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| Study | Sample characteristics | Study protocol | Setting (Lab/ Field) | Criterion comparison | Device | Device placement | Results (overall error relative to criterion) |
| Alsubheen, 2016 | N=13 (5 F)  Age: 40 ± 11.9 y  BMI: 27 ± 4.3 kg/m2 | Subjects performed a graded treadmill test. | Lab | IC – Sable system (Sable Systems International, Las Vegas NV) | Garmin vivofit (Garmin ltd, Olathe, Kansas, USA) | Wrist | Garmin vivofit:  -41.63% |
| Bai, 2017 | N=39 (16 F)  Age: 32 ± 11 y  BMI: 24.7 ± 4 kg/m2 | Subjects performed a semi-structured activity protocol consisting of sedentary activity, aerobic exercise, and light intensity physical activity on a treadmill. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | Apple watch (Apple Inc, Cupertino, California, USA)  Fitbit charge HR (Fitbit Inc, San Francisco, California, USA) | Wrist | Apple Watch:  -10.79%  Fitbit Charge HR:  17.88% |
| Benito, 2012 | N=29 (17 F)  Age: 22.5 y  BMI: 22 kg/m2 | Subjects performed circuits of resistance exercise at 30%, 50% and 70% of 15 repetition maximum. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | SenseWear Pro2 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro2 Armband: -46.60% |
| Berntsen, 2010 | N=20 (6 F)  Age: 35 y  BMI: 24 kg/m2 | Subjects performed lifestyle and sporting activities including strength exercises, ball games, occupational and home-based activities. | Lab | IC – MetaMax II (Cortex Biophysic, Leipzig, Germany) | SenseWear Pro2 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro2 Armband: -9.00% |
| Berntsen, 2012 | N=29 (29 F)  Age: 31 ± 4.1 y  BMI: 27 ± 3.2 kg/m2 | Subjects participated in a period of sedentary behaviour. 9 subjects then performed callisthenics and cycling on a bicycle ergometer. The other 20 subjects performed outdoor walking followed by relaxing, cycling and callisthenics. | Lab | IC – MetaMax II (Cortex Biophysic, Leipzig, Germany) | SenseWear Pro2 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro2 Armband: -10.34% |
| Bhammar, 2016 | N=34 (26 F)  Age: 30.1 ± 8.7 y  BMI: 26.2 ± 5.1 kg/m2 | Subjects performed a semi structured and a structured routine.  Semi-structured: 12 activities including 4 sedentary/light-intensity activities, 4 moderate-intensity activities, and 4 vigorous-intensity activities. The activities performed were randomly selected from a list of common activities.  Structured: A period of rest, followed by 7 activities of 8 minutes each. The activities performed were randomly selected from a list of common activities. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Mini Armband: 14.76% |
| Boudreaux, 2018 | N=50 (28 F)  Age: 22.4 y  BMI: 26.5 kg/m2 | Subjects performed separate trials of graded cycling and 3 sets of 4 resistance exercises at a 10-repetition maximum load. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics, East Sandy, UT, USA) | Apple Watch 2 (Apple Inc, Cupertino, California, USA)  Fitbit Blaze (Fitbit Inc, San Francisco, California, USA)  Fitbit Charge 2 (Fitbit Inc, San Francisco, California, USA)  Garmin Vivosmart HR (Garmin ltd, Olathe, Kansas, USA)  Polar: the Activity Watch 360 (Polar Electro Oy, Kempele, Finland)  Tomtom touch (TomTom, Amsterdam, the Netherlands) |  | Apple Watch 2: 48.20%  Fitbit Blaze: 28.66%  Fitbit Charge 2:  -30.97%  Garmin Vivosmart HR:  16.85%  Polar: the Activity Watch 360:  28.68%  Tomtom Touch: 28.66% |
| Brazeau, 2011 | N=31 (16 F)  Age: 26.7 y  BMI: 27.5 kg/m2 | Subjects performed 45 minutes of stationary cycling at 50% VO2peak. | Lab | IC – Ergocard exercise test station (MediSoft, Dinant, Belgium) | SenseWear Pro3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro3 Armband: -10.56% |
| Brazeau, 2014 | N=38 (18 F)  Age: 28.6 y  BMI: 23.8 kg/m2 | Subjects performed 45 minutes of treadmill exercise at 40% VO2peak then exercised on a stationary bike ergometer for 45 minutes at 50% VO2peak. | Lab | IC – Ergocard exercise test station (MediSoft, Dinant, Belgium) | SenseWear Pro3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro3 Armband:  14.94% |
| Brazeau, 2016 | N=20 (0 F)  Age: 26.2 ± 3.6 y  BMI: 23.1 ± 2.3 kg/m2 | Subjects completed a field observation and a lab protocol.  Field: 7-day comparison to DLW.  Lab: Subjects performed 60 minutes rest followed by treadmill exercise for 45 minutes at 22-41% VO2peak then stationary cycling for 45 minutes at 50% VO2peak. | Lab/ Field | DLW – 7 days  IC – Ergocard exercise test station (MediSoft, Dinant, Belgium) | SenseWear Pro3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro3 Armband:  7.06% |
| Brugniaux, 2010 | N=31 (16 F)  Age: 42.9 y  BMI: 22.7 kg/m2 | Subjects performed a 9.7km outdoor hike. | Field | IC – Metablograph with Hans Rudolph facemask (Hans Rudolph, Kansas City, MO, USA) | Polar: the Activity Watch 200 (Polar Electro Oy, Kempele, Finland) | Wrist | Polar: the Activity Watch 200: -13.17% |
| Calabro, 2014 | N=40 (19 F)  Age: 27.4 y  BMI: 22.8 kg/m2 | Subjects performed 60 minutes of structured activities including stationary biking, walking/ running on a treadmill, road biking, elliptical exercise and stair stepping and unstructured movements. The semi-structured measurement periods were performed in 5, 10, 10, 10, and 25-minute intervals and included sitting, walking, standing, stair climbing or light movements. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA)  SenseWear Pro3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Mini Armband: 0.89%  SenseWear Pro3 Armband:  2.33% |
| Calabro, 2015 | N=29 (17 F)  Age: 68.8 ± 6.3 y  BMI: 26.3 ± 4.9 kg/m2 | 14-day comparison to DLW. | Field | DLW – 14 days | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Mini Armband: -0.86% |
| Casiraghi, 2013 | N=18 (11 F)  Age: 48.6 ± 21 y  BMI: 24.6 ± 2.6 kg/m2 | Subjects performed a cycling protocol with three components: 1) Baseline where the subject sat on the cycle ergometer.  2) A 2-minute warm-up at 40 rpm at 40 watts.  3) Exercise increased to 60 rpm and intensity progressed by 7 watts/minute until exhaustion. | Lab | IC – SensorMedics Vmax 229 (SensorMedics Inc, Yorba Linda, CA, USA). | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -8.00% |
| Chowdhry, 2017 | N=30 (15 F)  Age: 27 ± 1.6 y  BMI: 23.4 ± 2.5 kg/m2 | Subjects performed two components:  1) A protocol of 4 activities of designed to replicate daily living tasks  2) 4 activities of 10 minutes in duration. These activities were walking on a treadmill, walking at the same speed with shopping bags, cycling on an ergometer and jogging on the treadmill. | Lab | IC – COSMED K4b2 (COSMED, Rome, Italy) | Apple watch (Apple Inc, Cupertino, California, USA)  Microsoft Band (Microsoft Corporation, Redmond, Washington, USA)  Fitbit Charge HR (Fitbit Inc, San Francisco, California, USA)  Jawbone UP24 (Jawbone, San Francisco, California, USA)  Bodymedia Core (HealthWear, Bodymedia, Pittsburg, PA, USA) | Wrist  Bodymedia core: Upper arm | Apple watch: -6.9%  Microsoft Band:  -49.15%  Fitbit Charge HR:  15.49%  Jawbone UP24:  -21.01%  Bodymedia Core:  7.98% |
| Colbert, 2011 | N=56 (45 F)  Age: 74.7 ± 6.5 y  BMI: 25.8 ± 4.2 kg/m2 | 10-day comparison to DLW. | Field | DLW – 10 days | SenseWear Pro 3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro 3 Armband: 58.53% |
| Correa, 2016 | N=87 (72 F)  Age: 42 ± 13 y  BMI: 31.6 ± 4.5 kg/m2 | 7-day comparison to DLW. | Field | DLW – 7 days | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA)  Actical (Phillips Respironics Inc, Murrysville, PN, USA) | Upper arm  Wrist | SenseWear Armband −416.95 kcal  Actical: 194.52 kcal |
| Diaz, 2015 | N=23 (13 F)  Age: N/A  BMI: N/A | Subjects performed a treadmill protocol consisting of walking at slow, moderate and brisk paces and jogging. | Lab | IC – Ultima CPX (Medgraphics, Saint Paul, MN, USA) | Fitbit Flex (Fitbit Inc, San Francisco, CA, USA) | Wrist | Fitbit Flex: 17.36% |
| Diaz, 2016 | N=13 (13 F)  Age: 32.0 ± 9.2 y  BMI: 24.2 ± 3.4 kg/m2 | Subjects performed a treadmill protocol consisting of walking at slow, moderate and brisk paces and jogging. | Lab | IC – Ultima CPX (Medgraphics, Saint Paul, MN, USA) | Fitbit Flex (Fitbit Inc, San Francisco, CA, USA) | Wrist | Fitbit Flex: 30.27% |
| Dondzila, 2016 | N=19 (5 F)  Age: 24.6 ± 3.1 y  BMI: 28.0 ± 3.8 kg/m2 | Subjects performed 5-minute stages of jogging on a treadmill at increasing velocity. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics, East Sandy, UT, USA) | Fitbit Charge (Fitbit Inc, San Francisco, California, USA) | Wrist | Fitbit Charge: -13.01% |
| Dooley, 2017 | N=62 (36 F)  Age: 22.46 y  BMI: 24.86 kg/m2 | Subjects performed 4 stages of treadmill exercise followed by a seated recovery period. The activity routine consisted of an unmeasured warm-up walking period and measured stages of slow, then brisk walking and jogging. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics, East Sandy, UT, USA) | Apple watch (Apple Inc, Cupertino, CA, USA)  Fitbit charge HR (Fitbit Inc, San Francisco, CA, USA)  Garmin Forerunner 225  (Garmin ltd, Olathe, Kansas, USA) | Wrist | Apple watch: 64.55%  Fitbit charge HR: 18.70%  Garmin Forerunner 225: 44.23% |
| Drenowatz, 2011 | N=20 (10 F)  Age: 24.3 y  BMI: N/A | Subjects performed three treadmill runs at 65, 75, and 85% VO2max. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -32.80% |
| Erdogan, 2010 | N=43 (27 F)  Age: 34.9 ± 5.5 y  BMI: 31.2 ± 3.7 kg/m2 | Subjects performed rowing exercises at 50% and 70% VO2max on an ergometer. | Lab | IC – COSMED K4b2 (COSMED, Rome, Italy) | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: 5.23% |
| Fruin, 2010 | Experiment 1: N=13 (0 F)  Experiment 2: N=20 (10 F)  Age: 20.2 ± 1 y  BMI: N/A | Experiment 1: Subjects performed two resting and a cycle ergometer session at 60% VO2peak.  Experiment 2: Subjects completed a treadmill protocol of jogging, running and uphill running. | Lab | IC – SensorMedics Vmax 229 (SensorMedics Inc, Yorba Linda, CA, USA). | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -1.76% |
| Furlanetto, 2010 | N=30 (15 F)  Age: 68 ± 7 y  BMI: 25 ± 3 kg/m2 | Subjects performed a walking protocol on a treadmill at three intensities. | Lab | IC – VO2000 aerograph (Medgraphics, Saint Paul, MN, USA) | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -6.99% |
| Gastin, 2017 | N=26 (12 F)  Age: 21.3 ± 2.4 y  BMI: 23.2 ± 2 kg/m2 | Subjects performed a protocol Involving resting periods, walking, jogging, running or a sport-simulated circuit. | Lab | IC – MetaMax 3b (Cortex Biophysic, Leipzig, Germany) | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -19.90% |
| Heiermann, 2011 | N=32 (19 F)  Age: 68.6 y  BMI: 26.4 kg/m2 | Subjects were required to rest. | Lab | IC – Vmax Spectra (SensorMedics Viasys Healthcare, Bilthoven, The Netherlands) | SenseWear Pro2 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro2 Armband: 10.80% |
| Imboden, 2017 | N=30 (15 F)  Age: 49.2 ± 19.2 y  BMI: 26.2 kg/m2 | Subjects performed a semi-structured activity protocol, performing ≥12 activities for subject-selected duration and pace. Activities were selected from a list of sedentary, household activities ambulatory and cycling activities. | Lab | IC – COSMED K4b2 (COSMED, Rome, Italy) | Fitbit flex (Fitbit Inc, San Francisco, California, USA)  Jawbone UP24 (Jawbone, San Francisco, California, USA) | Wrist | Fitbit flex: -15.29%  Jawbone UP24:  -40.00% |
| Jakicic, 2004 | N=40 (20 F)  Age: 23.2 ± 3.8 y  BMI: 23.8 ± 3.1 kg/m2 | Subjects performed 4 separate exercise protocols including treadmill walking, stair stepping, cycle ergometry, and arm ergometry. | Lab | IC – SensorMedics Vmax 229 (SensorMedics Inc, Yorba Linda, CA, USA). | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -11.76% |
| Johannsen, 2010 | N=30 (15 F)  Age: 38.2 ± 10.6 y  BMI: 24 ± 3.4 kg/m2 | 14-day comparison to DLW. | Field | DLW – 14 days | SenseWear Pro3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA)  SenseWear Mini Armband HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro3 Armband: -2.48% |
| Kim, 2015 | N=52 (19 F)  Age: 23.8 ± 5.2  BMI: N/A | Subjects performed 15 activities including resting, stair climbing, cycling, walking and jogging. Each activity was performed for 5 minutes, with 1-minute resting intervals. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | Bodymedia Core (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | Bodymedia Core: 5.80% |
| King, 2004 | N=21 (10 F)  Age: 37.55 y | Subjects performed 10 minutes of treadmill walking and running at various speeds. | Lab | IC – TrueMax 2400 (Consentius Technologies, Sandy, UT, USA) | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: 20.33% |
| Koehler. 2011 | N=14 (0 F)  Age: 30.4 ± 6.2 y  BMI: 23.2 ± 1.4 kg/m2 | 7-day comparison to DLW. | Field | DLW – 7 days | SenseWear Pro3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro3 Armband: -1.83% |
| Lee, 2011 | N=46 (21 F)  Age: 24.8 ± 5.6 y  BMI: 24.3 ± 3.6 kg/m2 | Subjects completed 4-minute periods of standing, walking, jogging, and running. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics, East Sandy, UT, USA) | ePulse Personal Fitness Assistant (ePulse) (Impact Sports Technologies, San Diego, CA, USA) | Forearm | ePulse Personal Fitness Assistant -3.46% |
| Lee, 2014 | N=60 (30 F)  Age: 26.4 y  BMI: 23.05 kg/m2 | Subjects performed 13 activities for 5 minutes. Activities were categorized into sedentary, treadmill walking, treadmill jogging and moderate-to-vigorous activities (ascending and descending stairs, stationary bike, elliptical exercise, Wii tennis play, and basketball). | Lab | IC – Oxycon Mobile 5.0 (Erich Jaeger, Viasys Healthcare, Germany) | BodyMedia CORE (BodyMedia Inc., Pittsburgh, PA, USA)  Jawbone UP (Jawbone, San Francisco, California, USA)  Basis B1 Band (Basis Science Inc, San Francisco, CA, USA)  Nike Fuel Band (Nike Inc., Beaverton, OR, USA) | Upper arm  Wrist | BodyMedia CORE:-5.31%  Jawbone UP:  -6.92%  Basis B1 Band:  -31.65%  Nike Fuel Band: -1.91% |
| Lopez, 20171 | N=36 (16 F)  Age: 37.7 ± 9.8 y  BMI: 23.4 ± 2.8 kg/m2 | Subjects performed a structured protocol including rest, computer use, standing, slow walking, running, basketball and overground cycling. | Lab | IC – MetaMax 3x (Cortex Biophysic, Leipzig, Germany) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Mini Armband: -16.00% |
| Mackey, 2011 | N=19 (8 F)  Age: 82 ± 3.3 y  BMI: 28.1 ± 3.8 kg/m2 | 12.5-day comparison to DLW. | Field | DLW – 12.5 days | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: -0.05% |
| Martien, 2015 | N=60 (47 F)  Age: 85.5 ± 5.5 y  BMI: N/A | Subjects performed activity for 4 minutes and separated by 4 minutes seated rest. Activities included: Walking, rising and sitting in chairs positioned 5 meters apart and moving light objects. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Mini Armband: -12.00% |
| Maschac, 20131 | N=19 (13 F)  Age: 55.65 y  BMI: 31.5 ± 3.6 kg/m2 | Subjects performed three walking sessions on a treadmill with different combinations of speed and incline. | Lab | IC – VO2000 aerograph (Medgraphics, Saint Paul, MN, USA) | SenseWear Pro 3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro 3 Armband: 50.69% |
| McMinn, 2013 | N=19 (6 F)  Age: 30 y  BMI: 23.6 kg/m2 | Subjects completed 3 treadmill walking trials at self-selected slow, medium, and fast speeds. | Lab | IC – Ultima CPX (Medgraphics, Saint Paul, MN, USA) | Actigraph GT3X+ (Actigraph Inc, Pensacola, FL, USA) | Wrist | Actigraph GT3X+ : -8.84% |
| Melanson, 2009 | N=7 (3 F)  Age: 31.8 ± 7.2 y  BMI: 27.8 ± 7.9 kg/m2 | Subjects performed individualised protocols, including bench stepping and stationary cycling. | Lab | MC – 22.8 hours | LifeChek Calorie Sensor (LifeChek, LLC, Pittsburgh, PA, USA) | Wrist | LifeChek calorie sensor -4.87% |
| Mikulic, 2011 | N=19 (11 F)  Age: 28 ± 6 y  BMI: 23 ± 3 kg/m2 | Subjects performed in-line skating exercises on a circular track at a self-selected pace. | Field | IC – COSMED K4b2 (COSMED, Rome, Italy) | SenseWear Pro 3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro 3 Armband : -73.33% |
| Montoye, 2017 | N=32 (14 F)  Age: 23.7 y  BMI: 25.5 kg/m2 | Subjects completed 14 exercises, 11 in the laboratory including walking, jogging and cycling ergometry and 3 track exercises included self-paced walking at both a leisure and brisk pace for 200 meters and self-paced jogging for 400 meters. Each was 5 minutes in duration. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics, East Sandy, UT, USA) | Fitbit Charge HR (Fitbit Inc, San Francisco, California, USA) | Upper arm | Fitbit Charge HR: 7.59% |
| Murakami, 2016 | N=19 (10 F)  Age: N/A  BMI: N/A | 1) 12.5-day comparison to DLW.  2) 24 hours in metabolic chamber where subjects where subjects were required to perform deskwork, watch television, housework, treadmill walking, and sleeping. | Lab/ Field | DLW – 12.5 days  MC – 24 hours | Withings Pulse O2 (Withings, Issy-les-Moulineaux, France)  Garmin vivofit (Garmin ltd, Olathe, Kansas, USA)  Fitbit Flex (Fitbit Inc, San Francisco, California, USA)  Misfit Shine (Misfit, San Francisco, California, USA)  Epson Pulsense (Epson, Suwa, Nagano Prefecture, Japan) | Wrist | Withings Pulse O2:  -22.03%  Garmin vivofit: -20.55%  Fitbit Flex: -1.04%  Misfit Shine: -2.36%  Epson Pulsense: -4.28% |
| Nelson, 2016 | N=30 (15 F)  Age: 48.9 ± 19.4 y  BMI: 26.3 ± 5.2 kg/m2 | Subjects performed a structured protocol consisting of sedentary, household, and ambulatory activities. | Lab | IC – COSMED K4b2 (COSMED, Rome, Italy) | Jawbone UP (Jawbone, San Francisco, California, USA)  Fitbit Flex (Fitbit Inc, San Francisco, California, USA) | Wrist | Jawbone UP: -2.12%  Fitbit Flex: 12.74% |
| Papazoglou, 2006 | N=29  Age: N/A  BMI: N/A | Subjects performed a resting protocol in a larger sample and 29 of the obese subjects participated in low intensity modes of exercise including cycle ergometry, stair stepping and treadmill walking. | Lab | IC – SensorMedics Vmax 229 (SensorMedics Inc, Yorba Linda, CA, USA) | SenseWear Pro 2 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Wrist | SenseWear Pro 2 Armband: 21.54% |
| Price, 2017 | N=14 (3 F)  Age: 23 y  BMI: 22.8 kg/m2 | Subjects walked on a treadmill at increasing velocities. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics, East Sandy, UT, USA) | Jawbone UP (Jawbone, San Francisco, California, USA)  Garmin vivofit (Garmin ltd, Olathe, Kansas, USA) | Upper arm | Jawbone UP: 56.91%  Garmin vivofit: 18.16% |
| Reece, 2015 | N=22 (11 F)  Age: N/A  BMI: N/A | Subjects performed a protocol including rest, sedentary activities and walking. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Wrist | SenseWear Mini Armband:  -3.79% |
| Reeve, 20141 | N: 18 (7 F)  Age: 22.6 y  BMI: 22.9 kg/m2 | Subjects performed 2 resistance training sessions that included 9 different exercises. The weight lifted was 70% of 1 repetition max with 90-second rest intervals. | Lab | IC – COSMED K4b2 (COSMED, Rome, Italy) | BodyMedia CORE (BodyMedia Inc., Pittsburgh, PA, USA)  SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | BodyMedia CORE: 13.8%  SenseWear Mini Armband: 23.7% |
| Rousset, 2015 | Free-living: N=41 (20 F)  Lab: N=49 (26 F)  Age: N/A  BMI: N/A | 1) 10-day comparison to DLW.  2) 24 hours in metabolic chamber, which included eating, deskwork, watching television, housework, treadmill walking, and sleeping. | Lab/ Field | DLW – 12.5 days  MC – 17 hours | SenseWear Pro 3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro 3 Armband: -2.80% |
| Shcherbina, 20171 | N=60 (31 F)  Age: 38.5 y  BMI: 23.65 kg/m2 | Subjects performed treadmill flat and incline running and cycle ergometry at low and moderate intensity. | Lab | IC – COSMED Quark CPNET (COSMED, Rome, Italy) | Apple watch (Apple Inc, Cupertino, CA, USA)  Basis Peak (Basis Science Inc, San Francisco, CA, USA)  Fitbit surge (Fitbit Inc, San Francisco, CA, USA)  Microsoft band (Microsoft Corporation, Redmond, WA, USA)  PulseOn (PulseOn Oy, Espoo Finland) | Wrist | |  | | --- | | Apple watch: -38.23% | | Basis Peak: -12.94%  Fitbit Surge: | | -3.86%  Microsoft Band | | -19.64% | | PulseOn: -24.47% | |
| Slinde, 2013 | N=62 (62 F)  Age: 33.2 ± 4.2 y  BMI: 30 ± 2.8 kg/m2 | 7-day comparison to DLW | Field | DLW – 7 days | SenseWear Pro 2 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Wrist | SenseWear Pro 2 Armband: -2.90% |
| Smith, 2012 | N=30 (30 F)  Age: 29.0 ± 4.3 y  BMI: 24.1 ± 3.0 kg/m2 | Subjects performed a series of activities of daily living activities and treadmill walking at increasing intensities. | Lab | IC – Parvo TrueOne 2400 (Parvo Medics East Sandy, UT, USA) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) Algorithm v2.2 | Upper arm | SenseWear Mini Armband: 18.43% |
| Stackpool, 2014 | N=20 (10 F)  Age: N/A  BMI: N/A | Subjects performed treadmill walking, treadmill running, elliptical exercise and an agility drills. | Lab | IC – Oxycon pro Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | Nike Fuel Band (Nike Inc, Beaverton, OR, USA)  Jawbone UP (Jawbone, San Francisco, California, USA)  Bodymedia Core (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | Nike Fuel Band: -3.99%  Jawbone UP: 3.09% |
| St-Onge, 2007 | N=45 (32 F)  Age: 35.1 ± 14 y  BMI: 23.9 ± 4.0 kg/m2 | 10-day comparison to DLW. | Field | DLW – 10 days | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Armband: 4.70% |
| Tucker, 2015 | N=24 (13 F)  Age: 28.4 ± 7.8 y  BMI: 23.8 ± 3.9 kg/m2 | Subjects performed two, 60-minute semi-structured routines consisting of sedentary/light-intensity, moderate-intensity and vigorous-intensity physical activity. | Lab | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | Nike Fuel Band (Nike Inc., Beaverton, OR, USA)  SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | Nike Fuel Band:  1.22%  SenseWear Armband: -2.10% |
| Van Helst, 2012 | N=21 (10 F)  Age: 29.3 ± 5.1 y | Subjects performed a treadmill protocol involving slow and moderate walking, running slowly, vigorously running and periods of rest. | Lab | IC – Gas analyzer (Respironics Novametrix Medical SystemW inc, NICO 7300, Wallingford, USA) | Vivago (Vivago Wellness, Paris, France) | Wrist | Vivago: -8.02% |
| Van Hoye, 2014 | N=44 (20 F)  Age: 21.1 ± 1.4 y  BMI: 21.8 ± 1.4 kg/m2 | Subjects performed an incremental running test on a treadmill. | Lab | IC – Metalyzer 3B (Cortex Biophysic, Leipzig, Germany) | SenseWear Pro 3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro 3 Armband: -32.96% |
| Van Hoye, 2015 | N=39 (18 F)  Age: 21.1 ± 1.4 y  BMI: 21.8 ± 1.4 kg/m2 | Subjects performed exercise consisting of 5 minutes standing followed by alternating walking and running at 35% and 65% VO2max. | Lab | IC – Metalyzer 3B (Cortex Biophysic, Leipzig, Germany) | SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA)  Algorithm v2.2  SenseWear Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) Algorithm v5.2 | Upper arm | SenseWear Pro 3 Armband: -  -15.23% |
| Vernillo, 2015 | N=20 (8 F)  Age: 30.1 ± 7.2 y  BMI: 22.1 ± 2.4 kg/m2 | Subjects performed randomized pole walking activities at a constant speed and a variety of gradients. | Lab | IC – COSMED Quark b2 (COSMED, Rome, Italy) | SenseWear Pro 3 Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA)  SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA) | Upper arm | SenseWear Pro 3 Armband:  -9.76%  SenseWear Mini Armband: -12.50 |
| Wahl, 2017 | N=20 (10 F)  Age: 25.2 y  BMI: 22.8 kg/m2 | Subjects performed a running protocol consisting of four 5-minute stages of treadmill running at different velocities followed by a period of intermittent running and then a 2.4 km outdoor run. | Lab/ Field | IC – Metalyzer 3B (Cortex Biophysic, Leipzig, Germany) | SenseWear Mini Armband (HealthWear, Bodymedia, Pittsburgh, PA, USA)  Beurer AS80 (Beurer GmbH, Ulm, Germany)  Polar Loop (Polar Electro, Kempele, Finnland)  Garmin vivofit (Garmin ltd, Olathe, Kansas, USA)  Garmin vivosmart (Garmin ltd, Olathe, Kansas, USA)  Garmin vivoactive (Garmin ltd, Olathe, Kansas, USA)  Garmin Forerunner 920XT (Garmin ltd, Olathe, Kansas, USA)  Fitbit Charge (Fitbit Inc, San Francisco, California, USA)  Fitbit charge HR (Fitbit Inc, San Francisco, California, USA)  Withings Pulse (Withings, Issy-les-Moulineaux, France) | Upper arm/Wrist | SenseWear Mini Armband:  -21.27%  Beurer AS80:  -58.07%    Polar Loop:  18.05%  Garmin vivofit:  -13.67%  Garmin vivosmart:  5.98%  Garmin vivoactive:  3.42%  Garmin Forerunner 920XT:  -21.02%  Fitbit Charge:  3.58%  Fitbit charge HR:  7.58%  Withings Pulse O2:  -15.98% |
| Wallen 2016 | N=22 (11 F)  Age: 24.9 y  BMI: 24.3 kg/m2 | Subjects performed a protocol including treadmill exercise and cycling ergometry. | Lab | IC – Metalyzer 3B (Cortex Biophysic, Leipzig, Germany) | Apple watch (Apple Inc, Cupertino, California, USA)  Fitbit charge HR (Fitbit Inc, San Francisco, California, USA)  Samsung Gear S (Samsung Electronics Co, Ltd, Suwon, South Korea)  Mio Alpha (Mio Global, Canada) | Wrist | Apple watch: -75.71  Fitbit charge HR:  -26.31%  Samsung Gear S:  -9.98%  Mio Alpha:  -53.19% |
| Woodman, 2017 | N=28 (8 F)  Age: 24.85 y  BMI: 24.25 kg/m2 | Subjects performed a range of activities including: supine rest, household tasks, treadmill walking, stair stepping, outdoor walking, cycling, and running at a self-selected pace. Seated rest, and ergometer cycling. | Lab/ Field | IC – Oxycon Mobile portable metabolic system (Erich Jaeger, Viasys Healthcare, Germany) | Withings Pulse (Withings, Issy-les-Moulineaux, France)  Basis Peak (Basis Science Inc, San Francisco, CA, USA)  Garmin vivofit  (Garmin ltd, Olathe, Kansas, USA) | Wrist | Withings Pulse: -133.33%  Basis Peak:  0.59%    Garmin vivofit:  -80.59% |
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Characteristics of studies meeting inclusion criteria of systematic review. Results represents the mean percentage error between device measurements and criterion measurements.

1Not included in meta-analysis.

Abbreviations: Female (F), body mass index (BMI), indirect calorimetry (IC), metabolic chamber (MC), doubly labelled water (DLW), Kilocalories (Kcal)