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Older people's participation in and engagement with falls prevention interventions in community settings: an augment to the cochrane systematic review

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Abstract

Background: randomised controlled trials (RCTs) of fall prevention conducted in community settings have recently been systematically reviewed.

Objective: to augment this review by analysing older people's participation in the trials and engagement with the interventions.

Design: review of the 99 single and multifactorial RCTs included in the Cochrane systematic review of falls prevention interventions.

Setting: community.

Participants: adults aged 60+/mean age minus one standard deviation of 60+.

Methods: calculated aggregate data on recruitment (proportion who accepted the invitation to participate), attrition at 12 month follow-up (loss of participants), adherence (to intervention protocol) and whether adherence moderated the effect of interventions on trial outcomes.

Results: the median recruitment rate was 70.7% (64.2–81.7%, $n = 78$). At 12 months the median attrition rate including mortality was 10.9% (9.1–16.0%, $n = 44$). Adherence rates ($n = 69$) were $\geq 80\%$ for vitamin D/calcium supplementation; $\geq 70\%$ for walking and class-based exercise; 52% for individually targeted exercise; approximately 60–70% for fluid/nutrition therapy and interventions to increase knowledge; 58–59% for home modifications; but there was no improvement for medication review/withdrawal of certain drugs. Adherence to multifactorial interventions was generally $\geq 75\%$ but ranged 28–95% for individual components. The 13 studies that tested for whether adherence moderated treatment effectiveness produced mixed results.

Conclusions: using median rates for recruitment (70%), attrition (10%) and adherence (80%), we estimate that, at 12 months, on average half of community-dwelling older people are likely to be adhering to falls prevention interventions in clinical trials.

Keywords: *patient adherence; falls, accidental; intervention studies; patient participation; review, systematic*

Introduction

Falls are the leading cause of both fatal and non-fatal unintentional injuries in older people [1, 2]. In the community, annually a third of adults aged 65+ fall and of these 5% sustain a hip fracture or serious soft-tissue damage, and these prevalence rates increase with age [3–7]. Fall prevention interventions have been systematically reviewed by the Cochrane Collaboration differentiating between randomised controlled trials (RCTs) that targeted community-dwelling and institutional-dwelling older people [8, 9]. In community settings (111 trials), there is robust evidence to support exercise and Tai Chi as effective falls prevention interventions, but only partial evidence for home safety, multifactorial and psychotropic medication withdrawal interventions [8].

A limitation of the recent Cochrane systematic reviews was that they did not examine older people's participation in and engagement with the interventions. Regardless of how efficacious an intervention may be, it will have poor effectiveness if older people either decline to participate or do not adhere to the intervention protocol [10–12]. We augmented the Cochrane systematic reviews of falls prevention interventions to assist in both interpretation of the results of the RCTs and design of future clinical trials. We investigated: (i) recruitment and retention in the reviewed RCTs; (ii) adherence to interventions prescribed within the RCTs and (iii) whether adherence moderates the effect of interventions on trial outcomes. We report here our review of trials conducted in community settings (see [13] for institutional settings).

Method

Search strategy and selection criteria

The primary outcomes of the Cochrane review were the rate of falls and number of fallers. RCTs and quasi-randomised trials were included, and samples were either aged 60+ or a mean age minus one standard

deviation of 60+. Studies were identified from electronic searches including the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register, the Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, PsycINFO and AMED [8]. The review included all interventions in community-dwelling older people to reduce falls. We included all single interventions and separately all multi-faceted interventions based on individual falls risk assessment (multifactorial interventions). However, 13 trials that employed more than one intervention simultaneously (multiple interventions) [14–26] were excluded as data from these trials would be confounded by the combination of interventions.

The original citations for the trials used in the Cochrane review [8] were used in our review except for two studies where the unpublished data [27, 28] had either since been published [29] or the recruitment and attrition data were available from a prospective cohort publication [30]. For the five trials where the Cochrane review used a conference abstract [19, 23, 31–33], we were able to obtain further data on adherence for one study [34]. The two studies that were published in French [35, 36] were orally translated by a lecturer in French studies to the first author who made notes to include the data from these trials.

We followed the Cochrane review protocol of classifying single interventions in accord with the Prevention of Falls Network Europe [8, 37]:

- Exercise: supervised and unsupervised programmes such as walking and aerobics.
- Medication: vitamin D and/or calcium supplementation or medication review.
- Environmental/assistive technology: home adaptations and the provision of aids.
- Surgery: invasive interventions such as cardiac pacing and cataract surgery.
- Interventions to increase knowledge: education in falls and their prevention.

- Fluid/nutrition therapy: provision of dietary weight-gain supplementation.

Outcome measures

Our outcomes were recruitment, attrition, adherence and whether adherence moderated the effect of interventions on primary outcomes (rate of falls and fallers). For recruitment, in order to generalise to all older people, we would have required data for the total sampling frame (of both those approached and not approached) for each study. In the absence of these data, we measured the inclusion rate, i.e. the proportion of individuals invited to participate who were enrolled into the studies. Where possible, we recorded non-participation into the subcategories of refusal, non-response or willing but excluded (volunteered but did not meet the study inclusion criteria). We then calculated overall acceptance rates by adding those included into the trials with those willing but excluded, because some interventions require strict exclusion criteria to be effective with the target population (e.g. cardiac pacing) [41]. For attrition, we measured the duration of study follow-up and the number of participants retained and lost at final follow-up because of mortality or other reasons. To maximise comparability between studies, we calculated attrition rates at 12 months, including studies that collected data beyond this point (e.g. final follow-up at 24 months) if they provided data at 12 months. For adherence to interventions that require continued action, we recorded all data that indicated participants' degree of engagement with the intervention. For moderator analyses, we then recorded any data that tested whether the level of participants' adherence had an influence on trial outcomes.

Procedure

Data were stored and analysed using Excel 2003 and SPSS 16.0. A research assistant input the data for recruitment and attrition categorised by intervention type. All the data were checked by the first author who then input the data for adherence and moderator analyses. For each intervention type, we performed descriptive statistics on the outcome measures by generating a percentage for each paper and then calculating the average percentage from all the papers. Medians and ranges/inter-quartile ranges are reported as the distributions of the data for the measures of interest were substantially skewed. Meta-analysis was inappropriate as we calculated descriptive values rather than aggregate values from existing descriptive statistics.

Results

Ninety-eight papers published between 1990 and 2009 were reviewed. One study conducted a 2×2 trial that separately tested the efficacy of exercise and vitamin D supplementation to reduce falls [38], and so the treatment groups were included as two separate single interventions. Therefore, 99 interventions were reviewed and categorised into one of the following intervention types: exercise ($n = 39$), medication ($n = 17$), environmental/assistive technology ($n = 6$), surgery ($n = 3$), interventions to increase knowledge ($n = 2$), fluid/nutrition therapy ($n = 1$) and multifactorial ($n = 31$).

Recruitment

Rates of recruitment into trials are presented in Table 1. Two studies that employed interventions to

Table 1. Recruitment rates to fall prevention interventions in community settings ($n = 97$)

	Intervention											
	Exercise ^a		Medication ^b		E/A technology ^c		Surgery ^d		Fluid/ nutrition therapy ^e		Multifactorial ^f	
Recruitment	Median	IR ^g	Median	IR	Median	IR	Median	IR	Median	IR	Median	IR
Invited into study (n)	499.00	627.00	1463.00	10577.00	109.00	—	482.00	—	227.00	—	1031.00	1956.00
Accepted the invitation (n) ^h	246.00	241.00	539.00	3772.50	321.50	1196.25	371.00	—	159.00	—	547.00	863.00
% accepted the invitation ^h	64.2	52.7	81.7	70.8	71.4	—	79.9	—	70.0	—	68.4	46.3
% no response	9.4	37.1	77.5	—	37.6	—	—	—	2.2	—	18.9	26.3
% refused participation	19.4	32.4	12.9	8.3	28.7	—	20.1	—	18.9	—	13.4	19.5
% excluded	16.6	25.6	17.0	66.2	29.6	—	13.5	—	48.0	—	20.9	30.4

‘—’ is used when a calculation is inappropriate as less than one study provided data for this cell.

‘—’ is used when the inter-quartile range could not be calculated as only two to three studies provided data for this cell.

The two trials that employed interventions to increase knowledge [39, 40] are not reported in the above table as they provided insufficient data to be included in the analysis of recruitment rates.

^a n for the column from top to bottom = 31, 39, 31, 9, 20, 26.

^b n for the column from top to bottom = 15, 17, 15, 1, 10, 10.

^cE/A technology, environmental and assistive technology, n for the column from top to bottom = 3, 6, 3, 1, 2, 2.

^d n for the column from top to bottom = 3, 3, 3, 0, 3, 3.

^e n for the column from top to bottom = 1, 1, 1, 1, 1, 1.

^f n for the column from top to bottom = 25, 31, 25, 13, 19, 21.

^gIR = interquartile range.

^hThese rows were calculated by adding the participants included in the trials with those willing but excluded due to the study exclusion criteria.

increase knowledge [39, 40] provided insufficient data to be included in our analysis of recruitment rates. There was heterogeneity in the number of older people invited (109–1,463, median = 490.5, $n = 78$) and the acceptance rate to participate in the RCTs (64.2–81.7%, median = 70.7%, $n = 78$). The study with the lowest acceptance rate reported inviting 1,690 older people of which 164 accepted the invitation (9.7%) [115]. The median refusal rate was 19.2% (12.9–28.7%, $n = 55$), the median rate of those willing but excluded was 19.0% (13.5–48.0%, $n = 63$) and the median non-response rate was 18.9% (2.2–77.5%, $n = 25$). The study with the highest refusal rate reported 1,261 (63.4%) of the 1,989 invited refused [42]; the study with the highest rate of those excluded by the researchers reported 22,763 (93.9%) of the 24,251 screened were not included [41] and the study with the highest non-response rate reported no response from 6,359 (90.2%) of the 7,054 contacted [43].

Attrition

The 12-month attrition rates are presented in Table 2. The median 12-month attrition rate was 10.9% (9.1–16.0%, $n = 44$), and the study with the highest attrition rate reported losing 50 (33.3%) of the 150 participants assigned to an intervention arm [44]. Median attrition due to mortality was 1.5% (0.9–15%, $n = 33$), and the median 12-month attrition rate adjusted for mortality reduced to 9.3% (7.5–10.8%, $n = 44$). Studies with the highest attrition rates at 12 months reported 29 of 150 (19.3%) lost due to mortality [44] and 86 of 297 (29.0%) lost for reasons other than mortality [30].

Adherence

Adherence rates were not reported in 25 studies [31, 36, 44–66] and were not relevant for the five studies that provided surgery [41, 67, 68] or a nurse-administered single dose of vitamin D supplementation [38, 69]. The remaining 69 studies reported adherence rates under the following categories: exercise ($n = 31$), medication ($n = 12$), environmental/assistive technology ($n = 4$), interventions to increase knowledge ($n = 2$), fluid/nutrition therapy ($n = 1$) and multifactorial ($n = 19$) (detailed notes on these studies are available as Supplementary data at *Age and Ageing* online, Appendix 1).

Exercise interventions prescribed—solely or in combination—walking, individually targeted (home-based), or group-based sessions. For walking interventions, studies reported declines in activity [70], adherence rates of 7/10 (7 out of 10 participants) at 6 months [71], 71.0% at 12 months [72] and 57.3% at 10 years [73]. For individually targeted exercise, as seen in Table 3, adherence rates were high at 82.0% over 10 weeks but reduced to 52.0% over 12 months. Similar rates were found for studies that prescribed home-

based exercise 2 [74] or 3+ [32, 75–78] times per week. For class-based exercise, as seen in Table 3, adherence rates were initially high at 82.9% and slightly dropped to 76.0% over 24 months. Similar rates were reported for attending rehabilitation [79], <10 classes [35, 80] and classes over 10 weeks [38], 6 months [81, 82] and 12 months [83].

For medication interventions, the highest adherence rate was for vitamin D supplementation injected annually: every participant received the injection at baseline and <1.0% did not receive the injection at 12 and 24 months [84]. For the remaining studies that relied on participants to self-administer the vitamin D and/or calcium supplements, adherence rates tended to decline from 74.5% at 12 months to 46.8% at 24 months, though studies at 36 and 60 months reported adherence rates of 80.0–81.0% (see Table 4). For medication review trials, two studies have shown initial success (–12.0% inappropriate medications and odds ratio = 1.86 for medication changes), but older people found difficulty in relinquishing the use of psychotropics, non-steroidal anti-inflammatory drugs, benzodiazepines and thiazide diuretics [85, 86].

For environmental/assistive technology interventions, the median adherence rate in two studies was 58.0% (12.9–75.0%) and 59.3% (19.0–88.2%) [87, 88]. Other studies reported that 7/15 had had cataract surgery and 78.0% wore a walker boot as their primary winter footwear [89]. For interventions to increase knowledge, 22/30 [40] and a median of 43.0% of participants made a change in response to the advice (30.0–52.0%) [39], with 69.0–76.0% participating in home-based exercise [39]. For fluid/nutrition therapy, 68.0% consumed half or more of an oral nutrition supplement every week [90].

For multifactorial interventions, non-attendance rates for medical assessments ranged 8.2–41.8% (median = 16.3%, $n = 5$) [91–95] and rates for declining subsequent referrals ranged 4.5–85.0% (median = 22.0%, $n = 9$) [42, 92, 93, 96]. Attendance to referrals reduced from 74.0% during year 1 to 50.0% during year 3 [94] but increased from 4 to 12 months for visiting an ophthalmologist (27/89 to 52/91) and changing psychotropic medication (5/54 to 18/54) [97]. The median overall adherence rate to assessment-based recommendations was 76.0% (46.0–86.0%, $n = 5$) [91, 95, 98–100]. At 12 months, adherence rates to home modification recommendations were over 70.0% for making at least one change [91, 101], 55/63 (95.0%) for using an assistive device more, 25/41 (89.0%) for using a new assistive device [97] and home inspection rates were 37.0 and 31.3% at 1 and 2 years, respectively [93]. Rates for walking 2+ times per week reduced from 54.0% at 2 months to 42.0% at 6 months and 28.0% at 10 months [92]. At 12 months, walking was either not carried out [93] or carried out on average 14 min a day, 17.4 days a month [97]. Exercising at home 3+ times per week

Table 2. Attrition rates at 12 months to fall prevention interventions in community settings ($n = 44$)

Attrition	Intervention									
	Exercise ^a		Medication ^b		E/A technology ^c		Surgery ^d		Multifactorial ^e	
	Median	IR ^f	Median	IR	Median	IR	Median	IR	Median	IR
n at baseline	236.00	137.00	575.50	4801.00	573.00	1385.75	239.00	—	316.00	181.00
n at follow-up	199.50	108.50	467.00	4296.75	460.00	1209.00	218.00	—	280.00	165.00
% retained at follow-up	89.9	8.5	89.1	16.9	85.5	10.1	90.9	—	84.0	12.4
% died by follow-up	1.5	2.0	0.9	14.8	15.0	—	1.3	—	4.0	3.2
% lost at follow-up other than mortality	8.0	9.8	10.8	7.5	9.3	11.2	7.5	—	10.4	15.2

‘—’ is used when the inter-quartile range could not be calculated as only two to three studies provided data for this cell.

^a n for the column from top to bottom = 14, 14, 14, 11, 14.

^b n for the column from top to bottom = 6, 6, 6, 4, 6.

^cE/A technology, environmental and assistive technology, n for the column from top to bottom = 4, 4, 4, 3, 4.

^d n for the column from top to bottom = 3, 3, 3, 3, 3.

^e n for the column from top to bottom = 17, 17, 17, 12, 17.

^fIR, inter-quartile range.

Table 3. Adherence rates to prescribed individually targeted and class-based exercise interventions for the prevention of falls in community settings (in %, $n = 23$)

Duration in months ^a	Exercise intervention					
	Individually targeted			Class based		
	n	Median	Range	n	Median	Range
2	1 [38]	82.0	—	1 [79]	82.9	—
3	—	—	—	4 [43, 74, 112, 113]	89.2 ^b	85.4–91.0
4	—	—	—	3 [78, 105, 114]	83.2	71.0–84.6
6	—	—	—	5 [77, 81, 82, 115, 116]	78.2 ^c	74.0–95.0
9	1 [77]	58.0	—	—	—	—
12	2 [72, 78]	52.0	43.0–61.5	5 [83, 103, 104, 109, 110]	73.2	42.3–78.7
24	—	—	—	1 [117]	76.0	46.0–100.0

^aFigures represent adherence across the duration period assessed rather than at the time of follow-up.

^bThe figure excluding dropouts (91.0%) was used instead of the figure including dropouts (84.0%) [43].

^cThe figure excluding dropouts (95.0%) was used instead of the figure including dropouts (81.0%) [77], and the median adherence rate was used from a study that provided exercise classes for 6 months each year over a 3-year period with rates of 78% for year 1, 74% for year 2 and 73% for year 3 [115].

Table 4. Adherence rates to prescribed vitamin D and/or calcium supplementation for the prevention of falls in community settings (in %, $n = 7$)

Follow-up month ^a	n	Median	Range
4	1 [118]	65.2	—
6	2 [106, 119]	75.7	61.3 to 86.0–94.0
12	4 [106, 118, 120, 121]	74.5	50.4–96.0
18	1 [106]	58.6	—
24	1 [118]	46.8	—
36	3 [119, 122, 123]	81.0	64.0–81.7
60	1 [124]	80.0 ^b	—

^aFigures represent adherence at the time of follow-up.

^bThis figure reduces to 66% if those that dropped out due to mortality are included.

reduced from 56.0% at 2 months to 37.0% at 6 months, 24.0% at 10 months [92], 37.1% at 1 year and 34.9% at 2 years [93]. Over 12 months, exercise was performed for an average of 11.3 days per month

[97] and the average number of classes attended was 21/78 (0–82/67–90) [102].

Adherence as a moderator

Moderator analyses were reported in 13 studies under the categories of exercise ($n = 5$), medication ($n = 2$), environmental/assistive technology ($n = 1$), fluid/nutrition therapy ($n = 1$) and multifactorial ($n = 4$). For exercise, non-significant results were reported for an individually targeted intervention [38] and four class-based interventions [83, 103–105], though one study reported non-significant trends for fall rates to be lower in the subgroup that attended $\geq 75\%$ of classes (46.0%) versus $< 75\%$ of classes and controls (62.8–66.6%) [83]. For medication, non-significant moderator effects were reported for the prevention of falls [85] and fractures [106]. For environmental/assistive technology, an optometrist examination increased the incidence of falls, hence moderator analyses were significant for increasing the incidence of falls and fractures [107]. For fluid/

nutrition therapy, while a significant result was reported, the change in incidence of falls was similar in the adherent subgroup (33 down to 0) to the intervention group (25 down to 0) [90]. For multifactorial interventions, participants who made at least one recommended change to their home had significantly fewer falls at 12 months (incidence rate ratio = 0.64) [101] and those who reduced their consumption of target medications (<3) were significantly less likely to fall (versus ≥ 3) (odds ratio = 3.31) [96]. However, two studies reported non-significant results [98, 108].

Discussion

We augmented a previous systematic review of RCTs to prevent falls in community-dwelling older people [8]. We analysed data on recruitment, attrition, adherence and the potential for adherence to moderate the effect of interventions on trial outcomes. Our review suggested that on average 7 in every 10 community-dwelling older people are likely to accept the invitation to participate in falls prevention interventions. Average rates for non-response, refusal and exclusion (due to trial criteria) were all one in five, and by 12 months the attrition rate was 9 or 11% with mortality included.

Adherence rates were over 80% for home- and class-based exercise interventions in the first 2–4 months and on average over 70% for walking and class-based interventions at 12 months. However, adherence rates dropped to half by 12 months for individually targeted interventions. Adherence to vitamin D/calcium supplementation varied but was $\geq 80\%$ at 3 and 5 years, and was 99% in one study where it was annually injected. Adherence rates approximated 60–70% for fluid/nutrition therapy and interventions to increase knowledge, 58–59% for home modifications, but no improvement was observed for medication review at 12 months or for withdrawal of certain drugs. Multifactorial interventions generally had adherence rates of over 75%, though adherence to individual components ranged from 28 to 95%. Compared with multifactorial interventions, single interventions attracted higher adherence rates for all types of exercise including walking (+43.0% at 12 months) [72, 92], individually targeted (+26.0% at 2 months; +14.9% at 12 months) [38, 72, 78, 93] and class based (+43.1% at 12 months) [83, 102–104, 109, 110]. Low adherence within multifactorial interventions may therefore explain why they are only as efficacious as single interventions [111]. However, further research is required to directly compare single and multifactorial interventions, as the differences in adherence rates observed in our review may be explained by differences in the samples recruited and measures of adherence employed.

For moderator analyses, despite the established evidence-base for exercise interventions to reduce falls [8], all five exercise studies reviewed reported non-significant moderator effects. Perhaps these non-significant findings can be explained by the lack of efficacy of the interventions to prevent falls [38, 83, 104], not including adherence to the home-based element of the programme [103], and

using the 50% attendance rate as the cut-point between groups rather than a higher cut-point (e.g. $\geq 75\%$) [105]. For medication, two studies reported non-significant results, though the measures were limited to fracture rates or a 90-day follow-up [85, 106]. Multifactorial studies also provided mixed results, and so future moderator analyses are required with interventions shown to be efficacious.

Implications

Our estimates suggest that the design of future RCTs to reduce falls in community-dwelling older people should anticipate on average a recruitment rate of 70%, dropout rate of 10% by 12 months and an 80% adherence rate during the intervention. This equates to an overall participation and engagement rate of 50.4% at 12 months. As with our review of RCTs in institutional settings [13], these estimates raise concern that falls prevention interventions may be effective with only a self-motivated subgroup of individuals. In practice, health professionals may be able to increase engagement among older people through increased follow-up appointments and implementing guidelines on promoting falls prevention interventions [125, 126].

Limitations

Reporting of data for our review outcomes was not uniform and in particular for adherence. Uniformity in presenting data would facilitate pooling of results, and we suggest future studies report the average adherence rate in values and percentages for individuals (rather than classes) and at the time-point of follow-up(s) (rather than time periods). This review was limited in only including RCTs, and data from trials do not necessarily translate to interventions delivered in routine care. It is likely that RCTs will have lower recruitment rates than routine care because they entail the undesirable features of assignment to a non-treatment control group and repeated assessments, and some may object to participating in research.

Future research

Researchers could investigate how to increase participation and engagement in falls prevention trials. From our review, in accordance with intervention types that had the lowest rates for participation, particular attention is to be paid to: increasing recruitment to exercise and multifactorial interventions; decreasing attrition to multifactorial and environmental/assistive technology interventions and increasing adherence to individually targeted exercise, home modifications, medication review and components of multifactorial interventions. These modes of intervention are also important given current clinical evidence, which is robust for exercise and Tai Chi [8].

Conclusion

By 12 months it is possible that only half of community-dwelling older people are adhering to falls prevention interventions. This finding has relevance both to those designing clinical research trials and to those providing falls prevention programmes with the intention of reducing the population incidence of falls among community-dwelling older people.

Key points

- Fall prevention interventions rely on the active participation of older people.
- On average, 71% of community-dwelling older people contacted are recruited and 11% lost by 12 months.
- Adherence rates were highest at $\geq 80\%$ for vitamin D/calcium supplementation and initially for home- and class-based exercise.
- On average, by 12 months, half of community-dwelling older people are likely to be adhering to trial interventions.
- Attention should be paid to increasing recruitment into trials and adherence to interventions with demonstrated effectiveness.

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Author's contributions

S.R.N.: study concept and design, acquisition of papers for review, recruitment and supervision of research assistant, quality check of data input by research assistant, input data on adherence and effect on trial outcomes, analysis and interpretation and preparation of manuscript (first draft).

C.R.V.: preparation of manuscript (revised the manuscript with additional information and interpretation).

Conflicts of interest

None declared.

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Supplementary data

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

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- The long list of references supporting this review has meant that only the most important are listed here and are represented by bold type throughout the text. The full list of references is available at *Age and Ageing* online as Supplementary data, Appendix 2.
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