

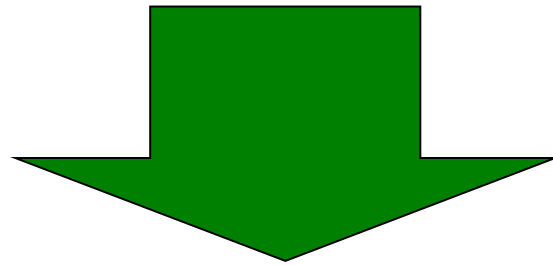
# *relevance and purpose*

- walking heel to toe (tandem gait) is
  - a dynamic balance assessment
  - a balance exercise for elderly.



prevention exercise of fall for elderly  
in social elderly care insurance of Japan

- TGI: tandem gait index (*Liu et al. 2005*)
  - TGI = expended timing + 2×mis-step(s)
    - considering not only an expended timing of tandem gait but also the number of mistakes during tandem gait (mis-step(s))
  - is a comprehensive dynamic balance test



The purpose of this study is to investigate the intra-rater and the inter-rater reliability of tandem gait tests.

# *method*

- subjects
  - 57 older people (49 females and 8 men,  $66.2 \pm 8.3$  years)
- tandem gait
  - The participants were instructed
    - to place one foot in front of the other making sure that, with each step, the heel of one foot was directly in front of the toes of the other foot a line of red tape (50mm width).
    - to walk forward as fast as possible without falling or making any mistakes.



- dependant variables
  - TGT: tandem gait time
    - We defined the expended timing of 5m tandem gait as TGT.
  - the mis-step(s)
    - steps taken with the whole foot outside the bounds of the red tape
  - TGI: tandem gait index



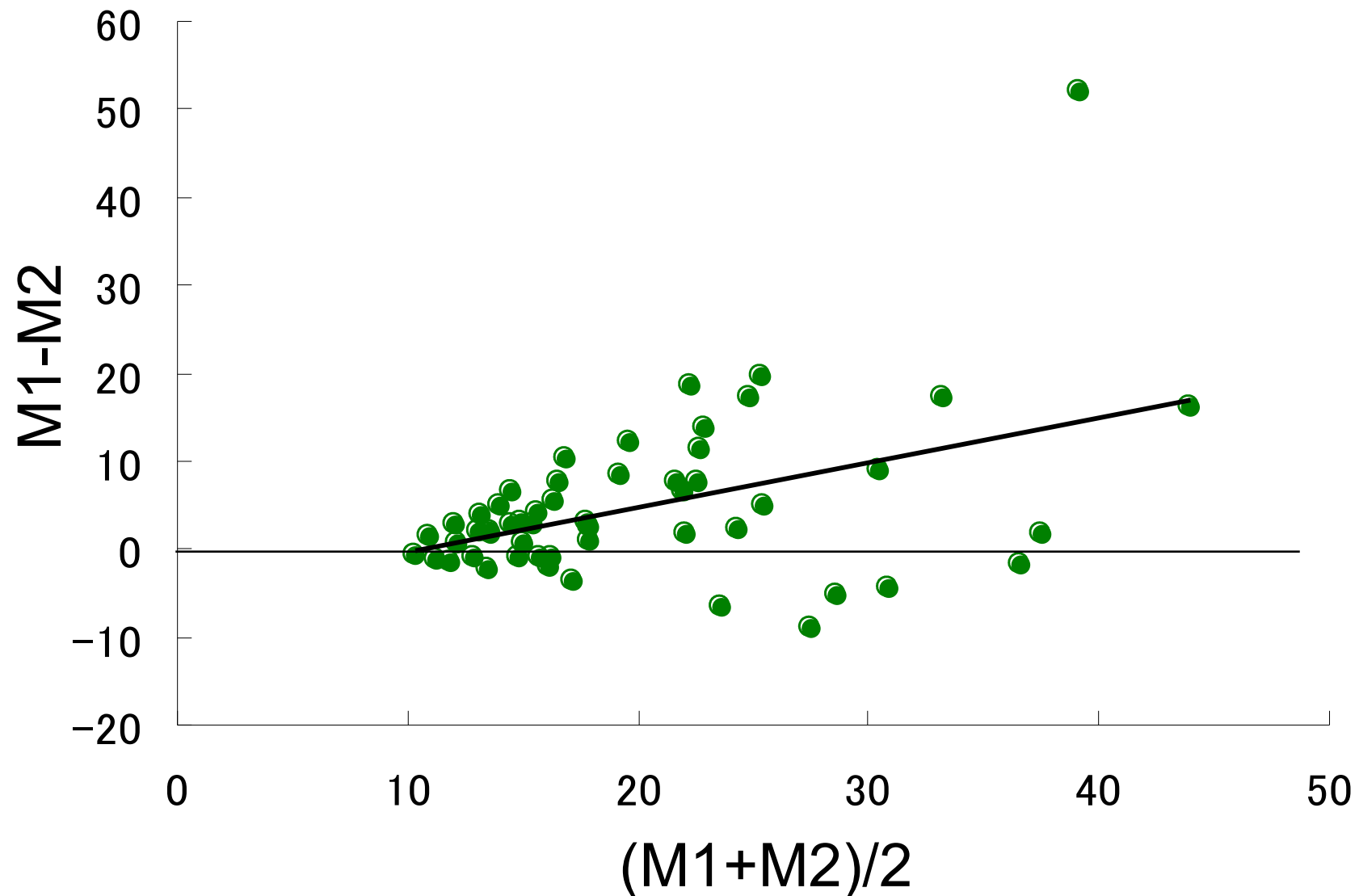
- assessors
  - assessor A: resident physical therapist (6 y. experience)
  - assessor B: physical therapy student
  - two assessors measure the TGT and TGI at the same time of day

# *statistics*

- Intraclass Correlation Coefficient (ICC)
  - The intra-rater reliability was calculated with ICC (1, 1)
  - in order to guarantee high reliability, we determined the number of measurements with ICC(1, k).
  - The inter-rater reliability was calculated with ICC(2, 1).
- Bland- Altman analysis (*Bland and Altman, 1986*)
  - purpose
    - to define the “limit of agreement”
    - to define the potential sources of systematic disagreement, fixed and proportional bias

## — procedure

- plot the differences between pair of values,  $(M1-M2)$ , against the corresponding means,  $(M1+M2)/2$ 
  - $M1, M2$ : values resulting from measurement of the same variable by two methods or two assessors



- “(optimistic) limit of agreement”

$$(\bar{d} - 2s) + t \times SE(\bar{d} \pm 2s) \sim (\bar{d} + 2s) - t \times SE(\bar{d} \pm 2s)$$

$\bar{d}$ : mean of difference,  $s$ : standard deviation of difference,

$SE(\bar{d} \pm 2s)$ : standard error of  $(\bar{d} \pm 2s) = \sqrt{\frac{3s^2}{n}}$

- define the systematic bias

- fixed bias

- » if there is no fixed bias between the two values, the mean of (M1-M2) should be zero
- » this hypothesis be tested by using 95% confidence interval (95% CI)

- proportional bias

- » if there is no proportional bias between the two values, the regression of differences on means should have a slope of zero
- » the Pearson's product-moment correlation coefficient and testing the hypothesis that  $r=0$



# result

- the intra-rater reliability

- tandem gait time: TGT

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	Bland-Altman analysis			
	ICC(1,1)	limit of agreement [sec]	fixed bias	proportional bias
assessor A	<b>0.78</b>	<b>-4.5 ~ 6.1</b>	<b>no</b>	<b>no</b>
assessor B	0.76	-5.1 ~ 6.3	no	yes

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- The condition for high intra-rater reliability of TGT was the three or more repetitive measurements.**

- tandem gait index: TGI

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	Bland-Altman analysis			
	ICC(1,1)	limit of agreement [sec]	fixed bias	proportional bias
assessor A	0.72	-6.7 ~ 11.2	yes	no
assessor B	0.40	-9.3 ~ 18.8	yes	yes

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- the inter-rater reliability

- tandem gait time: TGT

	ICC(1,1)	Bland-Altman analysis		
		limit of agreement [sec]	fixed bias	proportional bias
first test	0.77	-4.6 ~ 6.1	no	yes
<b>retest</b>	<b>1.00</b>	<b>-0.6 ~ 0.5</b>	<b>no</b>	<b>no</b>

- tandem gait index: TGI

	ICC(1,1)	Bland-Altman analysis		
		limit of agreement [sec]	fixed bias	proportional bias
first test	0.70	-12.2 ~ 10.6	no	yes
retest	0.58	-13.7 ~ 6.1	yes	no

# *discussion*

1. the tandem gait time (TGT)
  - has “fair” intra-rater reliability
  - can guarantee high reliability by three or more repetitive measurements.
2. the tandem gait index (TGI) has the systematic bias (fixed and/or proportional bias)
3. The reliability of both TGT and TGI depend on the experience of assessor