

# A Smart Sleep Apnoea Self-Management Support Program (4S) to Improve Positive Airway Pressure Therapy Adherence and Cardiovascular Health – A Pragmatic Randomized Controlled Trial With Mixed-Method Evaluation

Tsang Sabrina<sup>1</sup>, Yiu Denise<sup>2</sup>, Lit Maggie<sup>3</sup>, Chu Po-yee<sup>4</sup>, Lee Kuen-han<sup>3</sup>, Cheung George<sup>1</sup>, Lai Agnes<sup>1</sup>

<sup>1</sup>School of Nursing and Health Sciences, Hong Kong Metropolitan University, Hong Kong SAR, China; <sup>2</sup>Faculty of Health Sciences, Curtin University, Perth, Australia; <sup>3</sup>Queen Elizabeth Hospital, Hong Kong SAR, China; <sup>4</sup>Queen Mary Hospital, Hong Kong SAR, China;

## INTRODUCTION

- Integrating lifestyle modifications with strategies to enhance Positive Airway Pressure (PAP) Therapy adherence, supported by smartphone-based technology, offers a personalized care model for managing obstructive sleep apnea (OSA).
- This study evaluates the effect of the **Smart Sleep Apnea Self-management Support Programme (4S)** combined with usual care (UC), compared to **general hygiene information (GH)** plus UC, on improving apnoea severity and cardiovascular risk in OSA subjects.

## METHOD

- A pragmatic randomized controlled trial recruited 123 overweight, inactive subjects with moderate-to-severe OSA from outpatient clinics of two regional hospitals.
- Participants were randomly assigned to a **control group** receiving UC plus GH (n=59) or an **intervention group** receiving UC plus the 4S (n=64).

### The 4 key components of 4S for the intervention group

<b>01</b> Brief Motivational Interviewing Sessions	<b>02</b> Theory-based Theme-based Videos & Calls
<b>03</b> Proactive Personalised Chat-based & Phone Support	<b>04</b> E-platform

- Outcomes, including apnoea severity (primary), health-related cognition, PAP adherence, cardiovascular risk factors, and quality of life, were assessed at baseline, 4 months, and 12 months.

## RESULT

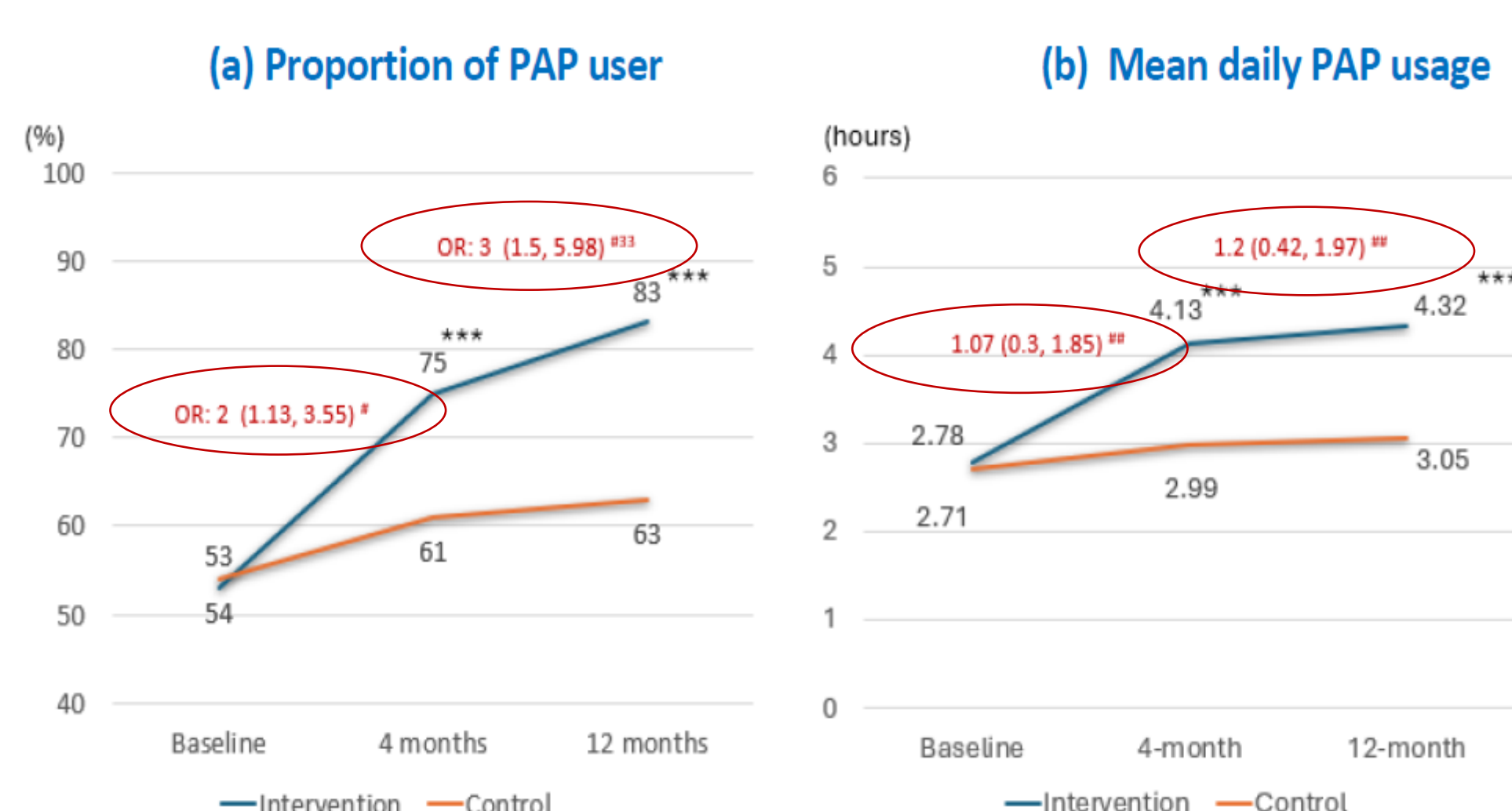
### Demographics

- 123 subjects (73.2% male, mean age 60 years & BMI 30 kg/m<sup>2</sup>) with moderate to severe OSA were recruited. No difference in patients' characteristics between 2 groups

	Intervention (n=64)	Control (n=59)
Age, years	61.6 ± 8.9	58.7 ± 10.9
Men	49 (76.6)	41 (69.5)
BMI, kg/m <sup>2</sup>	29.8 ± 3.9	31.0 ± 5.0
Respiratory event index, events/h	39.9 ± 18.8	39.4 ± 19.6

### Effects on Positive Airway Pressure (PAP) adherence

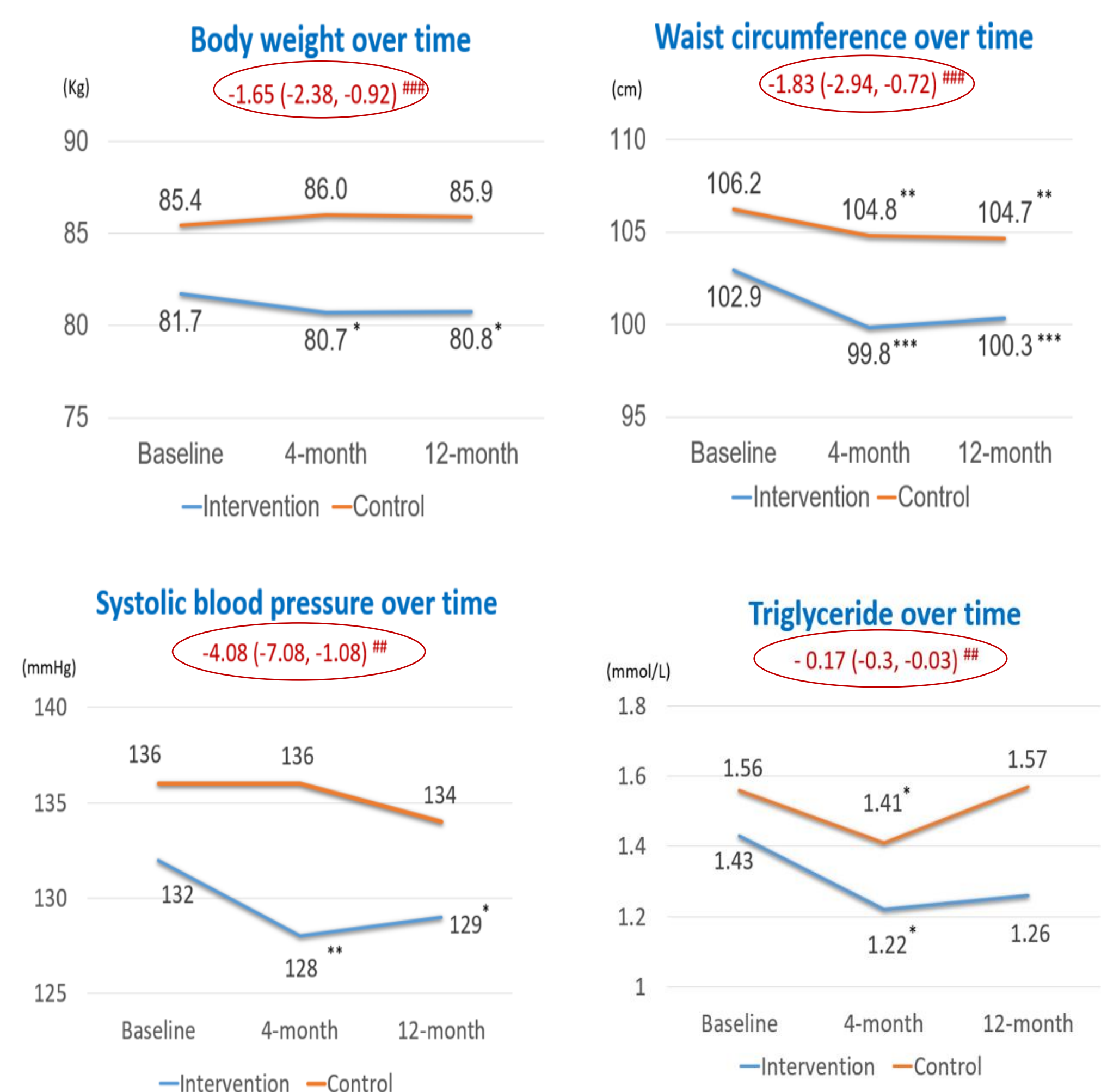
- The intervention group showed greater improvements in PAP adherence, with a threefold increase in users ( $P < 0.001$ ) and higher daily usage (+1.2 hours/day,  $P < 0.001$ ). The between-group differences were statistically significant.



## RESULT

### Effects on Cardiovascular Profile

- The intervention group showed greater reductions in body weight (-1.65kg,  $P < 0.001$ ), waist circumference (-1.83cm,  $P < 0.001$ ), systolic blood pressure (-4.08 mmHg,  $P < 0.001$ ), and triglyceride (-0.17 mmol/L,  $P = 0.02$ ). The differences between groups were statistically significant and sustained at 12 months.



### Effects on Health-related Quality of Life

- Significantly greater reduction in insomnia symptoms (-0.9 units,  $P = 0.04$ ) and better sleep functional outcome (+0.46 units,  $P = 0.02$ ) in the intervention group than the control group.

	Intervention Group N = 64		Control Group N = 59		Between-group difference	
	Mean ± SD	P Value <sup>1</sup>	Mean ± SD	P Value <sup>1</sup>	Estimates (95%CI)	P Value <sup>2</sup>
<b>Insomnia Severity Index</b>						
Baseline	8.28 ± 4.29		7.97 ± 4.51		-0.9 (-1.75, -0.04)	0.04*
4 months	7.19 ± 3.89	0.03*	7.81 ± 4.82	0.78		
12 months	6.7 ± 3.75	< 0.001***	7.51 ± 4.39	0.36		
<b>Epworth Sleepiness Scale</b>						
Baseline	7.8 ± 3.32		7.73 ± 4.59		-0.69 (-1.46, 0.09)	0.08
4 months	7.05 ± 3.65	0.06	7.47 ± 4.37	0.52		
12 months	7.14 ± 4.14	0.18	8.07 ± 4.01	0.45		
<b>Functional Outcomes of Sleep Questionnaire</b>						
Baseline	17.39 ± 1.93		17.29 ± 2.26		0.46 (0.07, 0.85)	0.02*
4 months	17.77 ± 1.81	0.09	17.59 ± 2.22	0.31		
12 months	17.94 ± 1.89	0.02*	17.73 ± 1.91	0.11		

### Effects on All Sleep Parameters of Newly Diagnosed Subjects

- For the newly diagnosed OSA subjects, the intervention group reported significantly greater improvements in all sleep parameters than the control group (all  $P < 0.05$ ).

	Intervention Group N = 27		Control Group N = 21		Between-group difference	
	Mean ± SD	P Value <sup>1</sup>	Mean ± SD	P Value <sup>1</sup>	Estimates (95%CI)	P Value <sup>2</sup>
<b>Apnea Hypopnea Index, events/hour</b>						
Baseline	37.56 ± 16.28		39.22 ± 17.27		-5.97 (-11.54, -0.41)	0.036*
4 months	32.9 ± 17.98	0.134	37.73 ± 17.47	0.576		
12 months	29.58 ± 14.83	0.013*	39 ± 19.18	0.948		
<b>Oxygen Desaturation Index, events/hour</b>						
Baseline	32.17 ± 16.43		38.33 ± 18.94		-9.61 (-14.74, -4.47)	< 0.001***
4 months	25.63 ± 15.63	0.031*	36.71 ± 17.8	0.541		
12 months	23.69 ± 11.99	0.012*	39.07 ± 18.88	0.797		
<b>Minimum oxygen saturation, %</b>						
Baseline	72.26 ± 12.76		71.38 ± 9.59		3.39 (0.48, 6.29)	0.023*
4 months	77.52 ± 7.58	0.007**	73.62 ± 10.72	0.200		
12 months	77.85 ± 7.83	0.029*	74.24 ± 8.67	0.090		

### Qualitative feedback

- At 12 months, feedback from the interviews with participants in the intervention group at 12 months highlighted that tailored, practical content and simple video messages supported healthy diet adherence.
- Flexibility, regular feedback, and easy activities (e.g., walking) encouraged exercise. Personalized messages, phone support, and practical PAP tips improved their PAP adherence.

## CONCLUSION

- The 4S programme significantly improved **PAP adherence**, **cardiovascular health**, and **quality of life**, proving to be a sustainable, effective approach for managing OSA.