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Dual-task Exercise for Stroke Patients

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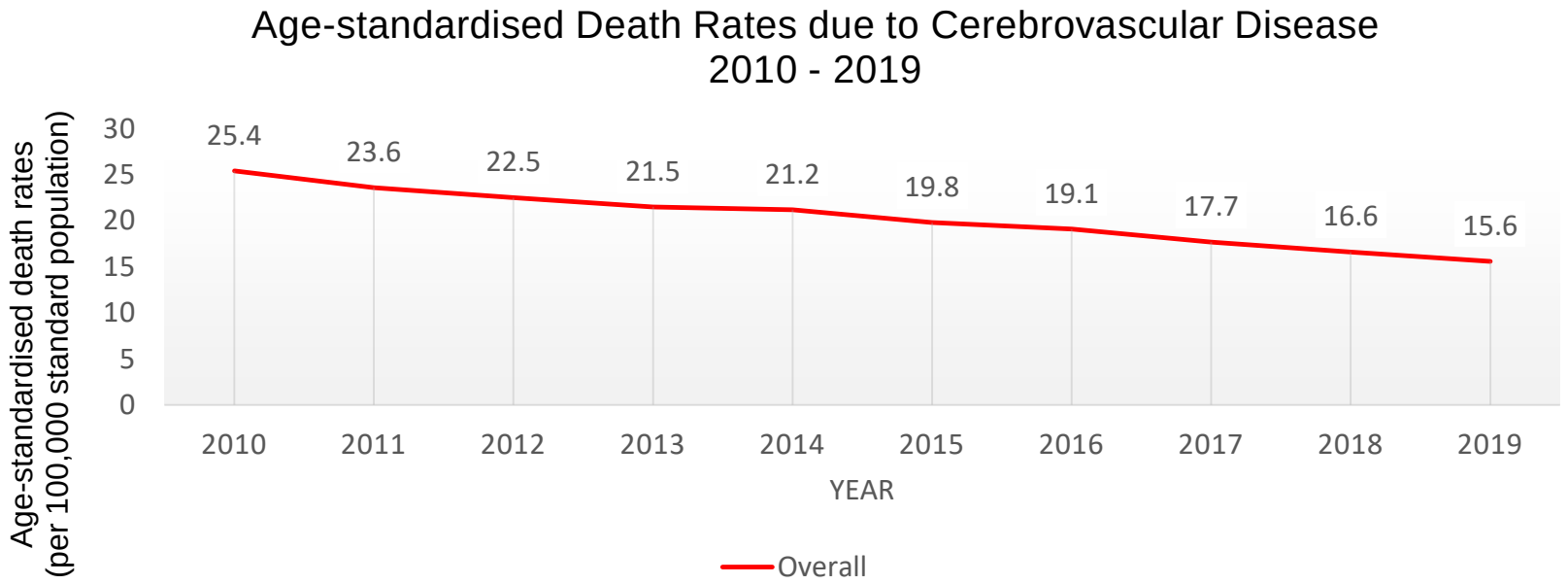
Background

Incidence of Stroke

Cerebrovascular Disease (Stroke)

- Over **25,800** hospital admissions in Hong Kong in 2017
- Death rates show steady downward trend
- Dealing with more stroke survivors in the community



Source: https://www.chp.gov.hk/en/statistics/data/10/27/339.html

Falls After Stroke

According to different studies, it is found that:

Fall rate after stroke	Percentage
During hospitalisation	11-65%
First 6 months after discharge from hospital	37-73%
Chronic stroke (stroke onset more than 6 months)	23-50%
Compared with age- and sex-matched peers	Relative risk: 2.2
Other fall-related complications	**Percentage**
Fall-related injuries	15-27%
Death	1.2-4%

Risk Factors of Falls Post-Stroke

Two major reasons

Reduced balance

Gait deficits

Other reasons

- Depression
- Cognitive deficits
- Self-care disability

Jorgensen et al., 2002; Czernuszenko et al., 2009; Weerdesteyn et al., 2008; Campbell et al., 2010; Xu et al., 2018

Conventional Physiotherapy

Conventional physiotherapy targets: balance and gait deficits in fall prevention

Balance exercise

Resistance training

Gait retraining
(manual assist, treadmill training, robot assisted gait training)

A recent Cochrane systematic review of literature and meta-analysis showed

- Uncertain that exercise may reduce the rate of falls and number of fallers compared with the control condition.
- For chronic stroke, exercise resulted in little or no difference in the rate of fall.

“Dual-task” Capability Required in Daily Lives

Performing an attention-demanding task while walking

- People always have to deal with “dual-task” in their daily lives:
  - Engaging in a conversation while walking
  - Using mobile phone while walking
  - Attending to the traffic signals while walking
  - Walking while shopping
- More deficits in stroke patients (Lundin-Olsson et al., 1997; Takatori et al., 2002)
- Associated with falls (Andersson et al., 2006; Hyndman et al., 2004; Hyndman et al., 2006; Baetens et al., 2013)

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Research Objectives

To examine the efficacy of the dual-task balance and mobility training program on:

- reducing the degree of cognitive-motor interference in mobility
- preventing falls in individuals with chronic stroke

Eligibility of Participants

- 50 years old or above
- 6 months or more after stroke
- Not institutionalized
- Medically stable
- Able to walk at least 10 m without manual assistance
- Ability to follow 3-step commands

Profile of Participants

- **84** patients with chronic stroke (28 participants/group)

Variable	Group 1 : Dual-task Training	Group 2 : Single-task Training	Group 3 : Control Group
Average age	59.9	61.2	62.4
Average time since stroke onset (years)	6.0	5.6	7.3
Gender (M/F)	6 / 22	8 / 20	10 / 18
Cognitive function Average MoCA score (0-30)	25.9	25.6	26.4
Leg motor impairment score (1-7)	5	5	5
Fallers in past year (n)	8	7	9

Study Design

- Stroke patients randomly allocated into 3 groups
- 60-minutes per session, 3 sessions per week for 8 weeks

Group 1 :
Dual-Task Training

30 mins
Flexibility exercises

30 mins **Dual-task training**
Balance / walking tasks +
Cognitive activities

Group 2 :
Single-Task Training

30 mins
Single-task
balance/mobility exercises

30 mins
Single-task
cognitive activities in sitting

Group 3 :
Control Group

60 mins
flexibility and upper limb exercises

Group 1 : Dual-Task Training

Primary balance / walking tasks

30 mins simultaneously

Cognitive tasks

examples

- Obstacle course
- Step-up
- Balancing/weightshifting
- Turning

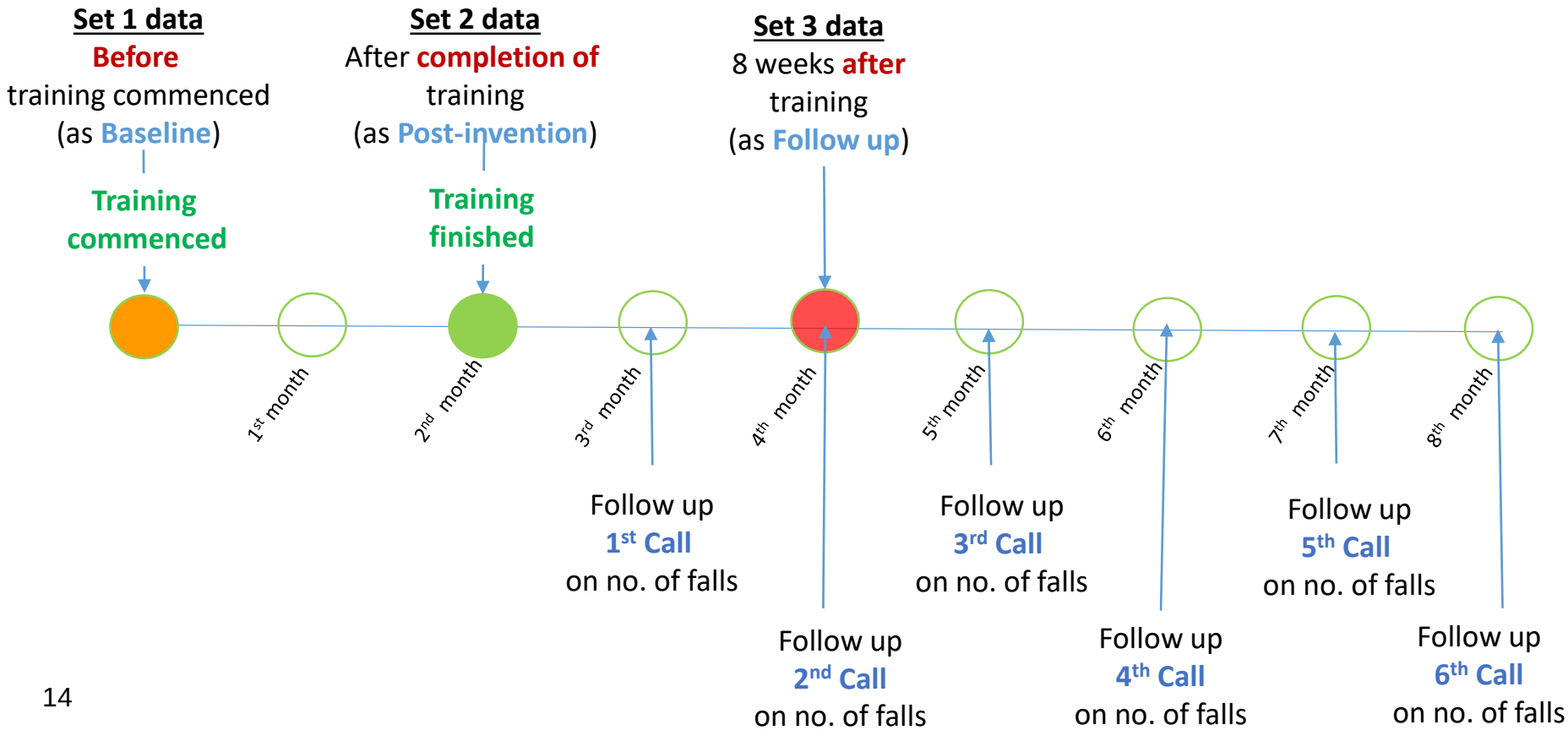
examples

- Verbal fluency (eg answering questions, telling stories)
- Mental tracking (eg counting)
- Working memory (eg memorizing shopping list)
- Discrimination and decision making (eg auditory discrimination)

Note:
Different levels of dual-task training are available and assigned to participants according to their severity of impairment

Evaluation Method

- Data was measured for each participant



Evaluation Method

Each participant underwent the following testing and his/her performance was recorded

Walking task (to measure the walking time)	
1	10-meter walk
2	Timed-up-and-Go (TUG)
3	Obstacle crossing

Cognitive task (to measure the accuracy)	
1	Verbal fluency
2	Serial 3 subtractions

Evaluation Method

Dual-task Effect (DTE%) in walking time

and

DTE% in Correct Response Rate (CRR)

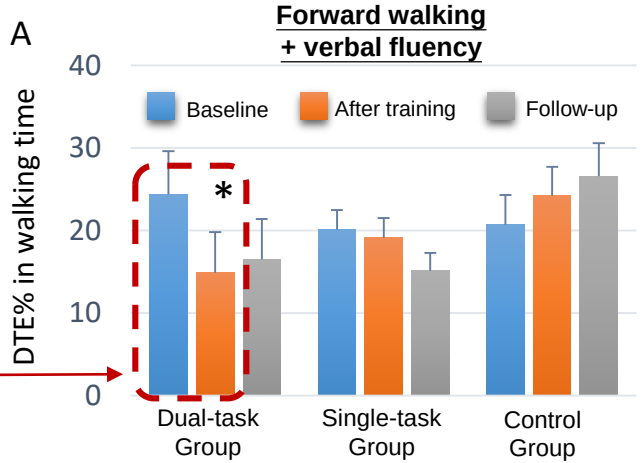
DTE% in Walking Time*	$= \frac{\text{Dual-task} - \text{Single-task}}{\text{Single-task}} \times 100$
DTE% in Correct Response Rate*	$= \frac{\text{Single-task} - \text{Dual-task}}{\text{Single-task}} \times 100$

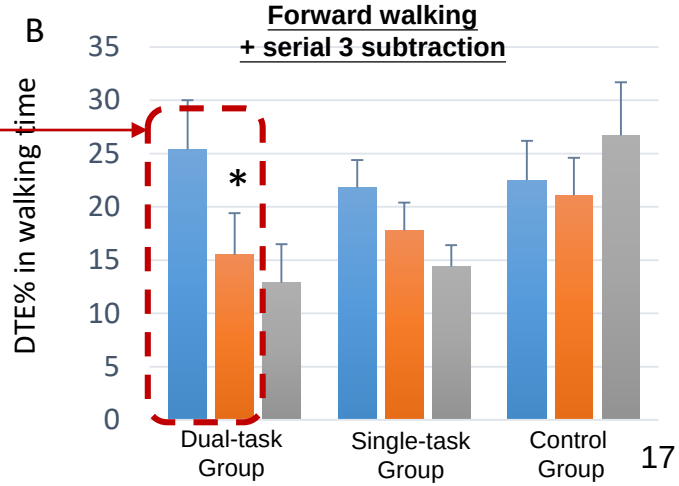
**the lower the value, the better the performance*

Result: Forward Walking

1. Forward Walking + Cognitive Task

- Improvement in the Dual-Task group after training, but not in the other two groups
- Walking + verbal fluency: DTE% decreased from 24% to 15% after Dual-Task training (i.e. 38% improvement)
- Walking + serial subtractions: DTE% decreased from 25% to 16% (i.e. 36% improvement)
- Training effect well maintained at 8-week follow-up





Result : Timed-Up-and-Go Test

2. Timed-Up-and-Go Test + Cognitive Task

- When combined with verbal fluency, Dual-task group showed significantly more improvement

Dual-task Group	Single-task Group	Control Group
Improved 53%	Improved 23%	Improved 13%

- When combined with serial subtractions, Dual-task group showed a trend of more improvement

Dual-task Group	Single-task Group	Control Group
Improved 50%	Improved 33%	Improved 3%

- No significant change in performance during the follow-up period

Result : Obstacle Crossing

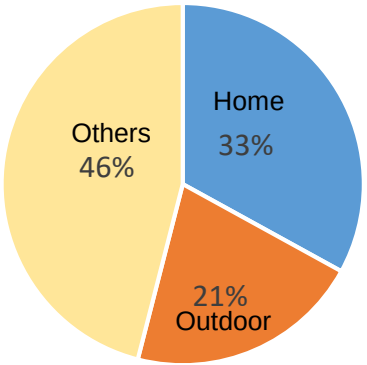
3. Obstacle Crossing + Cognitive Task

- This is the most difficult level of dual-task test among the three
- No significant improvement in Dual-Task obstacle crossing task in all groups, although a trend was observed
- Suggest to extend the training duration

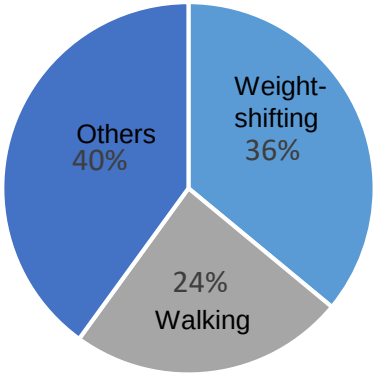
Other Findings: Fall Incidence

6-month follow-up period after training

- 17 fallers
- 33 falls in total
- Occurred at
  - 33% Home
  - 21% Outdoor

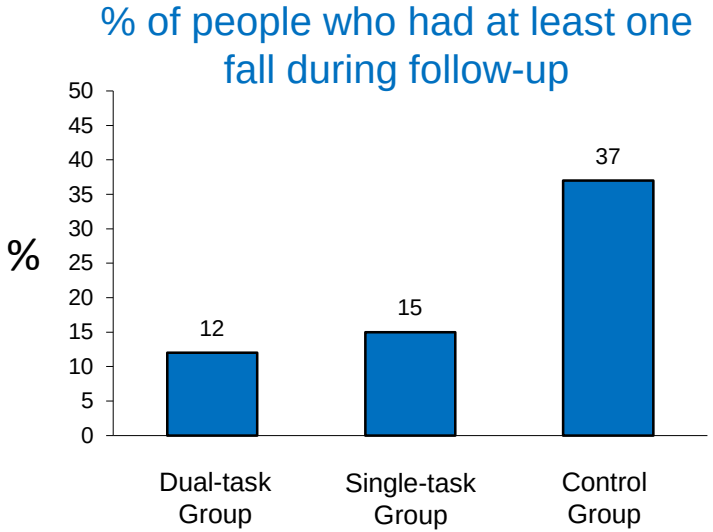


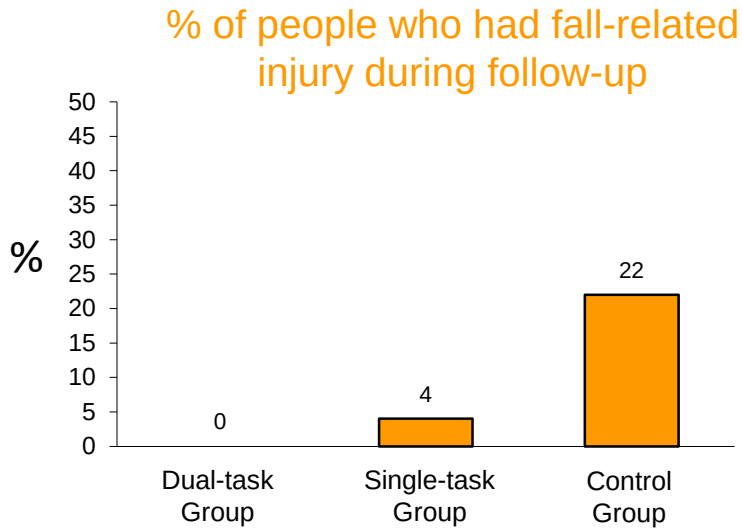
- Most common fall-related activities
  - 36% while weight-shifting
  - 24% while walking



Result: Number of Fallers and Injured Fallers

- **Dual-task** exercise led to significant **reduction** of fallers by **25.0%** and **fall-related injuries** by **22.2%**, compared with control group
- Such comparison between the single-task exercise group and control group showed a similar trend, but not significant

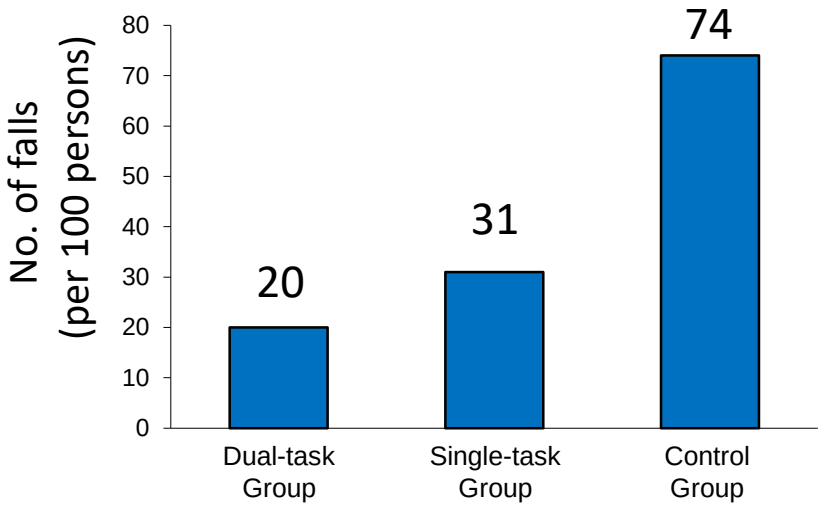




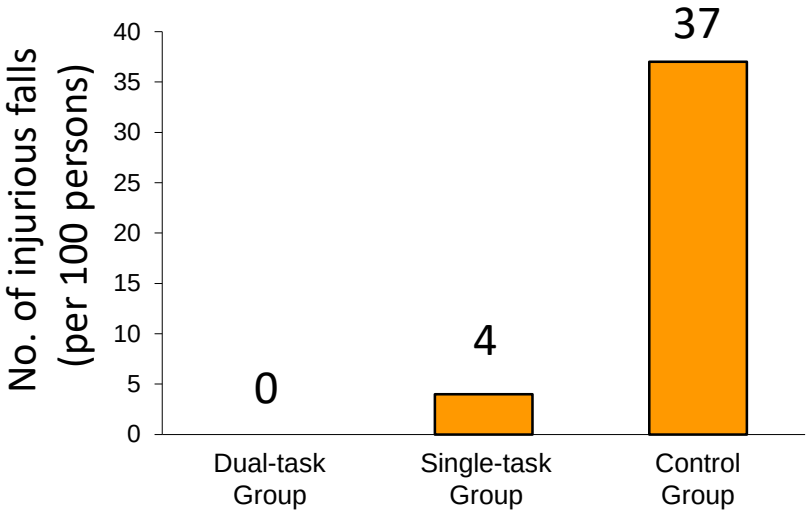
Result: Number of Fallers and Injured Fallers

- Significant **lower no. of falls** and fall-related injuries in **dual-task group** compared with control group

No. of falls (per 100 persons) during follow-up

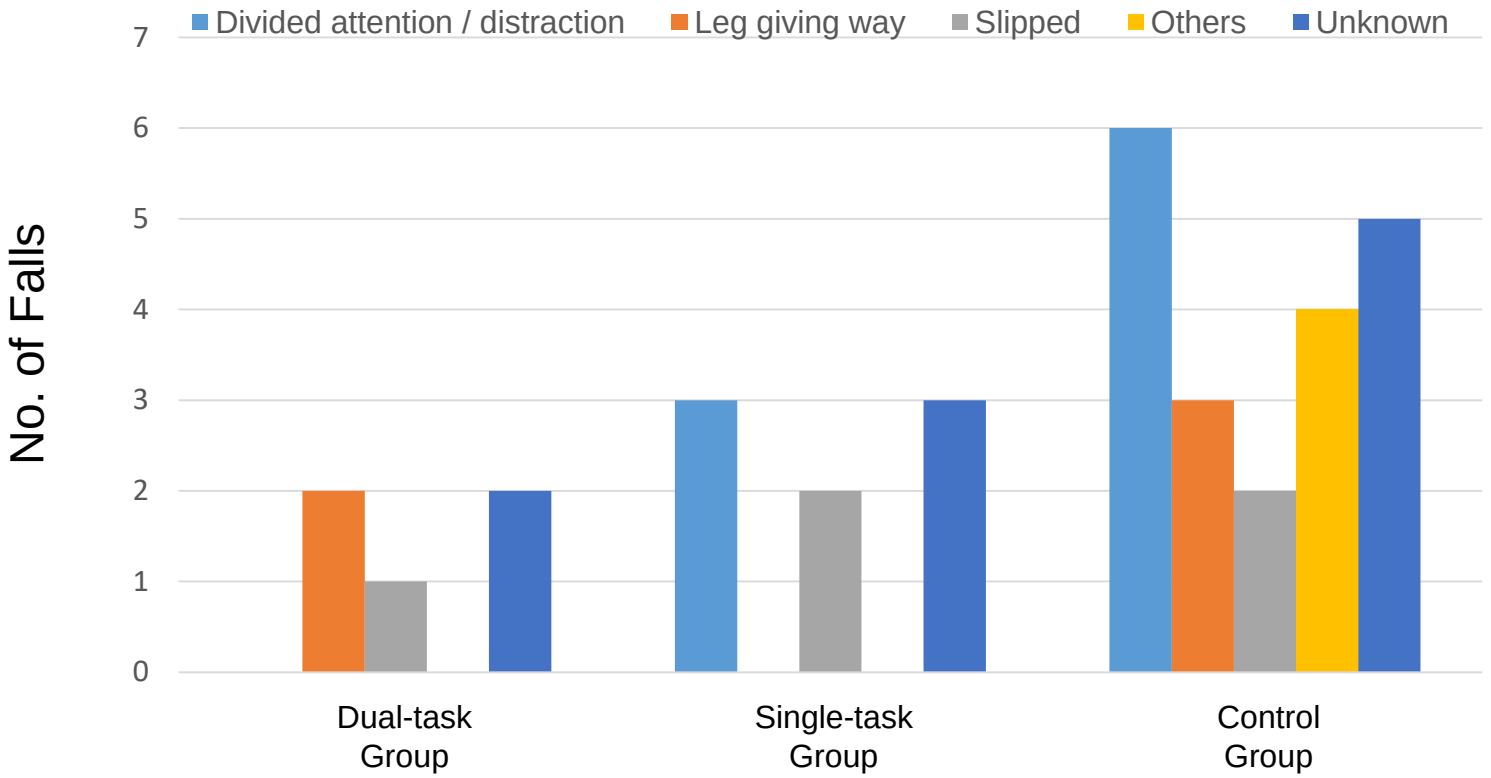


No. of injurious falls (per 100 persons) during follow-up



Other Findings: Circumstances of Falls

The most common perceived cause of falls was related to problems with divided attention (27%)



Conclusion

Conclusion

Dual-task training exercise can effectively facilitate stroke patients to resume their daily lives

- **Reduce** the risk of **falls** by **25.0%**
- **Reduce** fall-related **injuries** by **22.2%**
- **No special tools** are needed → can be widely adopted in community and home-based settings
- **Sustainable way** for stroke patients to continuously improve their quality of life

Note：
Stroke patient has to be assessed their readiness by physiotherapist for conducting dual-task training

Conclusion

The following non-governmental organisations are providing dual-task training services to stroke patients :

- Cheng Tak Yim Day Rehabilitation and Care Centre of The Hong Kong Society for Rehabilitation
- Continuing Rehabilitation Centre of The Spastics Association of Hong Kong

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