls from that value (Tables 15 and 16).

Table 15. Self-reported falls of Juniper Stepping On participants.

	Participants with Data at Either Time 1 or 2			Participants with Data at Both Time 1 and 2		
	Time 1	**Time 2**	**Difference**	**Time 1**	**Time 2**	**Difference**
N	357	284		240	240	
1+ falls	124 (34.7%)	46 (16.2%)	-18.5% p<0.0001*	65 (27.1%)	31 (12.9%)	-14.2% p<0.0001**
Total Falls	217	52	-165	104	37	-67
Average Falls	0.608	0.183	-0.425	0.433	0.154	-0.279

*Chi-squared test

**Paired t-test on mean change in number of falls

Inputs for the cost-savings analysis for Stepping On

The inputs to figure out fall-related costs using the percentage of falls requiring hospitalization and/or ED/OP physician visits used the same methodology as the MOB and TJQMBB analyses (Table 16).

Table 16. Inputs for Stepping On cost-savings analysis.

Input Type	Input	Source	Description
Total Sample Size	357	Juniper data	The total who reported # of falls at Time 1 (2040 total classes, 299 "completers")
	240	Juniper data	The total who reported # of falls at both Time 1 and Time 2 (1502 total classes, 230 "completers")
# of falls avoided	165	Juniper data	The observed decrease from Time 1 (217) to Time 2 (52) among all who reported falls at EITHER time (cell H67)
	152	Juniper data	The decrease from the observed falls at Time 1 (217) to the calculated falls at Time 2 using the Time 1 Sample size and the Time 2 average falls per person (357 x .209 = 101)
	67	Juniper data	The observed decrease from Time 1 (104) to Time 2 (37) among all who reported falls at BOTH times (cell U66)

As with the other fall-prevention programs, the total savings varies depending on the number of falls avoided and the assumed savings per fall assumed. Stepping On produced a total savings between $111,890-$2.2M, with savings per session attended and per completer potentially as high as $1,079 and $7,359, respectively (Table 17).

Table 17. Estimated cost savings for Stepping On.

Inputs					Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	Savings Per Fall Avoided	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
357	165	2,040	299	$13,335	$2,200,275	$6,163	$7,359	$1,079
357	152	2,040	299	$13,335	$2,026,920	$5,678	$6,779	$994
357	152	2,040	299	$1,670	$253,840	$711	$849	$124
240	67	1,502	230	$13,335	$893,445	$3,723	$3,885	$595
240	67	1,502	230	$1,670	$111,890	$466	$486	$74

Like the cost-savings analysis for MOB and TJQMBB, $0 cost savings were assumed for avoiding non-injurious falls, indicating conservative results for this analysis. When using savings per hospitalization and ED/OP physician visit avoided, the savings are more modest (Table 18).

Table 18. Estimated cost savings for Stepping On related to hospitalizations and ED visits.

Inputs								Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	% of Falls Needing Hosp	% of Falls Needing PhysEd	Savings Per Hosp Avoided	Savings Per Phys/ Ed Visit	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
357	165	2,040	299	3.1%	14%	$31,944	$3,139	$235,904	$661	$789	$116
357	152	2,040	299	3.1%	14%	$31,944	$3,139	$217,318	$609	$727	$107
240	67	1,502	230	3.1%	14%	$31,944	$3,139	$95,792	$399	$416	$64
357	165	2,040	299	11.0%	18%	$31,944	$3,139	$673,012	$1,885	$2,251	$330
357	152	2,040	299	11.0%	18%	$31,944	$3,139	$619,987	$1,737	$2,074	$304
240	42	1,502	230	11.0%	18%	$31,944	$3,139	$171,312	$714	$745	$114

Cost Savings of SAIL

The analysis of SAIL included 365 participants, the smallest enrollment among all the Juniper-supported fall prevention programs (Table 19).

Table 19. Self-reported falls of Juniper SAIL participants.

	Participants with Data at Either Time 1 or 2			Participants with Data at Both Time 1 and 2		
	Time 1	**Time 2**	**Difference**	**Time 1**	**Time 2**	**Difference**
N	178	141		106	106	
1+ falls	48 (27.0%)	29 (20.6%)	-6.4% p=0.2322*	23 (21.7%)	16 (15.1%)	-6.6% p=0.7074**
Total Falls	58	42	-16	25	29	+4
Average Falls	0.326	0.298	-0.028	0.236	0.274	+0.038

*Chi-squared test

**Paired t-test on mean change in number of falls

As with the other analyses, the number of falls that one could expect if the sample size at Time 2 had been the same as at Time 1 (*n*=5), was imputed to calculate the reduced number of falls from that value (Table 20).

The SAIL program had the lowest reduction in fall avoidance, resulting in modest cost savings. For the subset of participants with data at both periods, falls increased with no statistical significance. This result is due to a small sample size. Thus, the SAIL cost-savings analysis focuses on participants with survey questionnaire responses at Time 1 or Time 2; cost savings were not calculated for the subset of participants with survey questionnaires at both Times 1 and 2.

Inputs for the cost-savings analysis for SAIL

Inputs to figure out fall-related costs and the percentage of falls requiring hospitalization and/or ED/OP physician visits are the same as for the MOB, TJQMBB, and Stepping On analyses (Table 20).

Table 20. Inputs for SAIL cost-savings analysis.

Input Type	Input	Source	Description
Total Sample Size	178	Juniper data	The total who reported # of falls at Time 1 (n=2569 total classes, n=88 "completers")
Falls avoided	16	Juniper data	The observed decrease from Time 1 (n=58) to Time 2 (n=42) among all who reported falls at EITHER time (cell H67)
	5	Juniper data	The decrease from the observed falls at Time 1 (58) to the calculated falls at Time 2 using the Time 1 Sample size and the Time 2 average falls per person (178 x .298 = 5)

Applying the most conservative estimate for savings per fall avoided, $1,670, the SAIL program still produces a total savings of $8,350, savings per session of $3 and per completer of $95. Using savings per fall avoided of $13,335, the program provides significant total savings, per session attended and per completer (Table 21).

Table 21. Estimated cost savings for SAIL.

Inputs					Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	Savings Per Fall Avoided	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
178	16	2,569	88	$13,335	$213,360	$1,199	$2,425	$83
178	5	2,569	88	$13,335	$66,675	$375	$758	$26
178	5	2,569	88	$1,670	$8,350	$47	$95	$3

As with the other analyses, when assessing the cost savings from avoiding fall-related hospitalizations and ED/OP physician visits, the savings are more modest (Table 22).

Table 22. Estimated cost savings for SAIL related to hospitalizations and ED visits.

Inputs								Benefits (Cost Avoidance)			
Sample Size	Falls Avoided	Total # Sessions	Total # Completers	% of Falls Needing Hosp	% of Falls Needing PhysEd	Savings Per Hosp Avoided	Savings Per Phys/ Ed Visit	Total Savings	Savings Per Patient	Savings Per Completer	Savings Per Session Attended
178	16	2,569	88	3.1%	14%	$31,944	$3,139	$22,876	$129	$260	$9
178	5	2,569	88	3.1%	14%	$31,944	$3,139	$7,149	$40	$81	$3
178	16	2,569	88	11.0%	18%	$31,944	$3,139	$65,262	$367	$742	$25
178	5	2,569	88	11.0%	18%	$31,944	$3,139	$20,394	$115	$232	$8

OTHER BENEFITS

Improved Health and Well-Being

Non-monetary benefits are reflected by improvements in self-reported health, well-being, and quality of life and improvement in four domains: general health, fear of falling, concerns about falling, and well-being. Figure 3 shows the increase of participants who rated their general health as “very good” or “excellent.”

Figure 3. Self-rated general health among Juniper participants.

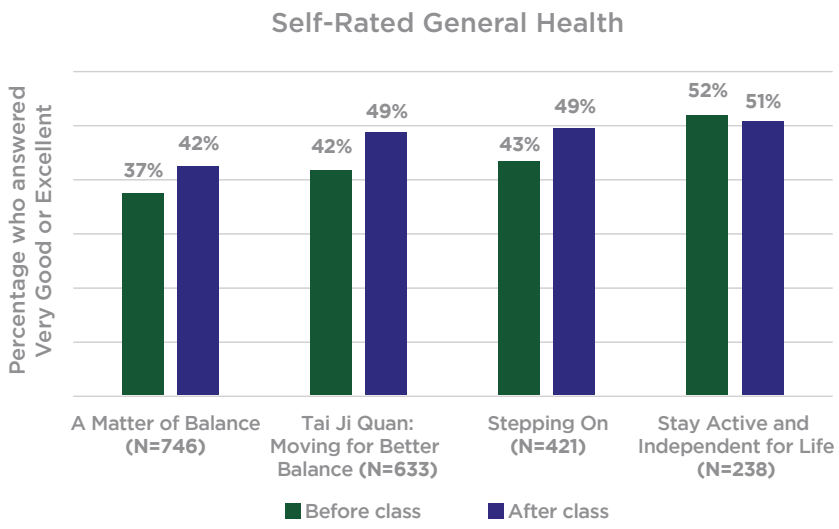


Figure 4 shows the proportion of participants who reported “Somewhat” or "A Lot" as a self-related fear of falling. As mentioned earlier, the fear of falling can lead to restricted physical and social activity. Therefore, reducing falls can lead to a higher quality of life.

Figure 4. Self-rated Fear of Falling among Juniper participants.

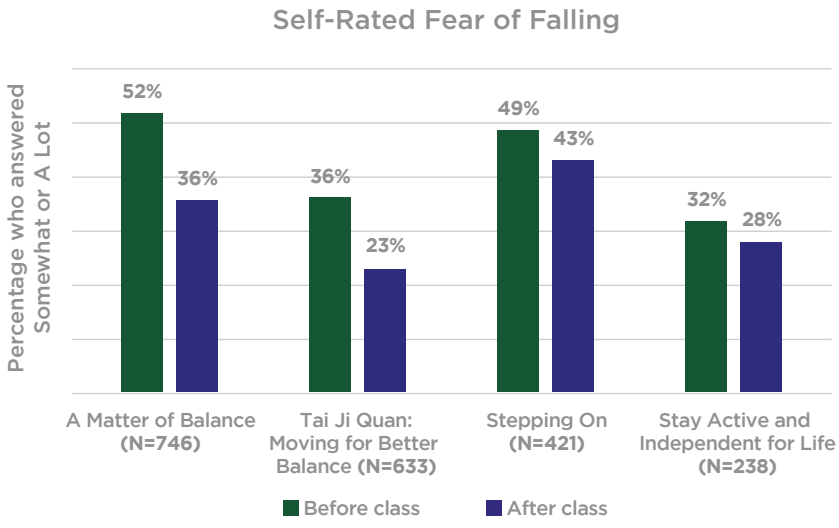


Figure 5 shows the increase of participants who rated their well-being as “very good” or “excellent."

Figure 5. Self-rated well-being among Juniper participants by program.

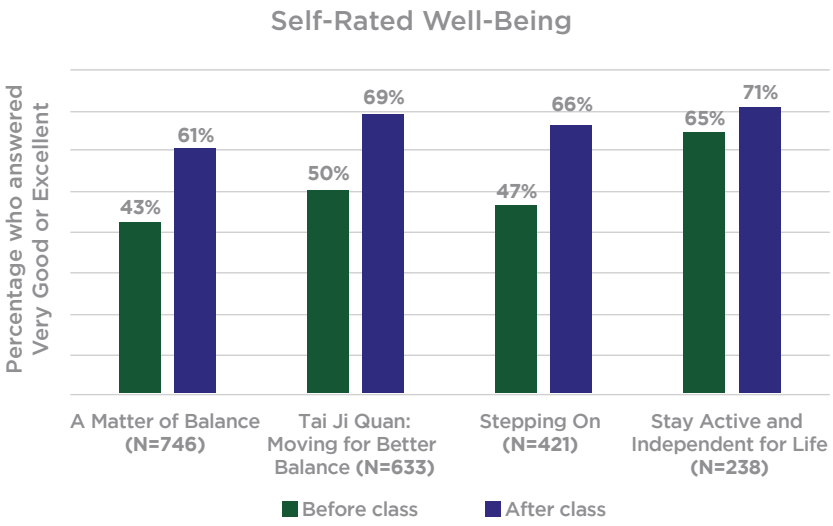


Table 23 shows all Juniper-supported fall prevention programs demonstrate statistically significant improvement in the four domain areas mentioned above. Specifically, 27-34% of participants were less fearful of falling and 20-33% were less concerned with falling across all programs. Between 27-40% of participants rated their well-being higher after attending a Juniper-supported fall prevention program. Three of the improvements from the SAIL program were not statistically significant.

Table 23. Changes in self-reported status.

		MOB	TJQ	SO	SAIL
General Health	N*	746	633	421	238
	Better after class	22.3%	25.4%	20.9%	16.0%
	Worse after class	13.0%	11.7%	13.3%	15.1%
	p-value**	<0.0001	<0.0001	0.0028	0.4447
Fear of Falling	N*	744	623	418	236
	Better after class	33.5%	29.4%	27.8%	27.1%
	Worse after class	14.9%	13.0%	17.7%	21.2%
	p-value**	<0.0001	<0.0001	0.0030	0.0564
Concern About Falling	N*	730	629	416	235
	Better after class	31.8%	25.6%	32.9%	19.6%
	Worse after class	18.1%	14.8%	13.5%	17.9%
	p-value**	<0.0001	<0.0001	<0.0001	0.883
Well-Being	N*	717	586	402	230
	Better after class	38.4%	40.3%	39.6%	27.0%
	Worse after class	12.8%	10.8%	10.2%	17.0%
	p-value**	<0.0001	<0.0001	<0.0001	0.01552

*N in each case represents the number with non-missing information at both time points

**All p-values in this table from the Wilcoxon Signed Rank test

IMPROVED SELF-EFFICACY

Additionally, participants indicated they felt the program(s) they attended were was helpful in many aspects of fall prevention and overall health and quality of life (Figures 6 and 7).

Figure 6. Juniper-supported fall prevention programs' impact on falls-efficacy.

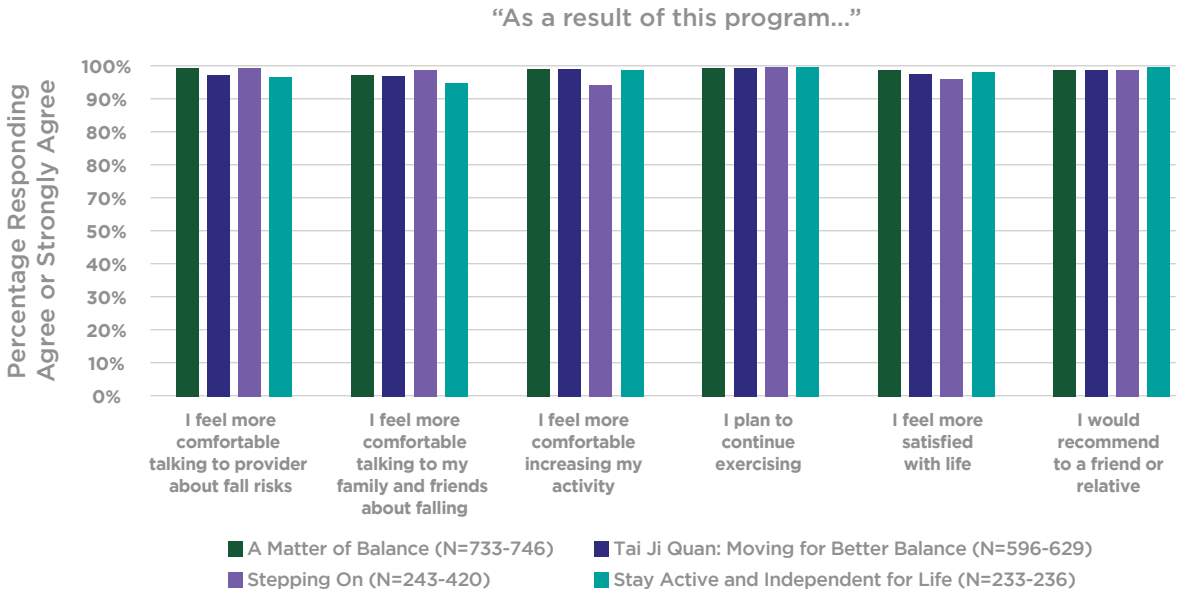
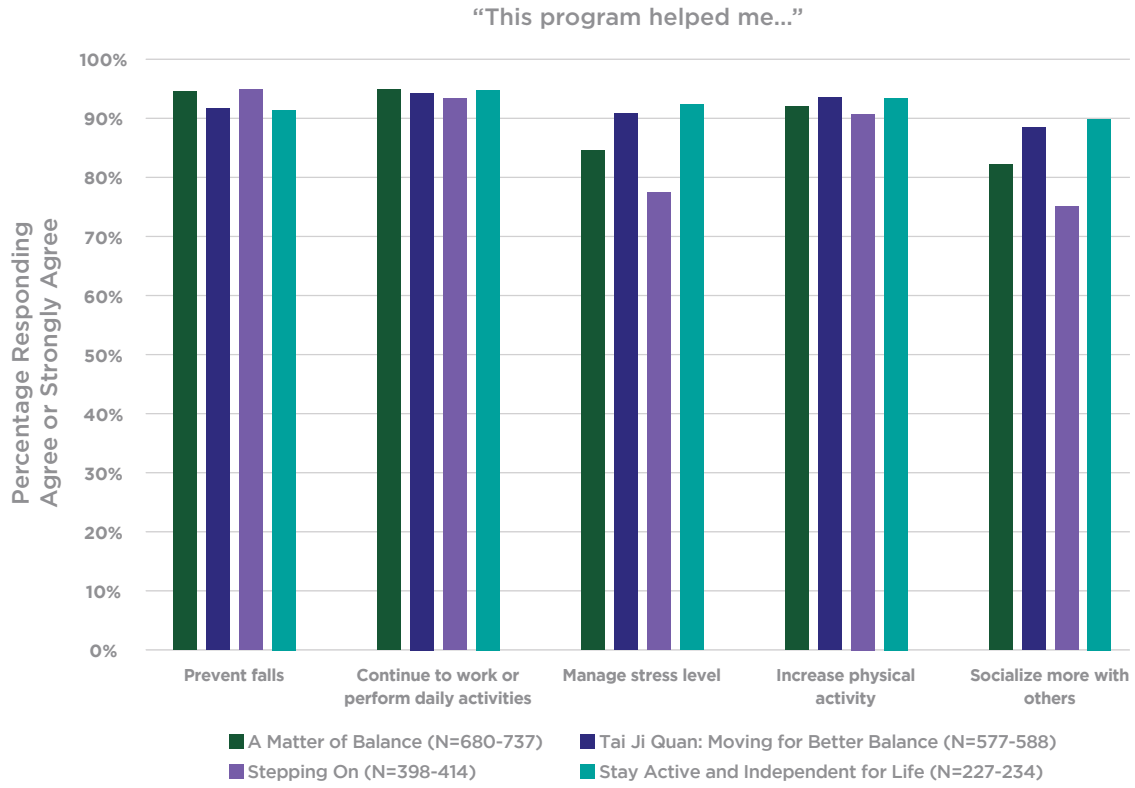


Figure 7. Juniper-supported falls prevention programs' impact on healthy behaviors.



ALIGNMENT WITH CMS'S STAR RATING MEASURES

Finally, it is reasonable to note that each program includes activities which directly align with CMS's Star Rating measures.

In the MOB program, participants learn exercises to improve strength, flexibility, balance and endurance and develop an action plan for exercise outside of class. Action plans are shared with the group to name barriers to exercise and receive solutions from their peers. Prior to exercising during the program, participants are required to sign the Physical Activity Readiness Questionnaire (PAR-Q), which prompts them to speak with their healthcare provider prior to exercising. Participants are encouraged to have their medications reviewed by their healthcare provider, encouraged to have their eyes checked to reduce their fall risk, and provided education on how orthostatic blood pressure relates to falls. Thus, the MOB program aligns with the following Star Ratings:

- Monitoring Physical Activity
- Care for Older Adults – Medication Review
- Diabetes Care – Eye Exam
- Controlling Blood Pressure
- Rheumatoid Arthritis Management
- Reducing the Risk of Falls
- Medication Adherence for Hypertension
- MTM Program for Completion Rate for CMR

Participants in the TJQMBB program sign the PAR-Q, prompting them to speak with their healthcare provider prior to exercising. This program aligns with the following Star Ratings:

- Monitoring Physical Activity
- Controlling Blood Pressure
- Reducing the Risk of Falls

A physical therapist, vision expert, community safety specialist, and pharmacist are guest speakers for Stepping On. To minimize their risk of falling, participants exercise as a group, learn to effectively communicate with their healthcare provider receive tools to review their medications reviewed with their healthcare provider or pharmacist, and encouraged to have their eyes checked. They also sign the PAR-Q, prompting them to speak with their healthcare provider prior to exercising.
Thus, Stepping On aligns with the following Star Ratings:

- Monitoring Physical Activity
- Care for Older Adults – Medication Review
- Diabetes Care – Eye Exam
- Controlling Blood Pressure
- Reducing the Risk of Falls
- Medication Adherence for Hypertension
- MTM Program for Completion Rate for CMR

Participants in the SAIL program are provided with questions to ask their healthcare provider and/or pharmacist and encouraged to have their medications reviewed. and are. They also sign the PAR-Q, prompting them to speak with their healthcare provider prior to exercising. SAIL aligns with the following Star Ratings:

- Monitoring Physical Activity
- Care for Older Adults – Medication Review
- Diabetes Care – Eye Exam
- Controlling Blood Pressure
- Rheumatoid Arthritis Management
- Reducing the Risk of Falls
- MTM Program Completion Rate for CMR

DISCUSSION

The results of this literature review suggest **overwhelming evidence of the effectiveness of Juniper-supported fall prevention programs** to reduce fall risk and quantifies the cost savings associated with avoiding fall-related healthcare utilization. These benefits were seen across studies and among numerous patient populations. Juniper-supported fall-prevention programs are effective across age groups, geographic areas, and differing levels of health and disease burden.

From this cost-savings analysis, significant savings associated with Juniper-supported fall-prevention programs were estimated on an aggregate, per session, per participant, and per completer basis. The extent to which a fall in an older adult can significantly influence their ongoing health status and healthcare utilization makes it not surprising that preventing falls will result in cost savings. The fall reduction observed among Juniper participants should not be discounted. In the MOB program, the percentage of participants experiencing a fall was reduced by over half. This finding is regardless of whether you look at all participants (37.1% at Time 1 to 17.1% at Time 2) or only participants with data at both time points (33% to 15%). Similarly, the average number of falls was 60% lower after program completion. The reductions in falls among participants of TJQMBB were statistically significant, despite low baseline fall rates (21%) compared to the published literature. The Stepping On program observed similar reductions: 34.7% to 16.2% for all participants, 27.1% to 12.9% for participants with data at both time points, and between a 65-70% reduction in the average number of falls.

Finally, **cost savings were sizable even when using conservative estimates of the associated cost avoided per fall avoided.** This suggests significant improvements in fall rates in these real-world cohorts from Juniper-supported fall prevention programs play a meaningful role in the overall cost savings; these savings are not simply a function of random fluctuation in participant falls.

RECOMMENDATIONS

The information presented here suggests that there **exists significant benefit and value from fall-prevention programs for older adults, regardless of their current mobility or level of physical functioning.** In addition to increasing strength and balance, there is evidence that these programs could reduce the fear of falling, increase physical activity, slow or reverse the progression of frailty and cognitive decline, and improve social and emotional well-being by reducing social isolation and loneliness.

In an effort to expand on the self-reported data, Juniper recently attempted to leverage Medicare Advantage claims data to explore patterns of fall-related claims before and after the start of Juniper classes. Unfortunately, those data included a low frequency of falls prior to class initiation for the identified cohort, and therefore no significant reduction after the start of the class was demonstrated. We suspect this is due to the fact that participation in Juniper programs is not limited to high fall-risk individuals, but instead reflects a variety of mobility and levels of physical functioning. Given the high participant satisfaction with the program, we hypothesize that many participants experience several of the additional benefits mentioned above, beyond the improvements in strength and balance they may have developed. That is, their high net promoter score may reflect general improvements in functioning (e.g., reducing any early indications of physical decline towards frailty), self-confidence, and self-actualization, and reductions in the fear of falling and experiences of social isolation or loneliness. Such information can be obtained from their responses to Juniper's questionnaires but are not available from claims.

Healthcare claims data are useful sources of information for identifying health outcomes and care utilization patterns. However, claims-based estimates of falls and fall-related injuries vary greatly depending on which codes are used,[2,111] (there is no existing standard) and obviously are limited to falls that result in a health encounter. We have shown in this review that only a fraction of falls result in injury (that presumably require medical attention), but falls of any type (injurious or non-injurious) are predictive of future falls[13,15] and may reflect a decline in physical functioning.[28] Therefore, while healthcare claims data can be useful in identifying some aspects of falls, these data should be complemented with other sources of information, such as patient-reported outcomes, clinical assessments, and observational studies, to provide a more comprehensive understanding of falls in healthcare settings.

While self-reported fall data can substantially underestimate the true fall rate,[112] such data are often effective in identifying who would benefit the most from fall prevention strategies. A 2022 study identified just two questions ("I feel unsteady with walking" and "I need my arms to stand from a chair") that successfully identified high fall-risk individuals.[113] Additionally, patient-reported data captures beliefs, opinions, and perceptions that are not available in claims. For example, a fear of falling has been shown to be associated with a reduction in social and physical activities,[13] and is not available from claims. Patient- or clinician-collected measures of gait, balance, and walking speed are also unavailable from claims but are often predictive of falls in older adults generally,[114,115] as well as in specialty populations, such as those with Parkinson's disease.[116] Juniper's dataset of participant-reported data provides extensive information unavailable in medical claims. These data can supplement existing quality measures and allow for insights into changes in perception, beliefs, and even behavior. Pre and post surveys are obtained from participants in all classes; such ongoing data collection ensures that the most current participant information is available at all times.

CONCLUSION

Evidence from Juniper participants suggests **these fall prevention programs produce significant cost savings, even when conservative estimates are used.** These results are consistent with previous research and economic studies that have consistently concluded that fall prevention results in healthcare cost savings for older adults. Additionally, patients express high levels of satisfaction in the programs and indicate reductions in perceptions of balance and likelihood of falling.

Given the increased focus on fall-prevention and wellness programs from The Joint Commission, NCQA, and CMS, these programs may fill a significant need for care delivery systems and health plans alike. Additionally, self-reported data from Juniper course participants provides insights into patient perspectives and perceptions, and yields information unavailable in claims data.

APPENDIX A. ADDITIONAL TABLES

A 1. Fall rates from published literature.

Percent Who Fall Per Year						
Source	**Patient Group**	**Age < 65**	**Age 65+**	**Age 70+**	**Age 75+**	**Age 80+**
Miller (2011)	Ages 50-64	20%				
WHO (2007)	Ages 65+		28%			
WHO (2007)	Ages 65+		35%			
Voukelatos (2007)	Ages 60+		41%			
Voukelatos (2007)	Ages 60+		49%			
Hopewell (2018)	Mean age 62-84		47.2%			
Wu (2010)	Ages 65-74		30%			
Miller (2011)	Ages 65+		33%			
Laing (2011)	Ages 65+		48%			
Carande-Kulis (2015)	Ages 65+		30%			
Florence (2018)	Ages 65+		24%			
Li (2016)	Ages 65+		34%			
Garbin (2023)	Ages 65+		32.7%			
WHO (2007)	Ages 70+			32%		
WHO (2007)	Ages 70+			42%		
Choi (2023)	Ages 70+			29.6% to 34.1%		
Wu (2010)	Ages 75+				37.50%	
Rikkonen (2023)	Ages 75+				59.7%	
Franklin (2019)	Ages 75-89				47.30%	
Carande-Kulis (2015)	Ages 80+					50%
Average		20%	35%	37%	42%	50%
Low		20%	24%	32%	38%	50%
High		20%	49%	42%	47%	50%

Fall Rates, Intervals <1 Year						
Source	**Patient Group**	**Age < 65**	**Age 65+**	**Age 70+**	**Age 75+**	**Age 80+**
Shumway-Cook (2007)	Ages 65+ per 3 months		27%			
Li (2005)	Ages 70+ per 3 months			31%		
Li (2005)	Ages 70+ per 3 months			42%		
Li (2013)	Ages 65+ per 3 months		58%			
Li (2014)	Ages 65+ per 6 months		51%			
Zijlstra (2009)	Ages 70+ per 6 months			55%		
Chen (2015)	Ages 60+ per 2 months	29% - 33%				
Smith (2014)	(women) per 1 month	21%				
Smith (2010)	(women) per 1 month	22%				
Repeat Falls						
Source	**Patient Group**	**Age < 65**	**Age 65+**	**Age 70+**	**Age 75+**	**Age 80+**
Florence (2018)	Ages 65+ per year		49%			
Li (2019)	Ages 70+ per 6 months			72%		
Choi (2023)	Ages 70+ with 1+ falls in 2 years after a fall			68.5%		
Chen (2015)	Ages 60+ with 2+ falls per 2months	9%				
Zijlstra (2009)	Ages 70+ with 2+ falls per 6 months			34-37%		
Zijlstra (2009)	Ages 70+ with 2+ falls			51-66%	(Using raw numbers in Table 1)	
Li (2014)	Ages 65+ with 2+ falls per 6 months		24.8%			
Li (2013)	Ages 65+ with 2+ falls per 3 months		13.0%			
Average # of Falls Per 6 Months						
Source	**Patient Group**	**Age < 65**	**Age 65+**	**Age 70+**	**Age 75+**	**Age 80+**
Mahoney (2020)	Ages 65+		0.7 to 1.2			
Ford (2017)	Ages 60+	0.87				
Isaranuwatchal (2017)	Ages 75-84				1.0-1.1	
Isaranuwatchal (2017)	Ages 85+					2.3-2.6

Average # of ED-worthy Falls						
Source	**Patient Group**	**Age < 65**	**Age 65+**	**Age 70+**	**Age 75+**	**Age 80+**
Ford (2017)	Ages 60+	0.07				
Ford (2017)	Ages 60+	0.028				
Percent of Falls Resulting in Care Utilization						
Source	**Patient Group**	**Age < 65**	**Age 65+**	**Age 70+**	**Age 75+**	**Age 80+**
Miller (2011)	Ages 65+ (Hospitalization)		3.1 - 4.7%			
Voukelatos (2007)	Ages 60+ (Medical Attention)	40 - 47%				
Carande-Kulis (2015)	Ages 65+ (Medical Attention)		33.40%			
Mahoney (2020)	Ages 65+ (ED/OP physician visit)		14-18%			
Bohl (2010)	Ages 65+ (Hospitalization)		11%			
Hopewell (2018)	Mean age 62-85 (Hospitalization)		267 per 1000 pts			
Hopewell (2018)	Mean age 62-85 (Other Medical Attention)		126 per 1000 pts			
Rikkonen (2023)	Ages 75+ (Medical Attention)				13.3%	

A 2. Estimated cost of falls from published literature.

				Converted to 2022 USD					
Source	**USD Year**	**Units**	**Type**	**Total**	**Hospital**	**ED**	**NH**	**Incremental**	**OP**
Rizzo (1998)	1996	per event	Injurious	$33,819	$19,209		$9,264		
Roudsari (2005)	2004	per event	Injurious		$26,217				
Heinrich (2010), Low	2006	per event	All		$14,176	$354			$619
Heinrich (2010), High	2006	per event	All	$15,390	$60,417	$1,231			$619
Bohl (2010) (quarterly)	2006	per event requiring med care	All	$42,362					
Wu (2010), age 65-74	2008	per event vs non-fallers	Recurrent					$14,262	
Wu (2010), age 75+	2008	per event vs non-fallers	Recurrent					$17,828	
Miller (2011)	2009	per fall requiring hospitalization	All	$53,862	$34,143				
Miller (2011)	2009	per fall avoided (low)	All	$1,670					
Miller (2011)	2009	per fall avoided (high risk individuals)	All	$3,852					
Wong (2011)	2006	per fall event vs individuals with no fall history	In-hospital					$18,779	
Howland (2015)	2013	per event	Injurious		$31,835	$3,529			
Carande-Kulis (2015)	2012	per event	All	$14,633					
Burns (2016)	2012	per event	Fatal						
Burns (2016)	2012	per event	non-fatal	$12,039	$37,610	$5,945			$7,156

A 3. Improvements in falls and related events from fall-prevention programs.

Improvements in falls and related events							
					Observed	**Absolute Change**	**Relative Risk**
MOB	Chen (2015)	Ages 65+, mean age = 79 (MOB) and 75 (control)	per 2 months	% of MOB group falling per 2 months	15/45 (33%) to 4/35 (11%)	22%	0.333333333
			per 2 months	% of MOB group w/ 2+ falls per 2 months	8.9% to 2.9%	6%	0.325842697
			per 2 months	Ave number of falls per 2 months	19/45 (.42) to 3/35 (.14)	0.28	0.333333333
			per 2 months	Likelihood vs Control Group	84% less likely to report fall		0.16
	Ghimire (2015)	Ages 65+, mean age = 80	per year	reduction in unplanned hospitalizations per year	0.05 per person per year (0.03, 0.07)	0.05	
			per year	Increase in office visits per year	0.43 per person per year (0.29, 0.56)	0.43	
			per year	Increase in physical therapy visits per year	0.5 per person per year 0.2, 0.8)	0.5	
	Zijlstra (2009)	Ages 70+	per 14 months	Odds ratio for falls at 14 months	0.5 (0.23-1.08)		0.5
			per 14 months	Odds ratio for recurrent falls at 14 months	0.38 (0.17-0.84)		0.38
	Smith (2014)	women, mean age = 76	per 30 days	Ave number of falls per 30 days prior	All: 0.34 to 0.22; age < 75: 0.37 to 0.25; age 75+: 0.32 to 0.20	0.12	0.647058824
	Smith (2010)	women, mean age = 76	per 30 days	Average number of falls per 30 days prior	All: 0.35 to 0.23	0.12	0.657142857
	Mazza (2021)	Ages 60+	Pre (3 mths prior to class) to post (since start of class)	Number of falls	1178 to 669	62%	
				Number of falls with injury	432 to 112	47%	

Improvements in falls and related events							
					Observed	**Absolute Change**	**Relative Risk**
TJQ-MBB	Li (2005)	Ages 70+	per 6 months	% of TJQ group falling baseline and at 6 months	42% to 28%	14%	0.666666667
			per 6 months	% with Injurious falls	19% to 7%	12%	0.368421053
			per 6 months	% receiving medical attention from fall	12% to 5%	7%	0.416666667
			per 6 months	Any 6-month fall vs control group	28% vs 46%	18%	0.608695652
			per 6 months	2+ falls vs control group	7.4% vs 22.6%	15%	0.327433628
			per 6 months	Ave num falls vs control group	0.4 vs 0.78	0.38	0.512820513
			per 6 months	Injurious falls vs control group	7% vs 18%	11%	0.388888889
			per 6 months	Medical Attention vs control group	5% vs 15%	10%	0.333333333
			per 6 months	Risk of multiple falls			0.45
	Li (2015)	Ages 40 to 85 with Parkinson's	per 9 months	% with falls over 9 months vs resistance group	33.8% vs 49.2%	15%	0.68699187
			per 9 months	% with falls over 9 months vs stretching group	33.8% vs 56.9%	23%	0.594024605
			per 9 months	Average number of falls vs resistance group	1.33 vs 2.65	1.32	0.501886792
			per 9 months	Average number of falls vs stretching group	1.33 vs 4.11	2.78	0.323600973
			per 9 months	Fall incidence rate vs resistance group	12 vs 23 per 100 person-months	11	0.52173913

Improvements in falls and related events							
					Observed	**Absolute Change**	**Relative Risk**
TJQ-MBB			per 9 months	Fall incidence rate vs stretching group	12 vs 38 per 100 person-months	26	0.315789474
	Li (2018)	Ages 70+ with fall in last 12 months	per 6 months	Average number of falls over 24 wks vs multimodal exercise	0.68 vs 0.98	0.3	0.693877551
			per 6 months	Average number of falls over 24 wks vs stretching group	0.68 vs 1.63	0.95	0.417177914
			per 6 months	1+ falls vs multimodal exercise group	37.9% vs 50.0%	12.1%	0.758
			per 6 months	1+ falls vs stretching group	37.9% vs 57.0%	19.1%	0.664912281
			per 6 months	2+ falls vs multimodal exercise group	13.4% vs 19.7%	6.3%	0.680203046
			per 6 months	2+ falls vs stretching group	13.4% vs 29.1%	15.7%	0.4604811
			per 6 months	Average number of injurious falls vs multimodal group	0.43 vs 0.55	0.12	0.781818182
			per 6 months	Average number of injurious falls vs stretching group	0.43 vs 0.81	0.38	0.530864198
	Li (2019)	Ages 70+, high-risk of falling because they had fallen in the past year or had impaired mobility	per patient-month	Fall incidence rate of moderate injurious falls vs multimodal	47.9 vs 56.5	8.6	0.847787611

Improvements in falls and related events							
					Observed	**Absolute Change**	**Relative Risk**
TJQ-MBB			per patient-month	Fall incidence rate of moderate injurious falls vs stretching	47.9 vs 89.9	42	0.532814238
			per patient-month	Fall incidence rate of serious injurious falls vs multimodal group	5.6 vs 12.2	6.6	0.459016393
			per patient-month	Fall incidence rate of serious injurious falls vs stretching group	5.6 vs 21.3	15.7	0.262910798
			per 1000 patient-months	Injury-related ED visits vs multimodal group	3.8 vs 8.1	4.3	0.469135802
			per 1000 patient-months	Injury-related ED visits vs stretching group	3.8 vs 14.3	10.5	0.265734266
			per 1000 patient-months	Fall-related hospitalizations vs multimodal group	1.9 vs 4.2	2.3	0.452380952
			per 1000 patient-months	Fall-related hospitalizations vs stretching group	1.9 vs 7.0	5.1	0.271428571
	Li (2016)	Ages 65+ who reported fall at baseline	per year	Of those who reported fall at baseline, those with no fall during 12-month follow-up	141 of 263	54%	
		Ages 65+		Number of falls	327 fewer	49%	
	Li (2013)	Ages 65+ who reported fall at baseline	per 6 months	Of those who reported fall at baseline, those with no fall during 6-month follow-up	127 of 221	58%	
		Ages 65+		Fall rate improvement	58% to 31%	0.27	0.534482759

Stepping On							
					Observed	**Absolute Change**	**Relative Risk**
	Clemson (2004)	Ages 70+ with a fall in previous 12 months		Fall reduction			RR = 0.69 (.50, .96)
	Guse (2015)	Ages 65+		IRR for IP and ED discharges for falls vs control group			0.916 (.878, .954) and 0.911 (.844, .940)
	Mahoney (2020)	Ages 65+	per 6 months	Fall reduction, first 6 months (rate ratio)			0.62 (.57, .68)
			per 6 months	Fall reduction, second 6 months (rate ratio)			0.72 (.65, .80)
	Ford (2017)	Ages 65+	per 6 months	Average number of falls vs baseline	0.87 to 0.45	0.429	0.517241379
				Average number of ED visits vs baseline	0.07 to 0.02	0.05	0.285714286
				Average number of hospitalizations vs baseline	0.02 to 0.01 (p=NS)	0.01	0.5
				Average number of hospital days vs baseline	0.21 vs 0.06 (p=NS)	0.15	0.285714286
SAIL							
					Observed	**Absolute Change**	**Relative Risk**
	Shum-way Cook (2007)	Ages 65+		Incident fall rate vs control group	1.33 vs 1.77 per person-year	0.44	0.751412429
				% with any fall	55% vs 57%	2%	0.964912281

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ADDENDUM

FOLLOW-UP ANALYSIS

To examine the sustainability of the reductions in falls among this population, Juniper conducted a survey of former participants to ask about their experiences since their class ended. The results would shed light whether improvements in strength, balance, and self-efficacy gained during their class remained several months later.

A survey was mailed to 628 former participants in February of 2024. A total of 283 responded, representing a 44% response rate, including participants of all four class types (MOB, SAIL, SO, and TJQ). Individuals were asked about any falls (and related injuries) since their class ended and about their fear of falling, activity level, isolation, and other aspects of well-being. All questions were modeled after questions in the surveys respondents had taken at the start and end of their class, so that responses could be compared over time.

An important note: the survey at the start of class asked participants to look back 90 days when reporting falls; for the follow-up survey, participants were asked to report falls since their class had ended, which on average was 207 days prior, ***more than twice as long as the look-back period of the survey taken at the start of class.***

During the 3 months prior to their class:

- Over 90 days, **28%** reported falling at least once, with a total of 117 falls;
- This equates to a fall rate of **1.75 falls per patient year**

Immediately following the class:

- Over an average of 58.2 days, **16%** reported falling at least once since the start of class (significantly less than prior to the class, $p<0.001$), with a total of 66 falls;
- The fall rate per time at risk was **1.48 falls per patient year**, a **15% reduction** from before class.

In the time since the class ended:

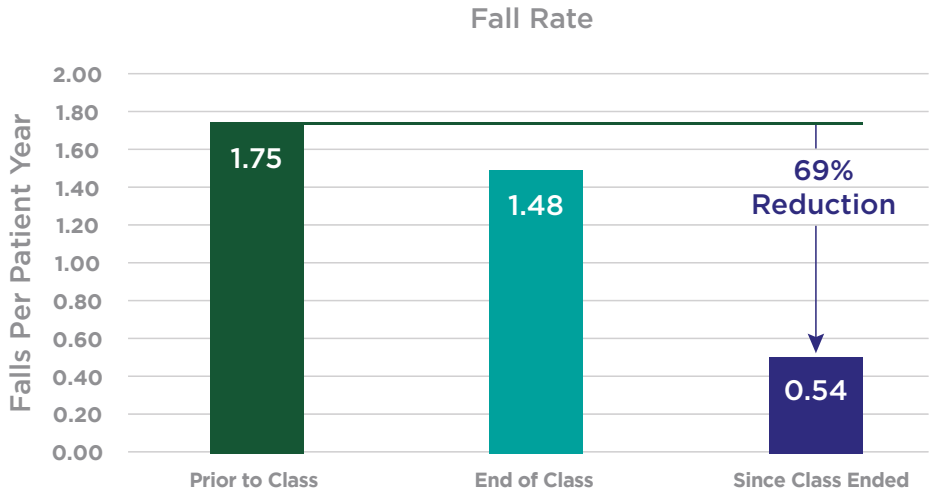
- Over an average follow-up of 207.3 days since their class ended, **21%** reported a fall, significantly less than prior to class ($p=0.0017$) **even though the reporting period was over twice as long, on average.**
- The fall rate was **0.54 falls per patient year** (86 falls); when compared to prior to their class, this produces a **"rate ratio" of 0.31**, which represents a **69% reduction in fall rate ($p<0.0001$).**

Also, compared with responses on the survey prior to the start of class:

- Participants reported significant reductions in the fear of falling **and** the interference with normal social activities by the end of class, **which were maintained through follow-up.**

FALL RATE

The fall rate was **0.54 falls per patient year** (86 falls); when compared to prior to their class, this produces a **"rate ratio" of 0.31**, which represents a **69% reduction in fall rate (p<0.0001).**



This significant reduction reflects fewer falls over a longer follow-up, indicating that the reduction in fall risk experienced from the class is sustainable over a longer period. This suggests that the gains in strength and balance are maintained and that **cost-savings associated with falls and fall-related injuries are likely to continue long after the class ends**.