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EVALUATING THE VALIDITY OF A SMARTPHONE STEP-COUNTER IN ADULTS WITH ASTHMA: A PROOF-OF-CONCEPT STUDY

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Introduction: Regular physical activity and structured exercise are often reported to be associated with improved asthma control - however the majority of published evidence is limited by short-term studies employing subjective measures of assessment (i.e. self-report / questionnaires). Modern smartphones typically include built-in activity sensors (i.e. possess the capability to monitor daily step-count) and thus may offer a cost-effective and pragmatic solution to the assessment of physical activity in clinical practice and/or research trials. The primary aim of this proof-of-concept study was therefore to evaluate the validity of the iPhone® (Apple Inc, USA) step-counter in adults with asthma and healthy controls.

Methods: The study was conducted as a cross-sectional laboratory based-trial. Ten healthy adults with no prior history of respiratory disease and ten adults with a prior physician diagnosis of asthma were enrolled. All completed baseline clinical assessment followed by a standardised walking treadmill challenge consisting of 3 x 3-minute stages at pre-determined speeds: 2.5kph, 5.0kph and 7.5kph. Steps were recorded using the following devices: (i) Yamax Digiwalker™ SW-200 Pedometer (Yamax, UK), (ii) iPhone® step-counter (upper body arm-band), (iii) iPhone® step-counter (lower body trouser pocket) - and evaluated against a video-verified manual step-count (i.e. gold-standard comparator) conducted by the investigator (CR).

Results: No difference was observed in manual total step-count between individuals with asthma (1018 steps) and healthy controls (1038 steps) (P=0.44). The iPhone® step-counter (both upper and lower body) provided close agreement with video-verified manual step-count, and importantly, outperformed the Yamax Digiwalker® SW-200 Pedometer across the majority of test stages. Specifically, the iPhone® (lower body) correlated strongly (r = 0.96; P<0.006) and produced the highest level of agreement with video-verified total step-count (mean bias: -11; limits of agreement: -43 to 21) (Table 1).

Conclusion: Our findings indicate that the iPhone® provides an accurate estimate of step-count in adults with asthma and healthy controls completing a standardised laboratory-based treadmill test. Prior to implementation, further research is required to determine the validity and reliability of this approach during daily active / free living conditions.

Table 1. Comparison of step-count devices during a standardised walking treadmill challenge.

Device (speed)	Step-count (mean SD)	P-value	ICC	Mean bias	LOA
Video-verified manual count (2.5kph)	253 (18)	-	-	-	-
iPhone upper	242 (42)	0.24	r = 0.33	-11	-89 to 67
iPhone lower	253 (21)	0.99	r = 0.77	0	-27 to 27
Digiwalker	179 (70)	<0.0001	r = 0.37	-74	-203 to 55
Video-verified manual count (5.0kph)	337 (17)	-	-	-	-
iPhone upper	336 (18)	0.86	r = 0.88	-1	-17 to 16
iPhone lower	333 (16)	0.003	r = 0.96	-4	-14 to 6
Digiwalker	329 (28)	0.23	r = 0.40	-8	-59 to 44
Video-verified manual count (7.5kph)	439 (29)	-	-	-	-
iPhone upper	431 (30)	0.009	r = 0.91	-8	-33 to 17
iPhone lower	430 (35)	0.009	r = 0.93	-9	-33 to 17
Digiwalker	433 (31)	0.004	r = 0.97	-6	-20 to 9
Video-verified manual count (total)	1028 (56)	-	-	-	-
iPhone upper	1009 (67)	0.08	r = 0.74	-19	-108 to 70
iPhone lower	1017 (58)	0.006	r = 0.96	-11	-43 to 21
Digiwalker	942 (99)	<0.0001	r = 0.66	-86	-233 to 60

Definition of abbreviations: ICC, Intra-class correlation; LOA, Limits of agreement