

Verisense Physical Activity Algorithm Research Summary

Verisense measures raw acceleration from the wrist to obtain long term sleep and physical activity data. The raw acceleration data is processed via the open-source GGIR algorithm (<https://cran.r-project.org/web/packages/GGIR/index.html>). This algorithm has been validated to a high standard and has been used extensively in academic research since 2014. This document summarizes the work that has gone on using this algorithm. Table 1 presents a summary of all the research that has been done using the same algorithms used in Verisense.

Table 1 - Summary of research using Verisense Physical Activity Algorithm.

Years(s)	No. studies	Cohorts	n	Age range [y]
2019	14	Dementia Adolescents Children Obese Hip arthroplasty Sedentary adults	93,220	9 – 87
2018	33	Stroke Pulmonary rehabilitation patients Cystic fibrosis Muscular dystrophy Type II diabetes Cardiovascular disease Obesity Sarcopenia Pregnant	64,332	9 – 78.9
2017	22	Post-menopausal Idiopathic pulmonary fibrosis Idiopathic inflammatory myopathy Bipolar disorder Bariatric surgery patients	24,961	6 – 77.5
2014 - 2016	9	Coronary artery disease Children Adolescents General population	8,153	7 – 83
TOTAL Studies	78	TOTAL n / Age range	190,666	6 – 87

2019 Research Summary

Ref	Cohort	n	Age	
			Mean or Range [yr]	Std [yr]
1	Adolescents	940	15.3	0.7
2	General population	85,760	56.8	8.0
3	Masters athletes	29	43.9	3.9
4	Adolescents	2526	18.0	0.0
5	General population*	83,726	60.0	16.6
6	Children	108	10.04	0.31
7	Obese children & adolescents	96	9.0 – 13.8	
8	General population	3,206	30.0	0.0
9	Dementia	26	79.8	5.8
10	Hip arthroplasty	51	24 – 87	
11	Middle aged adults	89	53.5	4.9
12	Obese children	208	10.4	1.2
13	Sedentary adults	74	53.7	5.1
14	Obese Children	107	10.3	1.13
	TOTAL n	93,220	9.0 – 87.0	

*denotes the use of a data-set that is used multiple times in this summary. Data-sets spanning multiple studies are only counted once when summing total patient usage.

2019 References

1. Euler, R., Jimenez, E. Y., Sanders, S., Kuhlemeier, A., Van Horn, M. L., Cohen, D., ... & Kong, A. S. (2019). Peer Reviewed: Rural–Urban Differences in Baseline Dietary Intake and Physical Activity Levels of Adolescents. *Preventing chronic disease*, 16.
2. Jones, S. E., Lane, J. M., Wood, A. R., Van Hees, V. T., Tyrrell, J., Beaumont, R. N., ... & Tuke, M. A. (2019). Genome-wide association analyses of chronotype in 697,828 individuals provides insights into circadian rhythms. *Nature communications*, 10(1), 343.
3. Exel, J., Mateus, N., Abrantes, C., Leite, N., & Sampaio, J. (2019). Physical activity and sedentary behavior in amateur sports: master athletes are not free from prolonged sedentary time. *Sport Sciences for Health*, 1-7.
4. Bielemann, R. M., Ramires, V. V., Wehrmeister, F. C., Gonçalves, H., Assunção, M. C. F., Ekelund, U., & Horta, B. L. (2019). Is vigorous-intensity physical activity required for improving bone mass in adolescence? Findings from a Brazilian birth cohort. *Osteoporosis International*, 1-9.
5. Lane, J. M., Jones, S. E., Dashti, H. S., Wood, A. R., Aragam, K. G., van Hees, V. T., ... & Song, Y. (2019). Biological and clinical insights from genetics of insomnia symptoms. *Nature genetics*, 51(3), 387.
6. Boddy, L. M., Noonan, R. J., Kim, Y., Rowlands, A. V., Welk, G. J., Knowles, Z. R., & Fairclough, S. J. (2018). Comparability of children’s sedentary time estimates derived from wrist worn GENEActiv and hip worn ActiGraph accelerometer thresholds. *Journal of science and medicine in sport*, 21(10), 1045-1049.
7. Zalewski, B. M., & Szajewska, H. (2019). No Effect of Glucomannan on Body Weight Reduction in Children and Adolescents with Overweight and Obesity: A Randomized Controlled Trial. *The Journal of pediatrics*.

8. da Silva, B. G. C., da Silva, I. C. M., Ekelund, U., Brage, S., Ong, K. K., Rolfe, E. D. L., ... & Horta, B. L. (2019). Associations of physical activity and sedentary time with body composition in Brazilian young adults. *Scientific reports*, 9(1), 5444.
9. Farina, N., Sherlock, G., Thomas, S., Lowry, R. G., & Banerjee, S. (2019). Acceptability and feasibility of wearing activity monitors in community-dwelling older adults with dementia. *International journal of geriatric psychiatry*, 34(4), 617-624.
10. Thewlis, D., Bahl, J. S., Fraysse, F., Curness, K., Arnold, J. B., Taylor, M., ... & Solomon, L. B. (2019). Objectively measured 24-hour activity profiles before and after total hip arthroplasty. *The bone & joint journal*, 101(4), 415-425.
11. Amaro-Gahete, F. J., De-la-O, A., Jurado-Fasoli, L., Ruiz, J. R., Castillo, M. J., & Gutiérrez, Á. (2019). Effects of different exercise training programs on body composition: A randomized control trial. *Scandinavian journal of medicine & science in sports*, 29(7), 968-979.
12. Gomez-Bruton, A., Arenaza, L., Medrano, M., Mora-Gonzalez, J., Cadenas-Sanchez, C., Migueles, J. H., & Osés, M. (2019). Associations of dietary energy density with body composition and cardiometabolic risk in children with overweight and obesity: role of energy density calculations, under-reporting energy intake and physical activity. *British Journal of Nutrition*, 121(9), 1057-1068.
13. Amaro-Gahete, F. J., Jurado-Fasoli, L., Gutiérrez, Á., Ruiz, J. R., & Castillo, M. J. (2019). Association of physical activity and fitness with S-Klotho plasma levels in middle-aged sedentary adults: The FIT-AGEING study. *Maturitas*, 123, 25-31.
14. Plaza-Florido, A., Migueles, J. H., Mora-Gonzalez, J., Molina-Garcia, P., Rodríguez-Aylon, M., Cadenas-Sanchez, C., ... & Michels, N. (2019). Heart rate is a better predictor of cardiorespiratory fitness than heart rate variability in overweight/obese children: The ActiveBrains project. *Frontiers in physiology*, 10, 510.

2018 Research Summary

Verisense Physical Activity Algorithm Research Summary

Ref	Cohort	n	Age	
			Mean or Range [yr]	Std [yr]
1	Shift workers	69	18 – 67	
2	Children	104	10.1	1.1
3	Older adults	34	69.6	8.0
4	Children	225	9 – 10	
5	Pokot of Kenya	46	36.6	2.8
6	Pulmonary rehabilitation patients	79	61.84	6.23
7	Children	165	10.4	0.9
8	Office workers	146	41.2	11.1
9	Cystic fibrosis	9	12	3
10	Stroke	41	70	11
11	Children	107	10.53	0.65
12	Muscular dystrophy	34	25 – 72	
13	Healthy adults	55	31.9	9.7
14	General population	130	21.9	2.1
15	Runners	35	41.9	11.4
16	Depression	62	38.1	12.3
17	Type II diabetes	298	55.9	7.3
18	Muscular dystrophy	255	44.8	11.7
19	Cardiovascular disease / diabetes / healthy	52,424	54.3	8.0
20	Children	2,636	6	0
21	Children	239	9 – 10	
22	Female adolescents	234	14	0.3
23	Female adolescents	1,361	12.8	0.8
24	Obese & overweight adults	120	44	9
25	Sarcopenia	131	78.9	2.3
26	Children	188	9 – 12	
27	Pregnant & obese	257	30.3	5.42
28	Pregnant	2,317		
29	Children	1,324	9 – 10	
30	African-American	799	55.9	16.2
31	Children	48	9 – 10	
32	Female	321	55.5	9.2
33	Healthy adults	39	21.1	4.3
	TOTAL n	64,332	9 – 78.9	

2018 References

1. van de Langenberg, D., Vlaanderen, J. J., Dollé, M. E., Rookus, M. A., van Kerkhof, L. W., & Vermeulen, R. C. (2018). Diet, physical activity, and daylight exposure patterns in night-shift workers and day workers. *Annals of work exposures and health*, 63(1), 9-21.
2. Migueles, J. H., Cadenas-Sanchez, C., Tudor-Locke, C., Löf, M., Esteban-Cornejo, I., Molina-Garcia, P., ... & Ortega, F. B. (2019). Comparability of published cut-points for the assessment of physical activity: Implications for data harmonization. *Scandinavian journal of medicine & science in sports*, 29(4), 566-574.
3. Sanders, G. J., Boddy, L. M., Sparks, S. A., Curry, W. B., Roe, B., Kaehne, A., & Fairclough, S. J. (2019). Evaluation of wrist and hip sedentary behaviour and moderate-to-vigorous physical activity raw acceleration cutpoints in older adults. *Journal of sports sciences*, 37(11), 1270-1279.
4. Taylor, S., Noonan, R., Knowles, Z., McGrane, B., Curry, W., & Fairclough, S. (2018). Acceptability and feasibility of single-component primary school physical activity interventions to inform the AS: Sk Project. *Children*, 5(12), 171.
5. Sayre, M. K., Pike, I. L., & Raichlen, D. A. (2019). High levels of objectively measured physical activity across adolescence and adulthood among the Pokot pastoralists of Kenya. *American Journal of Human Biology*, 31(1), e23205.
6. Chevance, G., Berry, T., Boiché, J., & Heraud, N. (2019). Changing implicit attitudes for physical activity with associative learning. *German Journal of Exercise and Sport Research*, 49(2), 156-167.
7. Buchan, D. S., & McLellan, G. (2019). Comparing physical activity estimates in children from hip-worn Actigraph GT3X+ accelerometers using raw and counts based processing methods. *Journal of sports sciences*, 37(7), 779-787.
8. Edwardson, C. L., Yates, T., Biddle, S. J., Davies, M. J., Dunstan, D. W., Esliger, D. W., ... & Munir, F. (2018). Effectiveness of the Stand More AT (SMarT) Work intervention: cluster randomised controlled trial. *bmj*, 363, k3870.
9. Shelley, J., Fairclough, S. J., Knowles, Z. R., Southern, K. W., McCormack, P., Dawson, E. A., ... & Hanlon, C. (2018). A formative study exploring perceptions of physical activity and physical activity monitoring among children and young people with cystic fibrosis and health care professionals. *BMC pediatrics*, 18(1), 335.
10. Shepherd, A. I., Pulsford, R., Poltawski, L., Forster, A., Taylor, R. S., Spencer, A., ... & Calitri, R. (2018). Physical activity, sleep, and fatigue in community dwelling Stroke Survivors. *Scientific reports*, 8(1), 7900.
11. Miller, A., Eather, N., Duncan, M., & Lubans, D. R. (2019). Associations of object control motor skill proficiency, game play competence, physical activity and cardiorespiratory fitness among primary school children. *Journal of sports sciences*, 37(2), 173-179.
12. Jimenez-Moreno, A. C., Charman, S. J., Nikolenko, N., Larweh, M., Turner, C., Gorman, G., ... & Catt, M. (2018). Analyzing walking speeds with ankle and wrist worn accelerometers in a cohort with myotonic dystrophy. *Disability and rehabilitation*, 1-7.
13. Buchan, D. S., McSeveney, F., & McLellan, G. (2019). A comparison of physical activity from Actigraph GT 3X+ accelerometers worn on the dominant and non-dominant wrist. *Clinical physiology and functional imaging*, 39(1), 51-56.
14. Acosta, F. M., Martinez-Tellez, B., Sanchez-Delgado, G., Migueles, J. H., Contreras-Gomez, M. A., Martinez-Avila, W. D., ... & Ruiz, J. R. (2018). Association of objectively measured physical activity with brown adipose tissue volume and activity in young adults. *The Journal of Clinical Endocrinology & Metabolism*, 104(2), 223-233.
15. Stiles, V. H., Pearce, M., Moore, I. S., Langford, J., & Rowlands, A. V. (2018). Wrist-worn Accelerometry for Runners: Objective Quantification of Training Load. *Medicine and science in sports and exercise*, 50(11), 2277.

16. Lambert, J. D., Greaves, C. J., Farrand, P., Price, L., Haase, A. M., & Taylor, A. H. (2018). Web-based intervention using behavioral activation and physical activity for adults with depression (the eMotion study): pilot randomized controlled trial. *Journal of medical Internet research*, 20(7), e10112.
17. Lean, M. E., Leslie, W. S., Barnes, A. C., Brosnahan, N., Thom, G., McCombie, L., ... & Rodrigues, A. M. (2018). Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. *The Lancet*, 391(10120), 541-551.
18. Okkersen, K., Jimenez-Moreno, C., Wenninger, S., Daidj, F., Glennon, J., Cumming, S., ... & Faber, C. G. (2018). Cognitive behavioural therapy with optional graded exercise therapy in patients with severe fatigue with myotonic dystrophy type 1: a multicentre, single-blind, randomised trial. *The Lancet Neurology*, 17(8), 671-680.
19. Cassidy, S., Fuller, H., Chau, J., Catt, M., Bauman, A., & Trenell, M. I. (2018). Accelerometer-derived physical activity in those with cardio-metabolic disease compared to healthy adults: a UK Biobank study of 52,556 participants. *Acta diabetologica*, 55(9), 975-979.
20. Bielemann, R. M., dos S Vaz, J., Domingues, M. R., Matijasevich, A., Santos, I. S., Ekelund, U., & Horta, B. L. (2018). Are consumption of dairy products and physical activity independently related to bone mineral density of 6-year-old children? Longitudinal and cross-sectional analyses in a birth cohort from Brazil. *Public health nutrition*, 21(14), 2654-2664.
21. Taylor, S., Noonan, R., Knowles, Z., Owen, M., McGrane, B., Curry, W., & Fairclough, S. (2018). Evaluation of a pilot school-based physical activity clustered randomised controlled trial—Active Schools: Skelmersdale. *International journal of environmental research and public health*, 15(5), 1011.
22. Owen, M., Kerner, C., Taylor, S., Noonan, R., Newson, L., Kosteli, M. C., ... & Fairclough, S. (2018). The feasibility of a novel school peer-led mentoring model to improve the physical activity levels and sedentary time of adolescent girls: the girls peer activity (G-PACT) project. *Children*, 5(6), 67.
23. Harrington, D. M., Davies, M. J., Bodicoat, D. H., Charles, J. M., Chudasama, Y. V., Gorely, T., ... & Edwards, R. T. (2018). Effectiveness of the 'Girls Active' school-based physical activity programme: A cluster randomised controlled trial. *International journal of behavioral nutrition and physical activity*, 15(1), 40.
24. Innerd, P., Harrison, R., & Coulson, M. (2018). Using open source accelerometer analysis to assess physical activity and sedentary behaviour in overweight and obese adults. *BMC public health*, 18(1), 543.
25. Westbury, L. D., Dodds, R. M., Syddall, H. E., Baczynska, A. M., Shaw, S. C., Dennison, E. M., ... & Patel, H. P. (2018). Associations between objectively measured physical activity, body composition and sarcopenia: findings from the Hertfordshire Sarcopenia Study (HSS). *Calcified tissue international*, 103(3), 237-245.
26. McLellan, G., Arthur, R., & Buchan, D. S. (2018). Wear compliance, sedentary behaviour and activity in free-living children from hip-and wrist-mounted ActiGraph GT3X+ accelerometers. *Journal of sports sciences*, 36(21), 2424-2430.
27. Phelan, S., Wing, R. R., Brannen, A., McHugh, A., Hagobian, T. A., Schaffner, A., ... & Yin, E. (2018). Randomized controlled clinical trial of behavioral lifestyle intervention with partial meal replacement to reduce excessive gestational weight gain. *The American journal of clinical nutrition*, 107(2), 183-194.
28. da Silva, S. G., Evenson, K. R., da Silva, I. C. M., Mendes, M. A., Domingues, M. R., da Silveira, M. F., ... & Hallal, P. C. (2018). Correlates of accelerometer-assessed physical activity in pregnancy—The 2015 Pelotas (Brazil) Birth Cohort Study. *Scandinavian journal of medicine & science in sports*, 28(8), 1934-1945.
29. Lloyd, J., Creanor, S., Logan, S., Green, C., Dean, S. G., Hillsdon, M., ... & Ryan, E. (2018). Effectiveness of the Healthy Lifestyles Programme (HeLP) to prevent obesity in UK primary-

- school children: a cluster randomised controlled trial. *The Lancet Child & Adolescent Health*, 2(1), 35-45.
30. Flórez, K. R., Richardson, A. S., Ghosh-Dastidar, M. B., Troxel, W., DeSantis, A., Colabianchi, N., & Dubowitz, T. (2018). The power of social networks and social support in promotion of physical activity and body mass index among African American adults. *SSM-population health*, 4, 327-333.
 31. Hurter, L., Fairclough, S., Knowles, Z., Porcellato, L., Cooper-Ryan, A., & Boddy, L. (2018). Establishing raw acceleration thresholds to classify sedentary and stationary behaviour in children. *Children*, 5(12), 172.
 32. Kerr, J., Marinac, C. R., Ellis, K., Godbole, S., Hipp, A., Glanz, K., ... & Berrigan, D. (2017). Comparison of accelerometry methods for estimating physical activity. *Medicine and science in sports and exercise*, 49(3), 617.
 33. Montoye, A. H., Westgate, B. S., Fonley, M. R., & Pfeiffer, K. A. (2018). Cross-validation and out-of-sample testing of physical activity intensity predictions with a wrist-worn accelerometer. *Journal of Applied Physiology*, 124(5), 1284-1293.

2017 Research Summary

Verisense Physical Activity Algorithm Research Summary

Ref	Cohort	n	Age	
			Mean or Range [yr]	Std [yr]
1	Adolescents	3,379	18.4	0.3
2	Children	120	9 – 10	
3	Children	1,324	9.8	0.3
4	General population	1,874	30	
5	Obese	76	56	
6	Pre / post menopausal	2,534	58.9	5.0
7	Idiopathic pulmonary fibrosis	35		
8	Older adults	1,210	77.5	5.0
9	Adolescents	628	14.5	1.6
10	Idiopathic inflammatory myopathy	5		
11	Adolescents	3,528	11 / 15 / 18	
12	Children	215	10.2	0.3
13	African-American	791	56.1	16.3
14	Children	1,324	9.8	0.3
15	Children	169	10.3	0.3
16	General population	25	10 – 41	
17	Older adults	971	>60	
18	Older adults	3,749	60 – 83	
19	Bipolar disorder	88	46.8	11.1
20	Children	2,604	6	
21	Bariatric surgery patients	22	46	
22	General population	20	23.2	5.9
	TOTAL n	24,961	6 – 77.5	

2017 References

1. da Silva, I. C. M., Hino, A. A., Lopes, A., Ekelund, U., Brage, S., Gonçalves, H., ... & Hallal, P. C. (2017). Built environment and physical activity: domain-and activity-specific associations among Brazilian adolescents. *BMC public health*, 17(1), 616.
2. Noonan, R. J., Boddy, L. M., Kim, Y., Knowles, Z. R., & Fairclough, S. J. (2017). Comparison of children's free-living physical activity derived from wrist and hip raw accelerations during the segmented week. *Journal of sports sciences*, 35(21), 2067-2072.
3. Lloyd, J., Creanor, S., Price, L., Abraham, C., Dean, S., Green, C., ... & Logan, S. (2017). Trial baseline characteristics of a cluster randomised controlled trial of a school-located obesity prevention programme; the Healthy Lifestyles Programme (HeLP) trial. *BMC public health*, 17(1), 291.
4. Kolle, E., Horta, B. L., Wells, J., Brage, S., Barros, F. C., Ekelund, U., & Hallal, P. C. (2017). Does objectively measured physical activity modify the association between early weight gain and fat mass in young adulthood?. *BMC public health*, 17(1), 905.

5. Chevance, G., Caudroit, J., Henry, T., Guerin, P., Boiché, J., & Héraud, N. (2018). Do implicit attitudes toward physical activity and sedentary behavior prospectively predict objective physical activity among persons with obesity?. *Journal of behavioral medicine*, *41*(1), 31-42.
6. Stiles, V. H., Metcalf, B. S., Knapp, K. M., & Rowlands, A. V. (2017). A small amount of precisely measured high-intensity habitual physical activity predicts bone health in pre-and post-menopausal women in UK Biobank. *International journal of epidemiology*, *46*(6), 1847-1856.
7. Atkins, C., Baxter, M., Jones, A., & Wilson, A. (2018). Measuring sedentary behaviors in patients with idiopathic pulmonary fibrosis using wrist-worn accelerometers. *The clinical respiratory journal*, *12*(2), 746-753.
8. Koolhaas, C. M., van Rooij, F. J., Schoufour, J. D., Cepeda, M., Tiemeier, H., Brage, S., & Franco, O. H. (2017). Objective measures of activity in the elderly: distribution and associations with demographic and health factors. *Journal of the American Medical Directors Association*, *18*(10), 838-847.
9. Kim, Y., Hibbing, P., Saint-Maurice, P. F., Ellingson, L. D., Hennessy, E., Wolff-Hughes, D. L., ... & Welk, G. J. (2017). Surveillance of youth physical activity and sedentary behavior with wrist accelerometry. *American journal of preventive medicine*, *52*(6), 872-879.
10. Bachasson, D., Landon-Cardinal, O., Benveniste, O., Hogrel, J. Y., & Allenbach, Y. (2017). Physical activity monitoring: a promising outcome measure in idiopathic inflammatory myopathies. *Neurology*, *89*(1), 101-103.
11. Nakamura, P. M., Mielke, G. I., Horta, B. L., Assunção, M. C., Gonçalves, H., Menezes, A. M., ... & Oliveira, I. O. (2017). Physical activity throughout adolescence and HbA1c in early adulthood: birth cohort study. *Journal of Physical Activity and Health*, *14*(5), 375-381.
12. Taylor, S., Curry, W., Knowles, Z., Noonan, R., McGrane, B., & Fairclough, S. (2017). Predictors of segmented school day physical activity and sedentary time in children from a northwest England low-income community. *International journal of environmental research and public health*, *14*(5), 534.
13. Richardson, A. S., Troxel, W. M., Ghosh-Dastidar, M. B., Beckman, R., Hunter, G. P., DeSantis, A. S., ... & Dubowitz, T. (2017). One size doesn't fit all: cross-sectional associations between neighborhood walkability, crime and physical activity depends on age and sex of residents. *BMC public health*, *17*(1), 97.
14. Lloyd, J., Creanor, S., Price, L., Abraham, C., Dean, S., Green, C., ... & Logan, S. (2017). Trial baseline characteristics of a cluster randomised controlled trial of a school-located obesity prevention programme; the Healthy Lifestyles Programme (HeLP) trial. *BMC public health*, *17*(1), 291.
15. Fairclough, S. J., Dumuid, D., Taylor, S., Curry, W., McGrane, B., Stratton, G., ... & Olds, T. (2017). Fitness, fatness and the reallocation of time between children's daily movement behaviours: an analysis of compositional data. *international journal of behavioral nutrition and physical activity*, *14*(1), 64.
16. Noonan, R. J., Fairclough, S. J., Knowles, Z. R., & Boddy, L. M. (2017). Context matters! sources of variability in weekend physical activity among families: a repeated measures study. *BMC public health*, *17*(1), 330.
17. Ramires, V. V., Wehrmeister, F. C., Böhm, A. W., Galliano, L., Ekelund, U., Brage, S., & da Silva, I. C. M. (2017). Physical activity levels objectively measured among older adults: a population-based study in a Southern city of Brazil. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 13.
18. Menai, M., Van Hees, V. T., Elbaz, A., Kivimaki, M., Singh-Manoux, A., & Sabia, S. (2017). Accelerometer assessed moderate-to-vigorous physical activity and successful ageing: results from the Whitehall II study. *Scientific reports*, *7*, 45772.

19. Bradley, A. J., Webb-Mitchell, R., Hazu, A., Slater, N., Middleton, B., Gallagher, P., ... & Anderson, K. N. (2017). Sleep and circadian rhythm disturbance in bipolar disorder. *Psychological medicine*, 47(9), 1678-1689.
20. Knuth, A. G., Silva, I. C. M., van Hees, V. T., Cordeira, K., Matijasevich, A., Barros, A. J., ... & Hallal, P. C. (2017). Objectively-measured physical activity in children is influenced by social indicators rather than biological lifecourse factors: evidence from a Brazilian cohort. *Preventive medicine*, 97, 40-44.
21. Afshar, S., Seymour, K., Kelly, S. B., Woodcock, S., van Hees, V. T., & Mathers, J. C. (2017). Changes in physical activity after bariatric surgery: using objective and self-reported measures. *Surgery for Obesity and Related Diseases*, 13(3), 474-483.
22. Rowlands, A. V., Mirkes, E. M., Yates, T. E., Clemes, S. A., Davies, M. J., Khunti, K., & Edwardson, C. L. (2018). Accelerometer-assessed physical activity in epidemiology: are monitors equivalent?.

2014 - 2016 Research Summary

Verisense Physical Activity Algorithm Research Summary

Ref	Cohort	n	Age	
			Mean or Range [yr]	Std [yr]
1	Coronary artery disease	58	79	4
2	Children	129	9 – 10	
3	General population	33	27.4	5.9
4	General population	3,457	60 – 82	
5	Adolescents	3,235	18	
6	General population	1,241	30	
7	General population*	3,457		
8	General population*	2,636	7 / 18 / 30	
9	General population*	3,975	60 – 83	
	TOTAL n	8,153	7 – 83	

*denotes the use of a data-set that is used multiple times in this summary. Data-sets spanning multiple studies are only counted once when summing total patient usage.

2014 – 2016 References

- Charman, S. J., van Hees, V. T., Quinn, L., Dunford, J. R., Bawamia, B., Veerasamy, M., ... & Kunadian, V. (2016). The effect of percutaneous coronary intervention on habitual physical activity in older patients. *BMC cardiovascular disorders*, 16(1), 248.
- Hiden, H., Woodman, S., & Watson, P. (2016, October). Prediction of workflow execution time using provenance traces: practical applications in medical data processing. In *2016 IEEE 12th International Conference on e-Science (e-Science)*(pp. 21-30). IEEE.
- Bakrania, K., Yates, T., Rowlands, A. V., Esliger, D. W., Bunnewell, S., Sanders, J., ... & Edwardson, C. L. (2016). Intensity thresholds on raw acceleration data: Euclidean norm minus one (ENMO) and mean amplitude deviation (MAD) approaches. *PloS one*, 11(10), e0164045.
- Bell, J. A., Hamer, M., van Hees, V. T., Singh-Manoux, A., Kivimäki, M., & Sabia, S. (2015). Healthy obesity and objective physical activity-. *The American journal of clinical nutrition*, 102(2), 268-275.
- Esteban-Cornejo, I., Hallal, P. C., Mielke, G. I., Menezes, A. M., Gonçalves, H., Wehrmeister, F., ... & Rombaldi, A. J. (2015). Physical activity throughout adolescence and cognitive performance at 18 years of age. *Medicine and science in sports and exercise*, 47(12), 2552.
- Horta, B. L., Schaan, B. D., Bielemann, R. M., Vianna, C. Á., Gigante, D. P., Barros, F. C., ... & Hallal, P. C. (2015). Objectively measured physical activity and sedentary-time are associated with arterial stiffness in Brazilian young adults. *Atherosclerosis*, 243(1), 148-154.
- Sabia, S., Cogranne, P., van Hees, V. T., Bell, J. A., Elbaz, A., Kivimaki, M., & Singh-Manoux, A. (2015). Physical activity and adiposity markers at older ages: accelerometer vs questionnaire data. *Journal of the American Medical Directors Association*, 16(5), 438-e7.
- da Silva, I. C., van Hees, V. T., Ramires, V. V., Knuth, A. G., Bielemann, R. M., Ekelund, U., ... & Hallal, P. C. (2014). Physical activity levels in three Brazilian birth cohorts as assessed with raw triaxial wrist accelerometry. *International journal of epidemiology*, 43(6), 1959-1968.
- Sabia, S., van Hees, V. T., Shipley, M. J., Trenell, M. I., Hagger-Johnson, G., Elbaz, A., ... & Singh-Manoux, A. (2014). Association between questionnaire-and accelerometer-assessed physical activity: the role of sociodemographic factors. *American journal of epidemiology*, 179(6), 781-790.