

Additional File 3: Suppl Table 1 Sample sizes (*n*) and number of steps derived from direct observation and each wearable technology at each treadmill speed for all sample (21–85 years)

	Treadmill speed, km/h (mph)									
	Slow				Normal				Fast	
	0.8 (0.5)	1.6 (1.0)	2.4 (1.5)	3.2 (2.0)	4.0 (2.5)	4.8 (3.0)	5.6 (3.5)	6.4 (4.0)	7.2 (4.5)	8.0 (5.0)
<i>n</i>	258	248	245	239	232	223	194	128	40	5
Direct observation	282.8 ± 96.9 (140 – 657)	365.4 ± 69.4 (195 – 666)	431.9 ± 52.1 (326 – 707)	484.7 ± 39.0 (386 – 653)	529.4 ± 33.2 (445 – 648)	568.9 ± 32.2 (501 – 659)	603.9 ± 34.4 (528 – 718)	644.0 ± 37.8 (562 – 742)	689.3 ± 43.2 (620 – 780)	727.4 ± 42.6 (675 – 787)
<i>n</i>	250	241	238	232	226	218	190	125	39	5
Actical	2.8 ± 21.8 (0 – 278)	21.2 ± 56.9 (0 – 650)	176.1 ± 128.9 (0 – 630)	419.7 ± 110.9 (0 – 648)	527.8 ± 78.5 (0 – 660)	564.9 ± 93.4 (0 – 675)	602.3 ± 94.7 (0 – 738)	642.0 ± 108.9 (0 – 818)	704.6 ± 43.9 (635 – 820)	740.0 ± 41.8 (685 – 795)
<i>n</i>	254	244	241	235	229	220	191	126	40	5
ActiGraph GT9X (Waist)	7.8 ± 28.8 (0 – 283)	64.5 ± 74.5 (0 – 505)	202.9 ± 103.0 (3 – 448)	418.9 ± 87.2 (30 – 558)	520.7 ± 49.1 (255 – 603)	567.2 ± 62.9 (3 – 675)	605.5 ± 51.7 (308 – 713)	633.5 ± 87.8 (0 – 815)	654.6 ± 104.9 (315 – 803)	607.0 ± 119.7 (418 – 728)
<i>n</i>	254	244	241	235	229	220	192	126	40	5
ActiGraph GT9X (Wrist)	52.1 ± 59.2 (0 – 315)	99.6 ± 67.7 (0 – 343)	118.6 ± 80.4 (0 – 413)	169.9 ± 95.2 (0 – 495)	235.8 ± 83.8 (5 – 563)	277.6 ± 75.6 (23 – 608)	310.0 ± 68.7 (68 – 738)	328.1 ± 59.2 (30 – 648)	357.6 ± 80.4 (245 – 800)	371.0 ± 22.7 (340 – 398)
<i>n</i>	249	239	236	230	225	217	188	124	39	5
activPAL	183.1 ± 121.9 (0 – 620)	352.6 ± 80.1 (20 – 660)	431.8 ± 50.8 (325 – 665)	484.6 ± 39.4 (380 – 650)	530.5 ± 33.2 (445 – 650)	569.4 ± 38.8 (270 – 665)	605.9 ± 34.4 (530 – 725)	646.0 ± 38.0 (560 – 775)	686.8 ± 38.2 (620 – 760)	717.0 ± 39.0 (675 – 780)
<i>n</i>	174	164	161	155	149	140	117	60	15	1
Apple Watch Series 1*	108.6 ± 157.5 (0 – 641)	291.0 ± 132.8 (0 – 666)	423.5 ± 74.6 (115 – 701)	475.9 ± 58.6 (98 – 728)	524.1 ± 64.1 (399 – 981)	565.5 ± 42.6 (449 – 681)	587.6 ± 59.4 (217 – 740)	630.6 ± 67.0 (272 – 751)	697.5 ± 62.2 (624 – 850)	662.0
<i>n</i>	258	248	245	238	232	220	194	127	40	5
Digiwalker SW-200	23.0 ± 56.0 (0 – 435)	100.8 ± 116.3 (0 – 659)	241.5 ± 145.0 (0 – 703)	352.7 ± 139.4 (0 – 710)	448.1 ± 120.3 (23 – 642)	527.0 ± 90.9 (57 – 653)	582.4 ± 67.1 (302 – 700)	636.9 ± 45.9 (427 – 734)	688.3 ± 46.3 (570 – 780)	730.2 ± 47.7 (675 – 801)
<i>n</i>	98	89	86	81	75	66	48	17	3	
Fitbit Ionic[†]	48.3 ± 118.4 (0 – 526)	185.9 ± 160.9 (0 – 534)	404.1 ± 90.2 (22 – 581)	477.4 ± 49.6 (385 – 640)	517.6 ± 40.3 (384 – 634)	550.2 ± 42.8 (420 – 659)	576.0 ± 52.1 (442 – 705)	629.7 ± 53.1 (534 – 749)	631.0 ± 44.6 (580 – 663)	
<i>n</i>	160	159	159	158	157	156	146	110	37	6
Fitbit One[‡]	6.0 ± 32.1 (0 – 344)	211.1 ± 135.4 (0 – 666)	412.8 ± 48.7 (317 – 665)	477.1 ± 35.6 (382 – 651)	526.0 ± 32.3 (442 – 647)	566.5 ± 32.5 (498 – 652)	601.7 ± 32.7 (528 – 675)	642.0 ± 37.8 (562 – 740)	686.9 ± 43.9 (620 – 780)	605.2 ± 299.1 (0 – 786)

<i>n</i>	98	89	86	81	75	66	48	17	3	
Fitbit Zip[†]	3.8 ± 27.5 (0 – 267)	35.4 ± 75.6 (0 – 383)	385.7 ± 124.6 (0 – 563)	480.1 ± 63.4 (29 – 608)	533.1 ± 62.3 (467 – 979)	566.1 ± 31.9 (503 – 652)	603.6 ± 38.6 (526 – 712)	644.8 ± 41.3 (563 – 738)	681.0 ± 39.2 (640 – 718)	
<i>n</i>	96	89	86	80	73	66	48	17	3	
Garmin vivoactive 3[†]	47.7 ± 114.6 (0 – 553)	271.0 ± 156.7 (0 – 550)	430.6 ± 64.8 (236 – 636)	482.1 ± 37.2 (398 – 573)	515.2 ± 54.4 (154 – 615)	564.0 ± 33.0 (495 – 655)	597.2 ± 34.4 (527 – 707)	637.4 ± 38.7 (558 – 707)	671.3 ± 31.9 (637 – 700)	
<i>n</i>	77	76	75	74	75	75	69	44	12	1
Garmin vivoactive HR^{**}	35.1 ± 102.6 (0 – 502)	308.5 ± 146.2 (0 – 665)	402.8 ± 70.0 (47 – 627)	471.0 ± 38.3 (379 – 619)	518.5 ± 31.0 (437 – 595)	546.5 ± 45.6 (322 – 603)	556.8 ± 78 .0 (329 – 897)	527.2 ± 90.1 (326 – 727)	510.4 ± 105.9 (369 – 663)	492.0
<i>n</i>	80	80	80	80	79	78	73	64	25	4
Garmin vivofit 2^{††}	15.5 ± 66.3 (0 – 525)	267.1 ± 130.8 (0 – 565)	401.7 ± 41.3 (320 – 515)	472.7 ± 33.7 (390 – 555)	524.9 ± 28.6 (460 – 580)	554.1 ± 36.9 (395 – 625)	547.9 ± 71.9 (295 – 675)	531.2 ± 105.1 (265 – 665)	572.4 ± 129.6 (325 – 790)	595.0 ± 102.7 (460 – 710)
<i>n</i>	77	76	76	75	75	72	70	45	12	1
Garmin vivofit 3^{**}	60.3 ± 123.0 (0 – 567)	337.1 ± 117.9 (21 – 665)	465.6 ± 95.2 (329 – 727)	477.9 ± 40.4 (413 – 651)	521.9 ± 34.7 (435 – 643)	566.8 ± 40.3 (497 – 757)	599.3 ± 42.7 (527 – 819)	637.9 ± 42.3 (563 – 725)	696.6 ± 52.3 (631 – 795)	781.0
<i>n</i>	224	215	214	210	208	201	179	122	39	5
GENEActiv (Waist)	236.3 ± 100.4 (30 – 625)	382.8 ± 75.5 (150 – 663)	430.6 ± 50.4 (325 – 660)	481.4 ± 37.9 (385 – 645)	529.3 ± 33.3 (445 – 650)	567.9 ± 35.5 (365 – 665)	605.2 ± 36.7 (468 – 725)	640.6 ± 72.2 (0 – 798)	694.9 ± 43.2 (623 – 788)	729.5 ± 42.6 (673 – 780)
<i>n</i>	217	209	207	203	201	194	175	118	40	5
GENEActiv (Wrist)	212.9 ± 106.6 (3 – 623)	392.4 ± 66.5 (208 – 670)	429.9 ± 45.4 (338 – 690)	471.2 ± 41.3 (333 – 625)	503.2 ± 51.0 (325 – 625)	525.4 ± 70.1 (295 – 665)	538.3 ± 90.7 (318 – 723)	552.1 ± 105.2 (303 – 740)	566.4 ± 126.4 (370 – 805)	578.5 ± 99.4 (425 – 685)
<i>n</i>	258	248	245	239	232	222	194	126	40	5
NL-1000	12.4 ± 46.4 (0 – 435)	95.8 ± 113.0 (0 – 679)	342.0 ± 120.6 (3 – 664)	458.8 ± 62.7 (74 – 653)	519.7 ± 59.2 (55 – 645)	565.2 ± 60.8 (90 – 967)	597.8 ± 60.4 (62 – 715)	643.7 ± 37.5 (562 – 741)	687.1 ± 41.1 (620 – 780)	723.6 ± 46.3 (670 – 793)
<i>n</i>	98	89	85	81	75	66	48	17	3	
PiezoRx[†]	85.7 ± 132.0 (0 – 553)	342.0 ± 126.9 (0 – 568)	448.2 ± 54.5 (217 – 578)	489.3 ± 37.6 (406 – 610)	530.8 ± 34.5 (465 – 639)	570.0 ± 33.4 (502 – 657)	594.2 ± 82.1 (105 – 717)	672.5 ± 130.1 (566 – 1159)	680.7 ± 36.7 (642 – 715)	
<i>n</i>	97	87	85	80	74	65	47	17	3	
Polar M600[†]	62.3 ± 123.6 (0 – 512)	174.0 ± 160.2 (4 – 564)	347.3 ± 134.7 (34 – 578)	463.4 ± 86 (20 – 617)	510.8 ± 65.6 (292 – 803)	552.4 ± 82.5 (24 – 708)	585.6 ± 63.8 (456 – 844)	626.2 ± 47.4 (548 – 731)	666.7 ± 36.1 (635 – 706)	
<i>n</i>	80	79	79	77	77	78	73	47	12	1
Samsung Gear Fit2^{**}	18.4 ± 75.9 (0 – 485)	106.1 ± 147.7 (0 – 631)	407.2 ± 119.4 (31 – 717)	467.1 ± 67.6 (1 – 638)	514.4 ± 36.7 (398 – 621)	557.7 ± 37.9 (467 – 664)	590.3 ± 33.8 (494 – 660)	627.0 ± 38.8 (557 – 711)	610.1 ± 69.0 (474 – 683)	620.0

<i>n</i>	98	89	86	81	74	66	48	17	3	
Samsung Gear Fit2 Pro [†]	33.9 ± 103.1 (0 – 589)	143.1 ± 157.7 (0 – 529)	386.4 ± 136.0 (0 – 679)	468.9 ± 38.9 (394 – 577)	508.8 ± 40.3 (439 – 613)	552.6 ± 41.9 (356 – 658)	584.9 ± 34.9 (485 – 685)	609.2 ± 27.5 (559 – 662)	637.0 ± 12.5 (625 – 650)	
<i>n</i>	253	243	240	234	227	218	189	125	40	5
StepWatch	271.7 ± 109.7 (45 – 625)	387.9 ± 65.0 (200 – 670)	433.8 ± 50.7 (355 – 690)	484.9 ± 38.3 (395 – 648)	530.3 ± 33.1 (450 – 650)	568.7 ± 37.2 (310 – 665)	605.2 ± 32.9 (530 – 700)	640.7 ± 35.6 (520 – 705)	636.0 ± 54.9 (530 – 705)	593.0 ± 86.9 (520 – 700)

Values represent the average number of steps ± standard deviation (minimum – maximum). *AppleWatch Series 1 was worn by Middle-Age (41–60 years) and Older Adults (61–85 years). †Fitbit Ionic, Fitbit Zip, Garmin vivoactive 3, PiezoRx, Polar M600, Samsung Gear Fit2 Pro were worn by Older Adults (61–85 years). ‡Fitbit One was worn by Young (21–41 years) and Middle-Age Adults (41–60 years). **Garmin vivoactive HR, Garmin vivofit 3, Samsung Gear Fit2 were worn by Middle-Age Adults (41–60 years). ††Garmin vivofit 2 was worn by Young Adults (21–41 years). See **Additional file 2** for a graphical classification of wearable technologies by age groups.

Additional File 3: Suppl Table 2 Sample sizes (*n*) and number of steps derived from direct observation and each wearable technology at each treadmill speed for Young Adults (21–40 years)

	Treadmill speed, km/h (mph)									
	Slow				Normal				Fast	
	0.8 (0.5)	1.6 (1.0)	2.4 (1.5)	3.2 (2.0)	4.0 (2.5)	4.8 (3.0)	5.6 (3.5)	6.4 (4.0)	7.2 (4.5)	8.0 (5.0)
<i>n</i>	80	80	80	80	79	78	73	64	25	4
Direct observation	225.3 ± 61.1 (140 – 505)	337.5 ± 44.9 (265 – 525)	418.0 ± 39.3 (360 – 550)	480.3 ± 32.1 (425 – 575)	529.2 ± 30.1 (465 – 605)	568.3 ± 30.2 (505 – 635)	606.0 ± 31.1 (540 – 675)	642.9 ± 32.1 (575 – 715)	685.0 ± 43.4 (620 – 780)	712.5 ± 30.7 (675 – 740)
<i>n</i>	78	78	78	78	77	76	71	62	25	4
Actical	1.6 ± 8.4 (0 – 70)	27.1 ± 52.9 (0 – 370)	224.3 ± 123.5 (0 – 520)	451.3 ± 86.8 (0 – 558)	531.4 ± 68.5 (0 – 615)	562.3 ± 97.9 (0 – 648)	607.7 ± 79.7 (0 – 685)	644.0 ± 89.6 (0 – 728)	699.0 ± 44.2 (635 – 820)	726.3 ± 32.8 (685 – 755)
<i>n</i>	79	79	79	79	78	77	72	63	25	4
ActiGraph GT9X (Waist)	3.8 ± 8.2 (0 – 45)	63.4 ± 64.7 (0 – 260)	207.7 ± 102.5 (23 – 425)	440.9 ± 77.6 (68 – 558)	522.6 ± 52.7 (263 – 588)	556.0 ± 83.8 (3 – 648)	601.0 ± 60.0 (308 – 685)	634.0 ± 71.3 (323 – 728)	656.6 ± 93.2 (358 – 803)	576.9 ± 114.3 (418 – 685)
<i>n</i>	79	79	79	79	78	77	72	63	25	4
ActiGraph GT9X (Wrist)	49.8 ± 41.7 (0 – 200)	109.4 ± 53.5 (25 – 310)	114.6 ± 62.5 (8 – 253)	166.7 ± 86.8 (3 – 378)	233.9 ± 75.8 (5 – 513)	269.7 ± 61.5 (78 – 575)	299.7 ± 54.5 (113 – 620)	322.0 ± 51.8 (168 – 648)	361.1 ± 95.4 (260 – 800)	364.4 ± 19.8 (340 – 385)
<i>n</i>	76	76	76	76	75	74	69	61	24	4
activPAL	151.1 ± 89.4 (0 – 455)	328.0 ± 56.2 (165 – 500)	418.1 ± 39.0 (355 – 550)	479.8 ± 32.1 (420 – 575)	529.9 ± 29.8 (465 – 605)	564.7 ± 45.9 (270 – 640)	606.8 ± 31.1 (540 – 675)	644.5 ± 32.4 (580 – 715)	679.4 ± 36.8 (620 – 745)	701.3 ± 19.3 (675 – 720)
<i>n</i>	80	80	80	80	79	78	73	64	25	4
Digiwalker SW-200	19.3 ± 53.0 (0 – 435)	107.4 ± 103.6 (0 – 510)	277.3 ± 127.8 (0 – 585)	401.2 ± 99.6 (120 – 710)	497.9 ± 55.4 (335 – 595)	559.2 ± 39.3 (415 – 625)	605.3 ± 36.6 (495 – 700)	641.7 ± 33.5 (535 – 705)	685.0 ± 47.3 (570 – 780)	712.5 ± 30.7 (675 – 740)
<i>n</i>	80	80	80	80	79	78	73	64	25	5
Fitbit One	2.8 ± 16.2 (0 – 135)	208.9 ± 119.0 (0 – 475)	413.4 ± 48.9 (320 – 655)	477.5 ± 31.2 (425 – 570)	527.2 ± 29.9 (460 – 605)	567.4 ± 31.4 (505 – 645)	605.1 ± 31.0 (535 – 675)	641.4 ± 33.3 (575 – 715)	683.8 ± 42.9 (620 – 780)	569.0 ± 319.3 (0 – 740)
<i>n</i>	80	80	80	80	79	78	73	64	25	4
Garmin vivofit 2	15.5 ± 66.3 (0 – 525)	267.1 ± 130.8 (0 – 565)	401.7 ± 41.3 (320 – 515)	472.7 ± 33.7 (390 – 555)	524.9 ± 28.6 (460 – 580)	554.1 ± 36.9 (395 – 625)	547.9 ± 71.9 (295 – 675)	531.2 ± 105.1 (265 – 665)	572.4 ± 129.6 (325 – 790)	595.0 ± 102.7 (460 – 710)
<i>n</i>	78	78	78	78	77	76	71	62	25	4
GENEActiv (Waist)	245.6 ± 65.0 (95 – 440)	385.6 ± 72.9 (215 – 583)	421.3 ± 44.0 (325 – 538)	477.0 ± 32.2 (410 – 558)	529.0 ± 29.5 (465 – 603)	565.1 ± 37.7 (365 – 638)	604.4 ± 35.2 (468 – 673)	641.7 ± 37.8 (493 – 715)	689.5 ± 43.1 (623 – 788)	716.9 ± 36.8 (673 – 755)

<i>n</i>	76	76	76	76	75	74	70	61	25	4
GENEActiv (Wrist)	216.3 ± 83.7 (40 – 468)	388.8 ± 56.7 (243 – 565)	424.0 ± 32.3 (360 – 510)	461.9 ± 35.6 (345 – 538)	488.7 ± 55.7 (325 – 563)	507.1 ± 67.2 (350 – 605)	506.0 ± 91.4 (320 – 635)	523.3 ± 99.6 (303 – 653)	563.2 ± 128.5 (370 – 805)	616.9 ± 57.9 (553 – 685)
<i>n</i>	80	80	80	80	79	78	73	64	25	4
NL-1000	9.6 ± 51.9 (0 – 435)	93.2 ± 116.2 (0 – 600)	359.9 ± 112.1 (115 – 625)	474.9 ± 45.6 (315 – 600)	521.6 ± 61.0 (55 – 610)	570.1 ± 30.2 (505 – 635)	606.8 ± 31.5 (535 – 675)	643.6 ± 32.4 (575 – 715)	683.0 ± 41.3 (620 – 780)	706.3 ± 29.3 (670 – 730)
<i>n</i>	79	79	79	79	78	77	72	63	25	4
StepWatch	218.7 ± 66.0 (90 – 505)	369.1 ± 50.0 (240 – 520)	418.2 ± 37.9 (365 – 540)	479.6 ± 31.9 (420 – 575)	529.9 ± 29.6 (470 – 605)	565.3 ± 41.9 (310 – 640)	606.5 ± 31.0 (540 – 675)	643.1 ± 30.0 (580 – 705)	639.4 ± 49.2 (535 – 705)	607.5 ± 93.1 (520 – 700)

Values represent the average number of steps ± standard deviation (minimum – maximum). See **Additional file 2** for a graphical classification of wearable technologies by age groups.

Additional File 3: Suppl Table 3 Sample sizes (*n*) and number of steps derived from direct observation and each wearable technology at each treadmill speed for Middle-Age Adults (41–60 years)

	Treadmill speed, km/h (mph)									
	Slow				Normal				Fast	
	0.8 (0.5)	1.6 (1.0)	2.4 (1.5)	3.2 (2.0)	4.0 (2.5)	4.8 (3.0)	5.6 (3.5)	6.4 (4.0)	7.2 (4.5)	8.0 (5.0)
<i>n</i>	80	79	79	78	78	78	73	47	12	1
Direct observation	262.5 ± 84.9 (154 – 604)	351.0 ± 71.1 (195 – 666)	423.0 ± 54.3 (326 – 707)	480.6 ± 41.2 (386 – 653)	527.8 ± 34.8 (445 – 648)	568.1 ± 34.2 (501 – 655)	600.4 ± 34.3 (528 – 676)	644.5 ± 43.8 (562 – 739)	699.3 ± 45.3 (639 – 759)	787.0
<i>n</i>	78	77	77	76	76	76	71	46	11	1
Actical	6.7 ± 38.0 (0 – 278)	28.0 ± 80.4 (0 – 650)	177.9 ± 130.4 (0 – 630)	426.8 ± 88.8 (218 – 648)	535.2 ± 33.1 (453 – 655)	578.0 ± 34.6 (510 – 670)	610.7 ± 33.8 (543 – 680)	644.6 ± 108.5 (0 – 818)	713.9 ± 43.3 (660 – 795)	795.0
<i>n</i>	79	78	78	77	77	77	72	46	12	1
ActiGraph GT9X (Waist)	5.7 ± 18.5 (0 – 138)	77.6 ± 86.6 (0 – 505)	233.1 ± 105.2 (3 – 425)	438.1 ± 74.8 (120 – 538)	523.0 ± 49.6 (255 – 595)	575.0 ± 38.5 (408 – 658)	608.3 ± 39.0 (473 – 685)	629.4 ± 113.1 (0 – 815)	694.2 ± 64.7 (520 – 758)	727.5
<i>n</i>	79	78	78	77	77	77	72	46	12	1
ActiGraph GT9X (Wrist)	39.5 ± 55.3 (0 – 300)	88.0 ± 75.7 (0 – 343)	103.3 ± 85.1 (0 – 353)	155.4 ± 98.5 (0 – 413)	230.8 ± 82.8 (5 – 400)	273.7 ± 73.6 (23 – 455)	309.8 ± 64.0 (68 – 498)	329.0 ± 63.9 (30 – 475)	346.7 ± 42.5 (245 – 395)	397.5
<i>n</i>	78	77	77	76	76	76	71	46	12	1
activPAL	163.0 ± 121.7 (0 – 565)	337.4 ± 85.8 (20 – 660)	422.5 ± 52 (325 – 665)	480.9 ± 41.8 (380 – 650)	528.6 ± 35.1 (445 – 645)	569.7 ± 35.3 (505 – 655)	601.3 ± 34.3 (530 – 670)	645.1 ± 43.9 (560 – 775)	697.5 ± 37.1 (645 – 750)	780.0
<i>n</i>	76	75	75	74	74	74	69	43	12	1
Apple Watch Serie 1	54.3 ± 129.8 (0 – 580)	268.7 ± 144.1 (0 – 666)	420.8 ± 71.0 (115 – 701)	473.7 ± 44.0 (378 – 648)	519.4 ± 39.8 (399 – 640)	562.5 ± 42.1 (449 – 681)	598.3 ± 39.5 (528 – 740)	631.6 ± 47.5 (495 – 739)	704.3 ± 66.9 (624 – 850)	662.0
<i>n</i>	80	79	79	77	78	78	73	46	12	1
Digiwalker SW-200	30.0 ± 67.9 (0 – 354)	129.4 ± 140.1 (0 – 659)	279.1 ± 140.3 (2 – 703)	404.1 ± 103.0 (82 – 644)	498.9 ± 66.3 (256 – 642)	558.4 ± 41.8 (422 – 653)	598.9 ± 38.8 (500 – 696)	644.0 ± 43.3 (564 – 734)	701.9 ± 47.4 (640 – 771)	801.0
<i>n</i>	80	79	79	78	78	78	73	46	12	1
Fitbit One	9.2 ± 42.3 (0 – 344)	213.4 ± 151.0 (0 – 666)	412.2 ± 48.9 (317 – 665)	476.7 ± 39.8 (382 – 651)	524.8 ± 34.7 (442 – 647)	565.6 ± 33.9 (498 – 652)	598.2 ± 34.1 (528 – 675)	642.8 ± 43.7 (562 – 740)	693.3 ± 47.3 (641 – 764)	786.0
<i>n</i>	77	76	75	74	75	75	69	44	12	1
Garmin vivoactive HR	35.1 ± 102.6 (0 – 502)	308.5 ± 146.2 (0 – 665)	402.8 ± 70.0 (47 – 627)	471.0 ± 38.3 (379 – 619)	518.5 ± 31.0 (437 – 595)	546.5 ± 45.6 (322 – 603)	556.8 ± 78.0 (329 – 897)	527.2 ± 90.1 (326 – 727)	510.4 ± 105.9 (369 – 663)	492.0

<i>n</i>	77	76	76	75	75	72	70	45	12	1
Garmin vivofit 3	60.3 ± 123.0 (0 – 567)	337.1 ± 117.9 (21 – 665)	465.6 ± 95.2 (329 – 727)	477.9 ± 40.4 (413 – 651)	521.9 ± 34.7 (435 – 643)	566.8 ± 40.3 (497 – 757)	599.3 ± 42.7 (527 – 819)	637.9 ± 42.3 (563 – 725)	696.6 ± 52.3 (631 – 795)	781.0
<i>n</i>	72	71	71	70	70	70	66	44	11	1
GENEActiv (Waist)	234.7 ± 111.9 (40 – 615)	369.2 ± 86.9 (150 – 663)	423.1 ± 53.0 (343 – 660)	479.4 ± 41.7 (385 – 645)	526.8 ± 35.9 (445 – 645)	568.1 ± 35.4 (503 – 658)	600.8 ± 35.0 (530 – 673)	634.1 ± 109.0 (0 – 798)	704.8 ± 44.4 (650 – 780)	780.0
<i>n</i>	68	67	67	66	66	66	63	41	12	1
GENEActiv (Wrist)	208.7 ± 123.6 (3 – 603)	399.2 ± 79.6 (208 – 670)	427.8 ± 56.7 (338 – 690)	471.5 ± 44.6 (333 – 625)	504.1 ± 48.9 (330 – 620)	522.4 ± 72.9 (295 – 628)	535.4 ± 85.5 (318 – 655)	564.5 ± 104.3 (318 – 720)	540.0 ± 120.5 (370 – 700)	425.0
<i>n</i>	80	79	79	78	78	78	73	45	12	1
NL-1000	16.8 ± 56.4 (0 – 351)	93.9 ± 122.1 (0 – 679)	333.9 ± 124.7 (35 – 664)	451.2 ± 57.2 (312 – 653)	519.4 ± 58.4 (116 – 645)	572.1 ± 56.6 (499 – 967)	598.3 ± 37.0 (511 – 676)	644.5 ± 43.8 (565 – 741)	698.3 ± 43.0 (643 – 765)	793.0
<i>n</i>	80	79	79	77	77	78	73	47	12	1
Samsung Gear Fit2	18.4 ± 75.9 (0 – 485)	106.1 ± 147.7 (0 – 631)	407.2 ± 119.4 (31 – 717)	467.1 ± 67.6 (1 – 638)	514.4 ± 36.7 (398 – 621)	557.7 ± 37.9 (467 – 664)	590.3 ± 33.8 (494 – 660)	627 ± 38.8 (557 – 711)	610.1 ± 69.0 (474 – 683)	620.0
<i>n</i>	79	78	78	77	77	77	72	46	12	1
StepWatch	242.8 ± 107.2 (45 – 620)	377.7 ± 66.8 (200 – 670)	425.7 ± 51.7 (365 – 690)	481.6 ± 40.1 (395 – 645)	528.6 ± 34.7 (450 – 645)	569.9 ± 35.0 (500 – 660)	602.2 ± 34.9 (530 – 675)	639.2 ± 40.2 (530 – 705)	629.6 ± 63.6 (530 – 705)	535.0

Values represent the average number of steps ± standard deviation (minimum – maximum). See **Additional file 2** for a graphical classification of wearable technologies by age groups.

Additional File 3: Suppl Table 4 Sample sizes (*n*) and number of steps derived from direct observation and each wearable technology at each treadmill speed for Older Adults (61–85 years)

	Treadmill speed, km/h (mph)								
	Slow				Normal			Fast	
	0.8 (0.5)	1.6 (1.0)	2.4 (1.5)	3.2 (2.0)	4.0 (2.5)	4.8 (3.0)	5.6 (3.5)	6.4 (4.0)	7.2 (4.5)
<i>n</i>	98	89	86	81	75	67	48	17	3
Direct observation	346.4 ± 93.9 (190 – 657)	403.1 ± 70.0 (253 – 601)	453.0 ± 54.2 (332 – 626)	493.1 ± 42.1 (407 – 649)	531.3 ± 35.1 (467 – 640)	570.7 ± 32.7 (503 – 659)	606.2 ± 39.4 (531 – 718)	647.1 ± 41.7 (563 – 742)	684.7 ± 39.6 (644 – 723)
<i>n</i>	94	86	83	78	73	66	48	17	3
Actical	0.4 ± 2.2 (0 – 15)	9.8 ± 24.6 (0 – 155)	129.2 ± 116.3 (0 – 498)	381.3 ± 138.4 (0 – 620)	516.4 ± 113.9 (0 – 660)	553.0 ± 127.8 (0 – 675)	581.9 ± 156.0 (0 – 738)	627.9 ± 167.4 (0 – 765)	716.7 ± 51.4 (668 – 770)
<i>n</i>	96	87	84	79	74	66	47	17	3
ActiGraph GT9X (Waist)	12.8 ± 42.8 (0 – 283)	53.8 ± 70.0 (0 – 375)	170.4 ± 92.7 (8 – 448)	378.2 ± 94.0 (30 – 525)	516.3 ± 44.9 (338 – 603)	571.1 ± 56.2 (248 – 675)	608.1 ± 55.6 (368 – 713)	642.4 ± 66.8 (448 – 750)	479.2 ± 177.5 (315 – 668)
<i>n</i>	96	87	84	79	74	66	48	17	3
ActiGraph GT9X (Wrist)	64.2 ± 71.3 (0 – 315)	100.9 ± 70.7 (3 – 270)	136.7 ± 88.1 (5 – 413)	187.4 ± 98.3 (5 – 495)	243.0 ± 93.1 (28 – 563)	291.3 ± 90.8 (58 – 608)	325.6 ± 89.9 (165 – 738)	348.5 ± 70.2 (188 – 518)	371.7 ± 75.6 (315 – 458)
<i>n</i>	95	86	83	78	74	67	48	17	3
activPAL	225.2 ± 133.1 (0 – 620)	388.0 ± 81.2 (220 – 575)	453.0 ± 52.8 (335 – 605)	492.9 ± 42.4 (395 – 650)	533.0 ± 34.6 (465 – 650)	574.3 ± 33.5 (510 – 665)	611.6 ± 38.7 (535 – 725)	654.1 ± 41.3 (575 – 745)	703.3 ± 53.0 (655 – 760)
<i>n</i>	98	89	86	81	75	66	48	17	3
Apple Watch Serie 1	150.7 ± 164.7 (0 – 641)	309.8 ± 120.2 (0 – 586)	425.9 ± 77.9 (118 – 564)	478.0 ± 69.6 (98 – 728)	528.6 ± 81.4 (418 – 981)	568.9 ± 43.2 (490 – 677)	572.2 ± 77.7 (217 – 723)	627.9 ± 103.1 (272 – 751)	670.0 ± 31.8 (635 – 697)
<i>n</i>	98	89	86	81	75	64	48	17	3
Digiwalker SW-200	20.5 ± 47.1 (0 – 238)	69.3 ± 95.6 (0 – 432)	173.6 ± 141.0 (0 – 518)	255.9 ± 152.7 (0 – 574)	342.7 ± 144.0 (23 – 576)	449.6 ± 126.9 (57 – 624)	522.6 ± 96.0 (302 – 662)	599.5 ± 72.2 (427 – 723)	660.7 ± 13.7 (646 – 673)
<i>n</i>	98	89	86	81	75	66	48	17	3
Fitbit Ionic	48.3 ± 118.4 (0 – 526)	185.9 ± 160.9 (0 – 534)	404.1 ± 90.2 (22 – 581)	477.4 ± 49.6 (385 – 640)	517.6 ± 40.3 (384 – 634)	550.2 ± 42.8 (420 – 659)	576.0 ± 52.1 (442 – 705)	629.7 ± 53.1 (534 – 749)	631.0 ± 44.6 (580 – 663)
<i>n</i>	98	89	86	81	75	66	48	17	3
Fitbit Zip	3.8 ± 27.5 (0 – 267)	35.4 ± 75.6 (0 – 383)	385.7 ± 124.6 (0 – 563)	480.1 ± 63.4 (29 – 608)	533.1 ± 62.3 (467 – 979)	566.1 ± 31.9 (503 – 652)	603.6 ± 38.6 (526 – 712)	644.8 ± 41.3 (563 – 738)	681.0 ± 39.2 (640 – 718)

<i>n</i>	96	89	86	80	73	66	48	17	3
Garmin vivoactive 3	47.7 ± 114.6 (0 – 553)	271.0 ± 156.7 (0 – 550)	430.6 ± 64.8 (236 – 636)	482.1 ± 37.2 (398 – 573)	515.2 ± 54.4 (154 – 615)	564.0 ± 33.0 (495 – 655)	597.2 ± 34.4 (527 – 707)	637.4 ± 38.7 (558 – 707)	671.3 ± 31.9 (637 – 700)
<i>n</i>	74	66	65	62	61	55	42	16	3
GENEActiv (Waist)	228.0 ± 118.3 (30 – 625)	394.2 ± 63.1 (243 – 575)	450.1 ± 50.2 (333 – 580)	489.3 ± 39.4 (400 – 610)	532.6 ± 35.1 (468 – 650)	571.5 ± 32.6 (510 – 665)	613.3 ± 40.9 (533 – 725)	654.4 ± 43.5 (570 – 750)	703.3 ± 47.6 (658 – 753)
<i>n</i>	73	66	64	61	60	54	42	16	3
GENEActiv (Wrist)	213.3 ± 112.1 (8 – 623)	389.6 ± 62.7 (223 – 563)	439.1 ± 44.8 (348 – 573)	482.5 ± 41.8 (355 – 598)	520.2 ± 41.5 (378 – 625)	554.2 ± 61.9 (308 – 665)	596.4 ± 67.8 (350 – 723)	629.8 ± 86.2 (345 – 740)	699.2 ± 51.4 (650 – 753)
<i>n</i>	98	89	86	81	75	66	48	17	3
NL-1000	11.2 ± 30.1 (0 – 214)	99.9 ± 102.4 (0 – 440)	332.7 ± 123.9 (3 – 620)	450.2 ± 78.1 (74 – 596)	518.0 ± 58.9 (112 – 632)	551.3 ± 86.2 (90 – 652)	583.1 ± 104.9 (62 – 715)	641.6 ± 39.7 (562 – 732)	675.7 ± 33.7 (640 – 707)
<i>n</i>	98	89	85	81	75	66	48	17	3
PiezoRx	85.7 ± 132.0 (0 – 553)	342.0 ± 126.9 (0 – 568)	448.2 ± 54.5 (217 – 578)	489.3 ± 37.6 (406 – 610)	530.8 ± 34.5 (465 – 639)	570.0 ± 33.4 (502 – 657)	594.2 ± 82.1 (105 – 717)	672.5 ± 130.1 (566 – 1159)	680.7 ± 36.7 (642 – 715)
<i>n</i>	97	87	85	80	74	65	47	17	3
Polar M600	62.3 ± 123.6 (0 – 512)	174.0 ± 160.2 (4 – 564)	347.3 ± 134.7 (34 – 578)	463.4 ± 86.0 (20 – 617)	510.8 ± 65.6 (292 – 803)	552.4 ± 82.5 (24 – 708)	585.6 ± 63.8 (456 – 844)	626.2 ± 47.4 (548 – 731)	666.7 ± 36.1 (635 – 706)
<i>n</i>	98	89	86	81	74	66	48	17	3
Samsung Gear Fit2 Pro	33.9 ± 103.1 (0 – 589)	143.1 ± 157.7 (0 – 529)	386.4 ± 136.0 (0 – 679)	468.9 ± 38.9 (394 – 577)	508.8 ± 40.3 (439 – 613)	552.6 ± 41.9 (356 – 658)	584.9 ± 34.9 (485 – 685)	609.2 ± 27.5 (559 – 662)	637.0 ± 12.5 (625 – 650)
<i>n</i>	95	86	83	78	72	64	45	16	3
StepWatch	339.7 ± 106.6 (70 – 625)	414.4 ± 67.6 (245 – 592)	456.1 ± 53.1 (355 – 622)	493.4 ± 41.2 (410 – 648)	532.4 ± 35.1 (468 – 650)	571.4 ± 34.0 (505 – 665)	608.0 ± 32.7 (535 – 700)	635.3 ± 42.9 (520 – 685)	633.3 ± 84.6 (540 – 705)

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