Institute for Musculoskeletal Health

A research partnership between Sydney Local Health District and the University of Sydney in musculoskeletal health and physical activity

Development and testing of a system dynamic model to project the health and economic impact of fall prevention initiatives in the community and aged care facilities

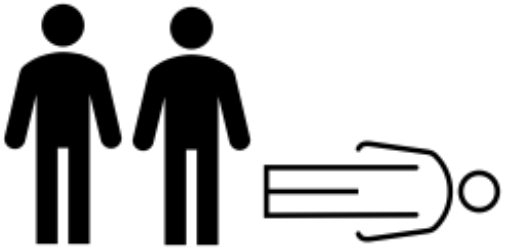
Marina Pinheiro, Danielle Currie, Saman Khalatbari Soltani, Andrew Milat, Adrian Bauman, Kirsten Howard, Cathie Sherrington

NSW Government Health Sydney Local Health District

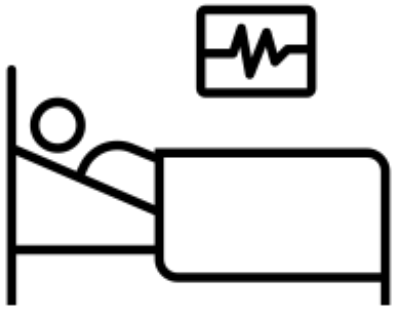
The University of Sydney

Falls are a common problem

Falls in Australians 65+



1 in 3 fall each year



364 admitted to hospital every day

$4.3 billion each year

Many falls are preventable

Strong evidence supporting fall prevention strategies

Many falls are prevented

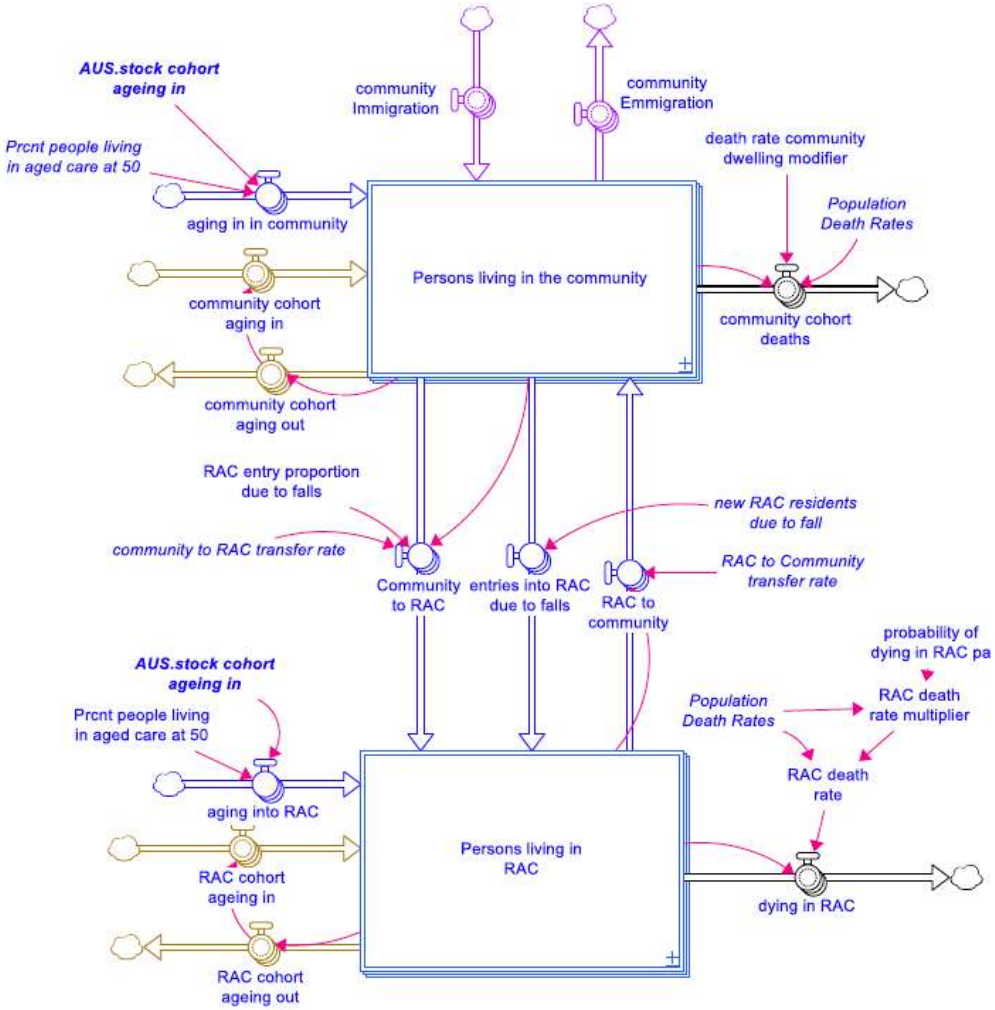
Impact of public health investment is difficult to project

- Complexity of health systems
- Reach
- Adoption
- Attrition
- Willingness to pay
- Population dynamics
- Interaction between factors over time

Economic evidence and resource allocation decisions

System dynamic modelling is well suited for simulating nonlinear behaviour in complex systems over time

Economic evaluations can be conducted using system dynamic modelling



Aim

To develop and test a system dynamics model to project the health and economic impact of fall prevention initiatives for people aged 50 years and over living in the community or in residential aged care facilities in Australia during 2023 to 2033

Methods

Updated and expanded a system dynamic model of osteoporosis and related burden in Australia

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Jones et al. Med J Aust 2024; 220:243-8

Participatory approach (32-member multidisciplinary modelling consortium)

Model inputs: literature, national and state databases (eg NSW Population Health Survey, AIHW)

Stella Architect

Methods

Behavioural validation: ability to reproduce historic trends from previous years

Face validity: stakeholder workshop

- Overview of the model
- Scenario testing
- Model critique

Methods

Extreme Condition Testing: testing the model under extreme, yet plausible, conditions to see if it produces reasonable results

Comparison with other model: high-quality published Markov model (22 scenarios)

Farag et al. Age and Ageing 2015; 44: 409–414

Agreement in classifying the intervention as cost-effective using an arbitrary willingness to pay threshold of $50,000 per QALY or DALY gained

Results

Model interactive components

i) Population dynamics

ii) Dynamics of the transition in/out of residential aged care

iii) Probability of falling and probability of having a fall-related injury requiring medical attention

iv) Strategies and scenarios

v) Economic components

Intervention – default parameters

Cochrane Library

Sherrington C, et al. Cochrane Database of Systematic Reviews 2019, Issue 1. Art. No.: CD012424

BMJ Journals

British Journal of Sports Medicine

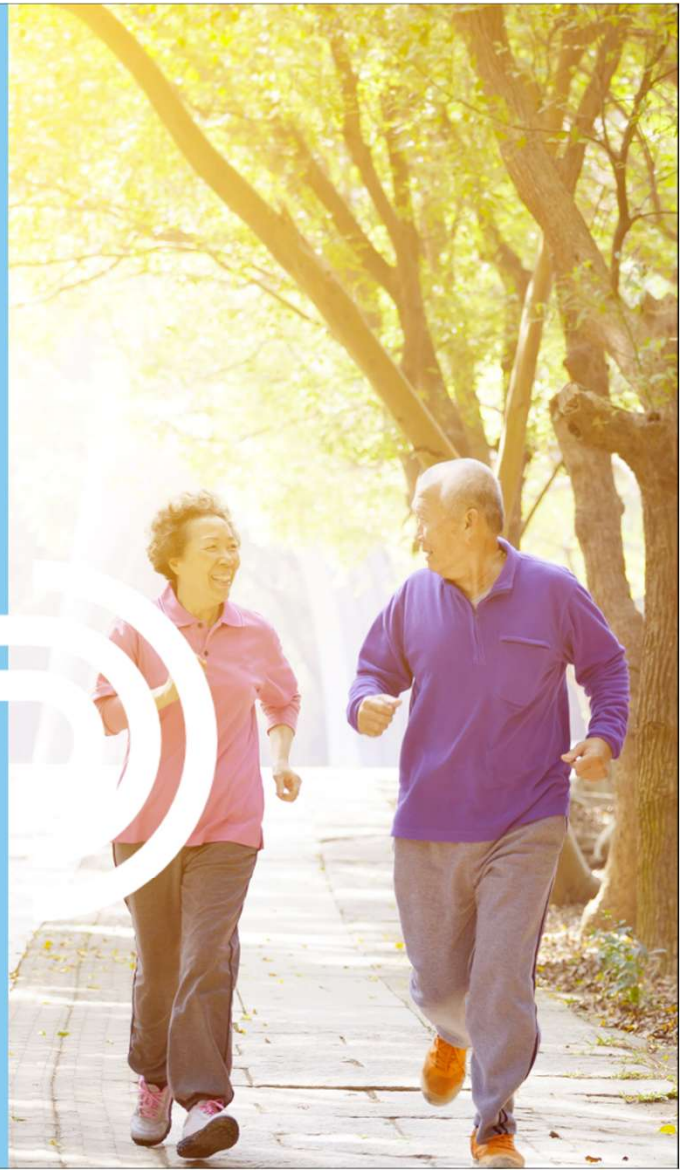
Pinheiro MB, *et al*. *Br J Sports Med* 2022;**56**:1353–1365.

Economic evaluations of fall prevention exercise programs: a systematic review

Falls prevention in Australia

The model's objective is to compare interventions targeted at reducing the number of falls experienced by older Australians living in the community and residential aged care.

START



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HOME ABOUT INSTRUCTIONS DASHBOARD CONTROL PANEL

POLICY OPTIONS

Falls prevention in the community

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Falls prevention in residential aged ca

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Open Control Panel

SELECT OUTPUT TYPE: Health | Economic | Intervention Reach

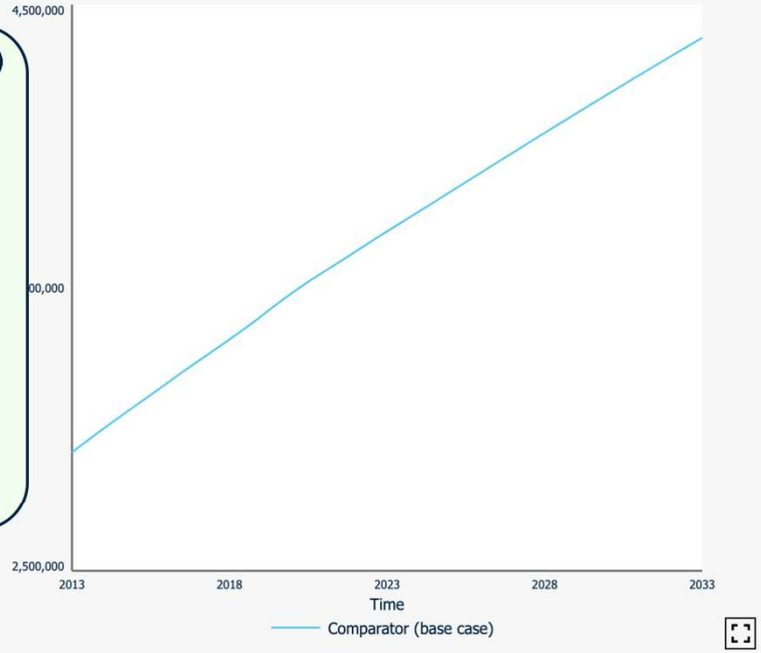
Select outcome to

Intervention snapshot

Start year	2024
End year	2029
Years to full implementation	3
Minimum age cut-off	60
Maximum age cutoff	80
% of eligible population targeted	100%
% of targeted population participating	5%
% reduction in falls risk for participating individuals	23%

Falls in the community

Annual rate: 1. Annual rate



Annual Count
4,382,900

Cumulative Count Starting in 2024
36,637,900

Cumulative difference from base case

comparison period: Ten years

(Starting in 2024)

0

2013 2033 Set Run Name Reset Comparator

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Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Falls prevention in residential aged care

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Open Control Panel

SELECT OUTPUT TYPE: Health | Economic | Intervention Reach

Total Costs

comparison period: Ten years

(Starting in 2024)

Annual

$30,693,196,000

Cumulative (2024 to 2034)

$179,893,220,000

(health sector expenditures)

$1,729,800,000

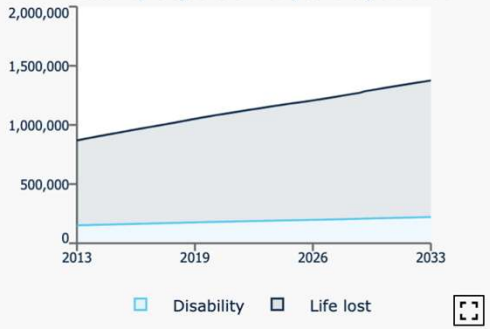
(intervention costs)

Cumulative difference from comparator (total costs)

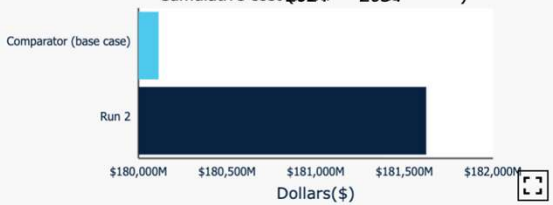
$1,509,346,000

Click here for detailed cost breakdown

Disability adjusted life years by source

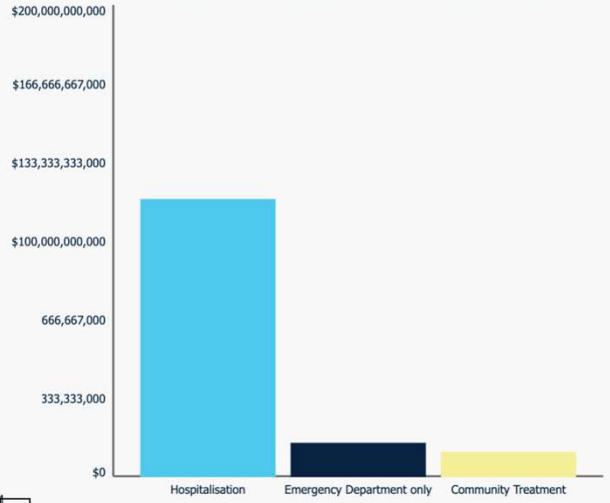


Cumulative cost (2024 2034)



5. Cumulative Direct Expenditures by type

Cumulative Direct Expenditures by type (over comparison period)



Falls Prevented (compared to base case)	DALYs avoided (compared to base case)	Cost per DALY avoided	Cost per treated fall prevented
16,530	22,020	$69,000	$91,000

Cumulative Net Benefit

(assuming a WTP cost per DALY of $50,000)

$-408,522,000

* all costs are presented in 2023 dollars (AUD)

2013 — 2033

Set Run Name | Reset Comparator

Falls Prevention in the Community

Hover here for a description of the default sample intervention

Population Reach

50 55 60 65 70 75 80 85 90 95 100

min and max age of eligible population

100%

% of age-specific population eligible to participate

5%

% of eligible population who will participate

Intervention Effect

% reduction in annual risk of falling for those who participate

0% 50% 100%

Intervention Cost

cost of Falls prevention in the community intervention per person

$988.00/person per year

Implementation Roll-out

Start Year: 2022 2024 2026 2028 2030

End Year: 2022 2025 2029 2032 2035

Years to full implementation: 1 3 6 8 10

Implementation ramp-up shape

Open Control Panel

2013 2033

Set Run Name

Reset Comparator

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POLICY OPTIONS

Falls prevention in the community

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Falls prevention in residential aged ca

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Open Control Panel

SELECT OUTPUT TYPE: Health | Economic | Intervention Reach

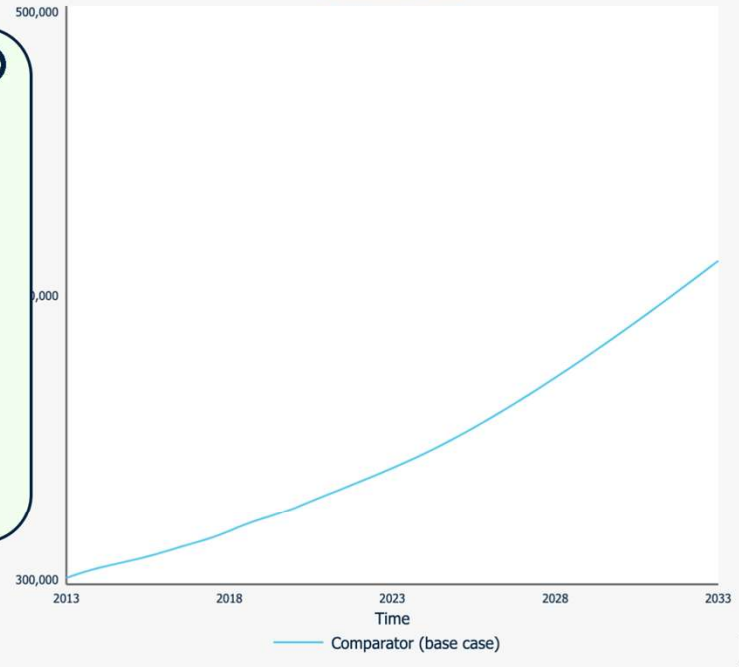
Select outcome to

Intervention snapshot

Start year	2024
End year	2030
Years to full implementation	5
Minimum age cut-off	65
Maximum age cutoff	104
% of eligible population targeted	50%
% of targeted population participating	25%
% reduction in falls risk for participating individuals	31%

Falls in RAC

Annual rate: 1. Annual rate



Annual Count
412,000

Cumulative Count Starting in 2024
3,379,400

Cumulative difference from base case

comparison period: Ten years
(Starting in 2024)

0

2013 2033

Set Run Name

Reset Comparator

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Falls prevention in the community

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Falls prevention in residential aged care

Turn intervention OFF/ON

View Intervention Snapshot

Edit Intervention Settings

Open Control Panel

SELECT OUTPUT TYPE: Health | Economic | Intervention Reach

Total Costs

comparison period: Ten years

(Starting in 2024)

Annual

$30,696,804,000

Cumulative (2024 to 2034)

$179,818,856,000

(health sector expenditures)

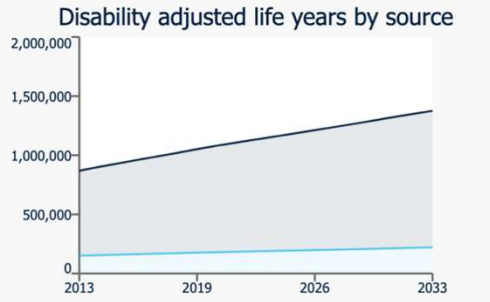
$92,400,000

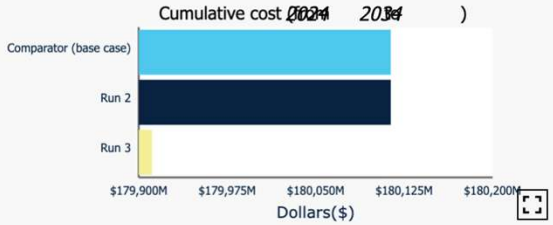
(intervention costs)

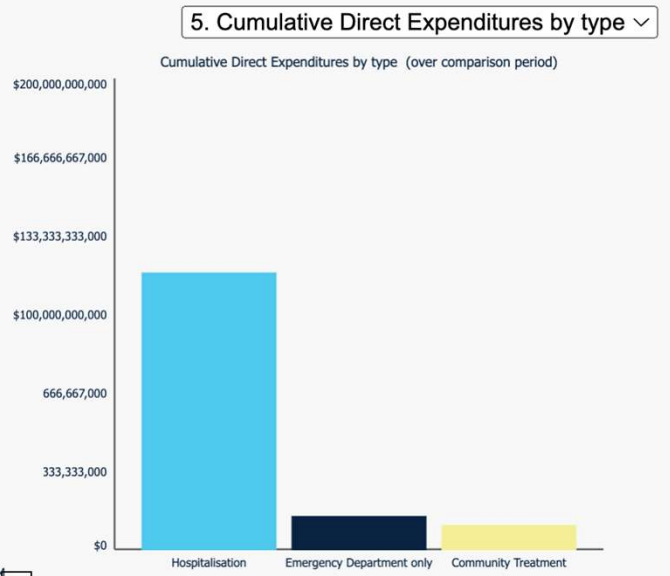
Cumulative difference from comparator (total costs)

$-202,451,000

Click here for detailed cost breakdown







Falls Prevented (compared to base case)	DALYs avoided (compared to base case)	Cost per DALY avoided	Cost per treated fall prevented
24,050	4,850	$-42,000	$-8,000

Cumulative Net Benefit

(assuming a WTP cost per DALY of $50,000)

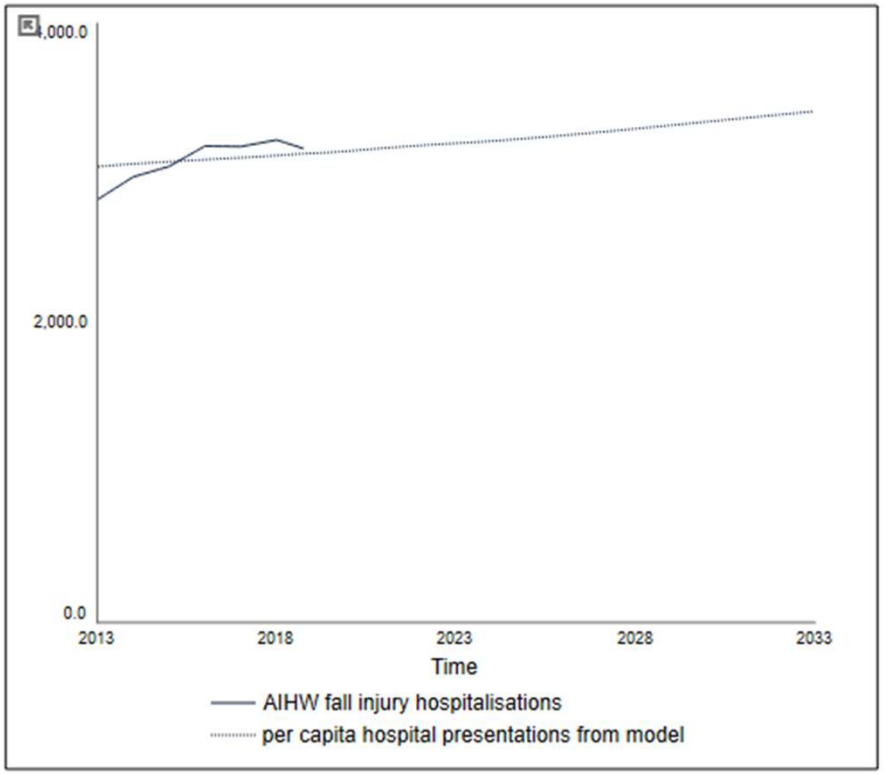
$444,958,000

* all costs are presented in 2023 dollars (AUD)

2013 2033 Set Run Name Reset Comparator

Results

Behavioural validation: Overall good ability to reproduce historical trends (AIHW data)



Results

Face validity: High (good or excellent ratings)

Extreme condition testing: Reasonable

Comparison with other model: Agreement 91% (20/22)

Discussion

Areas for further work:

- Further validation and testing is needed
- Improve policy-relevance of the model

New elements to be incorporated:

- Equity consideration
- Consideration of population falls risk
- Falls data (prevalence), unit costs, expand perspectives

Discussion

Potential impact

- Falls have not received sufficient policy attention as a public health issue. No national policy / strategy in Australia
- Potential to provide the evidence needed to support future national policy and actions
- Stakeholder engagement will ensure that the model is useful, relevant and trusted by users

Conclusion

- Preliminary validity, although further testing and development is needed
- Caution should be used when interpreting and using the results of this model
- We suggest that interpretation of outputs and selection of parameters for this model should be conducted using a **participatory approach** with **stakeholder engagement**

Thanks to

- Co-authors: Danielle Currie, Saman Khalatbari Soltani, Andrew Milat, Adrian Bauman, Kirsten Howard, Cathie Sherrington
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- NHMRC salary funding (ECF)

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Thank you!

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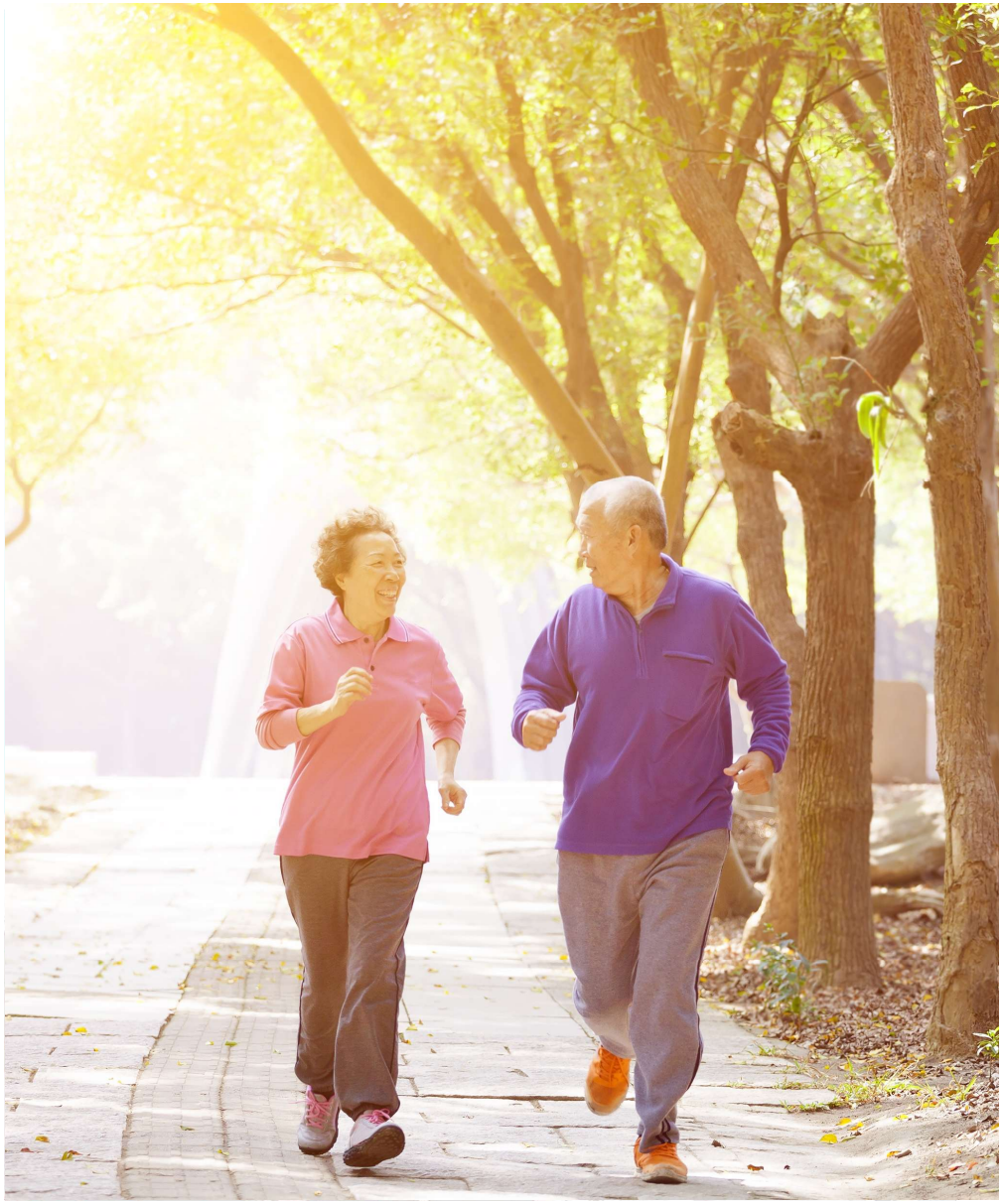

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