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-RESEARCH ARTICLE-

WEARABLE ACTIVITY-TRACKING DEVICE FEATURE PREFERENCE AMONGST SOUTH AFRICAN GENERATION Y STUDENTS

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─Abstract ─

Wearable activity-tracking devices such as pedometers, various electrode-based chest straps, accelerometer-based arm straps, fashion bracelets, jewellery, fitness bands and watches, earphones, and smart clothing have revolutionised health and sports monitoring. Based on the benefits of using this wearable technology, it is no surprise that the adoption thereof has increased rapidly. In 2019, the sports, fitness, and activity monitor market is estimated to generate 2.8 billion USD in global revenue. In South Africa, merely 13 percent of households own some form of wearable technology. Dominating this market is the youth, where 33.7 percent of these individuals are between the ages of 18 to 24 years, thus belonging to the Generation Y cohort. The literature, documenting wearable activity-tracking device feature preference amongst consumers, especially among this cohort, is limited. As such, this study explored South African Generation Y students' feature preferences on wearable activity-tracking devices in order to assist device manufacturers and marketing practitioners in developing and marketing devices that will appeal to this large segment. A non-probability convenience sample of 480 students, registered at three public HEIs in South Africa's Gauteng province, voluntarily completed self-administered questionnaires. A descriptive research design was followed and the captured data were analysed using measures of frequency. The findings indicate that the top five device features preferred by South African Generation Y students are measuring heart rate/blood pressure, tracking steps taken/distance travelled, calculating daily calories burnt, tracking sleep patterns and GPS tracking. In an effort to increase wearable activity-tracking

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device adoption amongst Generation Y students, both local and international device manufacturers need to consider these device feature preferences in order to manufacture and advertise such devices accordingly.

Key Words: Wearable activity-tracking devices, new technology adoption, feature preference, Generation Y, South Africa.

JEL Classification: M31, M37, O30

1. INTRODUCTION

Activity-tracking devices, commonly known as activity trackers or fitness trackers, comprise technology capable of measuring the user's physical movement and health-related metrics (Muller, 2019). These devices are available across various platforms, whether it is an attachable device, cycling computer, or a smartphone application. The wearable technology market, of which certain activity-tracking devices form part, is currently estimated to have a net value of approximately 7 643.1 million USD (R109 billion) and it is expected to increase to 8 592.4 million (R122.5 billion) in 2020 (Statista, 2018a), based on the average exchange rate of $1/R13.26 for August 2018 to July 2019 (Exchange-rates.org, 2019). In addition, within the global wearable technology market, fitness, activity, and sports trackers are projected to increase from 61 million units distributed in 2016 to 187 million units distributed in 2020 (Lamkin, 2016). Despite the mere 13 percent of South African households currently owning some form of wearable technology (Business Tech, 2018), the country had a market penetration rate of 3.81 percent in 2017 for wearable activity trackers specifically, which is projected to increase to 4.83 percent in 2020. To put this in perspective, of the total national population, as recorded mid-year in 2017 which totalled 56 521 900 individuals (Statistics South Africa, 2017), an additional 576 523 individuals will be using a wearable activity tracker within this three-year period. As such, South Africa ranks amongst the global leading economies (Statista, 2018b) and is expected to be the next big market for both smartwatches and fitness trackers (Business Tech, 2018).

The demographic segment that has shown a substantial interest in the wearable technology market is the youth, particularly individuals who form part of the Generation Y cohort. Markert (2004) defines this cohort, referred to as Millennials, as individuals born between 1986 and 2005. This is the first generation to evolve during a period where computers, mobile phones, electronic devices and the internet have been integral elements in their daily lives, which lead to them naturally thriving on technology and its innovations. Moreover, it is

the youth who are more motivated to be proactive in altering their lifestyle patterns in favour of their well-being and will eagerly pay premium prices to reach health-related goals (Gustafson, 2017). Consequently, it is not surprising that 48 percent of global wearable-device users fall within the Generation Y cohort (Marr, 2016). The South African wearable activity-tracking device segment is driven and dominated by the youth, with 33.7 percent of this market comprising individuals aged between 18 and 24 years (Statista, 2018b). In South Africa, the Generation Y cohort comprised roughly 36.2 percent of the country's total population of 56.5 million. The magnitude of this cohort brands them as an important segment for both international and South African device manufacturers, retailers, and e-commerce sites. Owing to the magnitude of this cohort and considering that the youth who are pursuing a tertiary education are attributed by a heightened future-earning probability and trendsetting potential (Bevan-Dye & Surujlal, 2011), an opportunity has emerged to appeal to the student portion of the Generation Y cohort.

Research regarding wearable activity-tracking devices comprises various studies focused around different themes. For instance, the number of studies specifically pertaining to wearable activity trackers totalled 463 between 2013 and 2017 (Shin *et al.*, 2019). Amid the 463 studies, the largest segment (26%) centred on technological functioning; 23 percent comprised patient treatment and medical settings; and 18 percent addressed behavioural change. Furthermore, 17 percent highlighted wearable activity tracker acceptance, adoption, and abandonment; 10 percent focused on self-monitoring; and 6 percent pertained to privacy. These studies, along with more recent research, focus mostly on wearable device reliability and/or validity, comparing different brands and specific models of devices, the accuracy of such devices, medical attributes and patient treatment by means of using wearable technology, promoting physical activity or physical activity intervention, device acceptance and factors influencing the adoption or abandonment of wearable activity trackers, and the privacy concerns posed by using these types of devices (Bassett, Freedson & John, 2019; Bunn, Wells, Manor, & Webster, 2019; Muller, 2019; Jones *et al.*, 2018; Lamont, Daniel, Payne & Brauer, 2018; Muller, de Klerk & Bevan-dye, 2018; Yang, Schumann, Le & Cheng, 2018; Chu *et al.*, 2017; Shinde *et al.*, 2017; Steinert, Haesner & Steinhagen-Thiessen, 2017; Diaz *et al.*, 2016; Kaewkannate & Kim, 2016; Lamb, Huang, Marturano & Bashir, 2016; Roe, Salmon & Twiggs, 2016; Wang *et al.*, 2016; Cadmus-Bertram *et al.*, 2015; Case, Burwick, Volpp & Patel, 2015; Kooiman *et al.*, 2015; Fulk *et al.*, 2014; Lee, Kim & Welk, 2014; Fausset *et al.*, 2013; Noah, Spierer, Jialu & Bronner, 2013). However, the majority of these

studies used smaller samples (between 0-100) and the research and data collection methods were mostly observational, experimental, interventional, or qualitative in nature, with the exception of a few that were quantitative and survey-based. In addition, the target population of these studies mostly comprised participants outside of the Generation Y, university student cohort.

Thus far in 2019, two studies emerged that emphasised wearable activity-tracking device feature preference, one of which included university students as a sample. Hong (2015) explored Korean university students' perception of wearable device features. In the study, participants had to indicate the level of importance of each of nine features, and the results were linked to the product life cycle (PLC) and marketing mix. Similarly, Steinert *et al.* (2017) investigated 12 categorical preferences, including, amongst others, comfort, design, quality, manner of attachment, and synchronisation of five specific fitness trackers using 20 older adults outside of Gen Y as a sample. It is evident that the literature documenting the feature preference of wearable activity-tracking devices amongst consumers, especially among the South African Generation Y cohort, is limited. Hence, this study aims to identify Generation Y students' feature preference of wearable fitness, activity, and sports trackers - collectively termed wearable activity-tracking devices - with the aim of closing the gap in the literature. The findings will assist device manufacturers and marketing practitioners in developing and marketing devices that will appeal to this large segment.

2. LITERATURE REVIEW

2.1. Wearable activity-tracking devices defined

There is much confusion amongst consumers as to the accurate definition of activity-tracking devices. Reinforcing this confusion is that various consumers believe it to be synonymous to smartwatches – a type of wearable industry of its own accord (International Data Corporation, 2016). Granted that both types of wearables comprise related features, fitness trackers are used for producing more comprehensive workout data, whereas smartwatches are suitable for users with a need to remain up to date with calls, emails, and text messages without having to take out their phones (Chang, 2017). Smartwatches are essentially an extension of the user's smartphone. Conversely, an activity-tracking device refers to any physical device or application on smartphones that is capable of tracking the user's movement and metrics on a real-time basis (Muller, 2019) whilst being able to connect wirelessly to an IT device for the purpose of visually displaying the recorded information (Techopedia, 2018; Kingston, 2015). In accordance with this

information, wearable activity-tracking devices are defined as "any type of device that is attachable to the human body, including clothing items, capable of measuring the user's movement and fitness-related metrics, whilst simultaneously providing real-time feedback by means of a smart device"; the emphasis is on these devices being wearable in nature.

2.2. Wearable activity-tracking device types, characteristics, and features

A review of the literature could not divulge research studies or articles that summarise the types of wearable activity trackers that are available on the market at a specific point in time. As such, a brief description of the different types of wearable activity-tracking devices as of the end of 2018 follows. An extensive search identified several types of devices, namely, basic to advanced clip-on pedometers (Van Heerden, 2016); heart-rate based chest straps, arm straps (Halse, 2018), and headbands (Price, 2017); fashion bracelets (Halse, 2018); fitness bands with or without an interface (Nield, 2017); smart clothing (Mackenzie, 2015); smart rings (Van Heerden, 2016); smart jewellery, such as the Swarovski activity crystal (Stuart, 2016); headphones or earphones, known as hearables (Dubey, 2017); smart sneakers (Eadicicco, 2016); smart insoles (Nguyen, 2016); digital and analogue watches, where a combination of the two is also available.

Some of the abovementioned wearable activity trackers use a combination of accelerometers, altimeters, sensors, and algorithms to track the number of steps taken, distance travelled, or calories burnt by the user (Beckham, 2012). Other devices can measure the user's static or optical heart-rate data (Rettner, 2014); record different sport sessions, such as running or cycling (Hong, 2015); and measure stress levels (Nield, 2017). Smart Shirts such as Hexoskin, a type of smart clothing, provide exact cardiac, respiratory, sleep, and activity metrics (Draper, 2018). As these devices evolve, various models allow the user to manually enter the data about the food they consume directly onto the device or corresponding application (Caddy, 2016), and even comprise a posture reminder function or inactivity alert (Bumgardner, 2017) to remind the user to move when becoming sedentary for extensive periods of time in a day. In addition, more advanced models offer additional features such as measuring the user's detailed sleep patterns, being splash-proof or waterproof, having a full-colour display, and synchronising capabilities. Some devices have an integrated GPS system for superior tracking functions and by means of colourful, interchangeable bands (Duffy & Colon, 2016) allow the user to accessorise their devices to suit their attire. The statistical metrics generated by these devices can be shared, if required by the user, with friends through social media channels (Pressman, 2017).

3. METHODOLOGY

3.1. Research design, sampling method, and data collection

The study followed a descriptive research design, employing a single cross-sectional, quantitative research approach. The target population for this study was defined as Generation Y university students aged between 18 and 24 years, who were registered at public South African higher education institutions (HEIs). The sampling frame comprised the 26 registered South African public HEIs (Business Tech, 2015), from which a judgement sample of three campuses located in the Gauteng province were selected: one from a traditional university, one from a university of technology, and one from a comprehensive university. A non-probability convenience sample of 600 students was drawn and 200 questionnaires distributed at each of the three campuses. The researcher and a trained fieldworker collected the data following the mall-intercept approach.

3.2. Research instrument and data analysis

The required data were collected using self-administered survey questionnaires. This survey questionnaire comprised one section focusing on collecting the sample participants' demographic information and another section focusing on participants' background information regarding activity-tracking devices. The questions in the latter section varied between dichotomous-type questions and single-questions necessitating multiple responses. The survey questionnaire included a cover letter that explained the nature and purpose of the study and indicated to participants that their responses would be kept confidential and used for statistical purposes only. The completion of the questionnaires was done on a strictly voluntary basis. The captured data were analysed using the IBM Statistical Package for Social Sciences (SPSS) Version 25 for Windows. The data analysis procedures comprised descriptive statistics, using measures of frequency.

4. RESULTS AND DISCUSSION

Of the 600 questionnaire distributed, 543 were returned. Of the returned questionnaires, 480 fell within the defined target population. As such, this study had an 80 percent actual response rate. Table 1 indicates that there were slightly more females (59.4%) than males (40.2%) and that the majority of the sample fell within the Black/African (89%) ethnicity group. Smaller representations came from other ethnic groups, those are 3.3 percent Coloured individuals, of which 2.1 percent were either Indian or Asian individuals, and 5.2 percent of the sample fell within the White ethnic group. The sample represented all of the age groups,

where the majority of the sample participants were aged between 18 and 21 years. Of the nine South African provinces, only one province (Northern Cape) had no representatives, with the highest representation being from the Gauteng province. There were slightly less responses from the comprehensive university (25.2%) than from the traditional university (37.5%) and the university of technology (37.3%). A description of the sample participants is summarised in Table 1.

Table 1: Sample description

Gender	**%**	**Age**	**%**	**Province**	**%**	**Institution**	**%**
Male	40.2	18	20.6	Eastern Cape	4.0	Traditional	37.5
Female	59.4	19	27.9	Free State	6.7	Technology	37.3
Missing	0.4	20	17.7	Gauteng	52.3	Comprehensive	25.2
		21	17.3	Kwazulu-Natal	4.4		
Ethnicity	**%**	22	9.0	Limpopo	17.5		
Black/African	89.0	23	5.0	Mpumalanga	7.7		
Coloured	3.3	24	2.5	North West	6.5		
Indian/Asian	2.1			Northern Cape	0		
White	5.2			Western Cape	0.6		
Missing	0.4			Missing	0.4		

Descriptive statistics, using measures of frequency, were computed to gain insights into the sample participants' background information pertaining to activity-tracking devices. The questionnaire items requested participants to indicate whether they currently own an activity-tracking device and whether they are interested in tracking their daily activity. The functionality of a smartphone application to measure one's daily activity and advanced metrics is very limited. However, at the time of data collection, wearable activity-tracking devices were still regarded as novel and unknown to the majority of the sample participants. As such, to gain an understanding of the population sample's familiarity with any type of activity-tracking technology, the participants were requested to indicate whether they own a smartphone and whether they had an activity-tracking application installed on the device. The results of the four items regarding participants' activity-tracking device background information are presented in Table 2.

Table 2: Activity-tracking device background information

Item	Yes (%)	No (%)	Missing (%)
Participants' ownership of a wearable activity-tracking device	6.1	93.3	0.6
Participants' interest in tracking their daily activity	76.5	23.3	1.2
Participants' ownership of a smartphone	94.2	5.6	0.2
Activity-tracking application present on participants' smartphone	26.0	73.3	0.6

As indicated in Table 2, only 6.1 percent of the sample owned a wearable activity-tracking device at the time of data collection. Therefore, it is evident that the awareness and adoption of wearable activity-tracking devices is still in the early phase amongst members of the South African Generation Y cohort. However, despite this low ownership of activity-tracking devices, it is reassuring that 76.5 percent of the sample participants had shown an interest in tracking their daily activity. According to Table 2, the majority of the sample participants (94.2%) owned a smartphone, of which 26 percent had some form of activity-tracking application installed on the device. Based on the possession of such applications, albeit by a mere quarter of the sample, and the 76.5 percent of the sample who had shown an interest in tracking their daily activity, it can be deduced that they are more likely to use more advanced technology, such as wearable activity trackers, to track their preferred metrics in future. It is thus imperative for device manufacturers, retailers, e-commerce sites, as well as their relative marketing departments to create awareness of these products amongst members of the Generation Y cohort.

Both local and international device manufacturers, especially well-established brands, should manufacture and market devices that will suit the needs of the target population. In order to assist in uncovering the needs of this target population, a snapshot of the device feature preferences was drawn from a sample of participants in this study. The participants had to indicate their five most favoured wearable activity-tracking device features out of a possible 15 response options. The 15 possible response options as well as the results are presented in Table 3 in descending order of popularity.

Table 3: Frequency responses of Generation Y students' wearable activity-tracking device feature preference

Feature	*f*	%
Measuring heart rate and blood pressure	311	64.8
Tracking steps and distance travelled	224	46.7
Calculating daily calories burnt	207	43.1
Tracking sleep patterns	185	38.5
GPS tracking	185	38.5
Waterproof / water resistant	161	33.5
Multi-sport tracking (swimming, running, cycling, gym, etc.)	140	29.2
Smart notifications	115	24.0
24/7 Activity tracking	112	23.3
Active time	88	18.3
On-screen workout programme	77	16.0
Food logging	77	16.0
Perspiration (sweat) levels	64	13.3
Inactivity alert	36	7.5
Interchangeable bands	16	3.3

Notes for table: Given that participants were able to choose five options; the data should be interpreted with care. For instance, for each feature n=480.

It is evident from Table 3 that a wearable activity-tracking device's function for measuring heart rate and blood pressure was the main priority according to the majority, 64.8 percent, of the sample participants. Tracking steps and distance travelled (46.7%), calculating daily calories burnt (43.1%), tracking sleep patterns (38.5%), GPS tracking (38.5%), and being waterproof or water resistant (33.5%) all received favour by more than 30 percent of sample participants. Wearable activity-tracking devices' ability to measure perspiration (13.3%), alerting the user of prolonged inactivity (7.5%), as well as being customisable by means of interchangeable bands (3.3%) were the three least favoured features among the sample participants. This indicates to device manufacturers where the focus should be regarding device functionality. These findings are in line with a prior study that indicates the prioritisation of features on these devices that track users'

steps and distance travelled, calories burnt, sleep patterns, pulse and blood pressure, diet, and active time (Hong, 2015).

In order to make this data more useful to the industry, which could lead to a more practical implementation for device manufacturers to develop specific devices, retailers, e-commerce sites, and their relevant marketing departments to advertise and promote the preferred features, this study focused on the five most important features of a wearable activity-tracking devices based on the sample participants' responses. The results derived from Table 3 indicate that the top five preferred features amongst the sample participants include measuring heart rate and blood pressure (311 responses), followed by tracking steps and distance travelled (224 responses), calculating calories burnt (207 responses), and tracking sleep patterns and GSP tracking which received the same amount of responses (185) each.

In an effort to increase South African revenues derived from selling wearable activity trackers and consequently boosting the local economy, South African device manufacturers should design and manufacture wearable activity trackers based on Generation Y students' feature preference. Alternatively, local retailers and e-commerce sites should focus on acquiring wearable activity-tracking devices that comprise these features and emphasise their marketing efforts on Generation Y consumers. The availability of a device that is tailored to the needs of the target market will lead to increased sales and market penetration rate amongst these consumers. Owing to the rapid technological advances and ever-changing features, device manufacturers should remain up to date with feature preferences amongst their largest consumer group, which in this case is the Generation Y cohort.

5. LIMITATIONS AND FUTURE RESEARCH

This study had some limitations, one of which was collecting data from a non-probability convenience sample. While extensive demographic questions were used to determine the degree of representativeness of the sample to the target population, the results should be interpreted carefully and not necessarily generalised to the broader South African population, especially since the study only sampled one of the nine South African provinces. Another limitation is that the study used a single cross-sectional research design, which merely provides a snapshot in time. Future research should employ a longitudinal research design, sample each of the nine provinces, incorporate a larger population sample, and use a probability sampling technique. Another opportunity for future research is to sample the broader Generation Y and not limit the research to students registered

at HEIs, as well as include other Generations. As these technologies advance, research should focus on the consumers' preferences based on the latest wearable activity-tracking device features in order to stay up to date with the needs of the target population.

6. CONCLUSION

Increasing the acceptance and subsequent adoption of wearable activity-tracking devices amongst South African consumers, thereby increasing the penetration rate of these devices, depends largely on the manufacturing and supply of products that satisfy consumer needs. This study investigated Generation Y students' wearable activity-tracking devices feature preference in order to assist both local and international device manufacturers, retailers, and e-commerce sites to develop and market these devices to their target population effectively. These entities can use the findings of the study to manufacture and market affordable devices comprising the ability to measure heart rate and blood pressure, steps and distance travelled, calories burnt, sleep patterns, and GPS tracking ability.

REFERENCES

Bassett, D.R., Freedson, P.S. & John, D. (2019). Wearable activity trackers in clinical research and practice. *Kinesiology Review*, 8(1), 11–15.

Beckham, J. (2012). *Fitness trackers use psychology to motivate couch potatoes*. https://www.wired.com/2012/04/fitness-tracker-psychology/ Accessed 2016/11/10.

Bevan-Dye, A.L. & Surujlal, J. (2011). Attitudes towards materialism in sport and materialism tendencies amongst Black Generation Y students. *African Journal for Physical, Health Education, Recreation and Dance, supplement,* 17(4), 43-55.

Bumgardner, W. (2017). *Fitness bands and apps with sitting time alerts*. https://www.verywell.com/inactivity-tracking-devices-and-sitting-time-apps-3434970 Accessed 2017/03/28.

Bunn, J., Wells, E., Manor, J. & Webster, M. (2019). Evaluation of earbud and wristwatch heart rate monitors during aerobic and resistance training. *International Journal of Exercise Science*, 12(4), 374–384.

Business Tech (2015). *Here are South Africa's 26 Universities*. https://businesstech.co.za/news/general/101412/here-are-south-africas-26-universities/ Accessed 2017/03/27.

Business Tech (2018). *South Africa expected to be the next big market for smartwatches and fitness trackers*. https://businesstech.co.za/news/mobile/243043/south-africa-expected-to-be-the-next-big-market-for-smartwatches-and-fitness-trackers/ Accessed 2019/07/16.

Caddy, B. (2016). *Food trackers: the best calorie counter apps and wearables*. https://www.wareable.com/health-and-wellbeing/food-trackers-the-best-calorie-counter-apps-and-wearables Accessed 2017/03/28.

Cadmus-Bertram, L.A., Marcus, B.H., Patterson, R.E., Parker, B.A. & Morey, B.L. (2005). Randomized trial of a Fitbit-based physical activity intervention for women, *American Journal of Preventative Medicine*, 49(3), 414–418.

Case, M.A., Burwick, H.A., Volpp, K.G. & Patel, M.S. (2015). Accuracy of smartphone applications and wearable devices for tracking physical activity data, *Journal of the American Medical Association*, 313(6), 625–626.

Chang, A. (2017). *Fitness trackers buying guide*. https://www.tomsguide.com/us/fitness-tracker-buying-guide,review-2549.html Accessed 2018/08/28.

Chu, A.H.Y., Ng, S.H.X., Paknezhad, M., Gauterin, A., Koh, D., Brown, M.S. & Müller-Riemenschneider, F. (2017). Comparison of wrist-worn Fitbit flex and waist-worn ActiGraph for measuring steps in free-living adults, *PLoS ONE*, 12(2).

Diaz, K.M., Krupka, D.J., Chang, M.J., Shaffer, J.A., Ma, Y., Goldsmith, J., Schwartz, J.E. & Davidson, K.W. (2016). Validation of the Fitbit one® for physical activity measurement at an upper torso attachment site. *BMC Research Notes*, 9, 213.

Draper, S. (2018). *Hexoskin smart shirt monitors and records heart rate, breathing and movement*. https://www.wearable-technologies.com/2018/06/hexoskin-smart-shirt-monitors-and-records-heart-rate-breathing-and-movement/ Accessed 2018/08/27.

Dubey, A. (2017). *10 best wireless Bluetooth headphones for running*. https://techreviewpro.com/top-best-wireless-bluetooth-headphones-for-running-8860/ Accessed 2017/09/19.

Duffy, J. & Colon, A. (2016). *The best fitness trackers of 2016*. http://www.pcmag.com/article2/0,2817,2404445,00.asp Accessed 2016/11/06.

Eadicicco, L. (2016). *These smart sneakers can track your workout for you*. http://time.com/4166277/under-armor-smart-sneakers/ Accessed2017/09/19.

Exchange-rates.org. (2019). *South African Rands (ZAR) per US Dollar (USD)*. https://www.exchange-rates.org/history/ZAR/USD/G/M Accessed 2019/07/10.

Fausset, C.B., Mitzner, T.L., Price, C.E., Jones, B.D., Fain, W.B. & Rogers, W. (2013). Older adults' use of and attitudes toward activity monitoring technologies. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, *Human Factors and Ergonomics Society*, 57(1) 1683–1687.

Fulk, G.D., Combs, S.A., Danks, K.A., Nirider, C.D., Raja, B. & Reisman, D.S. (2014). Accuracy of 2 activity monitors in detecting steps in people with stroke and traumatic brain injury. *Physical Therapy*, 94(2), 222–229.

Gustafson, T. (2017). *Younger consumers are more health conscious than previous generations.* https://www.huffingtonpost.ca/timi-gustafson/younger-consumers-are-mor_b_14290774.html Accessed 2018/07/31.

Halse, K. (2018). *10 best Bluetooth heart rate monitors 2018*. https://heavy.com/tech/2015/04/best-bluetooth-heart-rate-monitor/ Accessed 2018/08/27.

Haslam, C. (2016). *Counting sleep: the best sleep tracker and monitors*. https://www.wareable.com/withings/best-sleep-trackers-and-monitors Accessed 2016/11/06.

Hong, S-K. (2015). An explorative study of the features of activity trackers as IoT based wearable devices. *Journal of Internet Computing and Services*, 16(5), 93-98.

International Data Corporation (2016). *Worldwide wearables market increases 67.2% amid seasonal retrenchment, according to IDC*. http://www.idc.com/getdoc.jsp?containerId=prUS41284516 Accessed 2016/10/25.

Jones, D., Crossley, K., Dascombe, B., Hart, H.F. & Kemp, J. (2018). Validity and reliability of the Fitbit Flex™ and ActiGraph Gt3x+ at jogging and running speeds. *International Journal of Sports Physical Therapy*, 13(5), 860–870.

Kaewkannate, K. & Kim, S. (2016). A comparison of wearable fitness devices, *BMC Public Health*, 16, 433.

Kingston, K. (2015). *Devices to track the calories you burn*. http://www.livestrong.com/article/499335-devices-to-track-the-calories-you-burn/ Accessed 2016/11/06.

Kooiman, T.J.M., Dontje, M.L., Sprenger, S.R., Krijnen, W.P., van der Schans, C.P. & de Groot, M. (2015). Reliability and validity of ten consumer activity trackers. *BMC Sports Science, Medicine and Rehabilitation*, 7, 24.

Lamb, K., Huang, H-Y., Marturano, A. & Bashir, M. (2016). Users' privacy perceptions about wearable technology: examining influence of personality, trust, and usability. Advances in Human Factors in Cybersecurity, *Advances in Intelligent Systems and Computing*, 501, 55–68.

Lamkin, P. (2016). *Wearable technology market to be worth $34 billion by 2020*. https://www.forbes.com/sites/paullamkin/2016/02/17/wearable-tech-market-to-be-worth-34-billion-by-2020/#492c34533cb5 Accessed 2017/01/5.

Lamont, R.M., Daniel, H.L., Payne, C.L. & Brauer, S.G. (2018). Accuracy of wearable physical activity trackers in people with Parkinson's disease. *Gait and Posture*, 63, 104–108.

Lee, J-M., Kim, Y. & Welk, G.J. (2014). Validity of consumer-based physical activity monitors. *Medicine in Science and Sports Exercise*, 46(9), 1840–1848.

Mackenzie, N. (2015). *Gear we love: wearable fitness trackers*. http://www.espn.com/espnw/athletes-life/article/12309553/wearable-fitness-trackers Accessed 2017/09/19.

Markert, J. (2004). Demographics of age: generational and cohort confusion. *Journal of current issues and research in advertising*, 26(2), 11-25.

Marr, B. (2016). *15 noteworthy facts about wearables in 2016*. https://www.forbes.com/sites/bernardmarr/2016/03/18/15-mind-boggling-facts-about-wearables-in-2016/#227b93982732 Accessed 2018/10/29.

Muller, C. (2019). Generation Y students' attitude towards and intention to use activity-tracking devices. Doctoral thesis. Vanderbijlpark: North-West University.

Muller, C., de Klerk, N. & Bevan-dye, A.L. (2018). Relationship between social image, brand name, subjective norms and South African Generation Y students' attitude towards wearable activity-tracking devices. *International Journal of Business and Management Studies*, 10(2), 83-98.

Nguyen, M. (2016). *Walk on smart insoles: the next move in activity tracking*. https://www.wearable-technologies.com/2016/04/walk-on-smart-insoles-the-next-move-in-activity-tracking/ Accessed 2018/08/27.

Nield, D. (2017). *How to buy a fitness tracker: everything you need to consider*. https://www.wareable.com/fitness-trackers/how-to-buy-a-fitness-tracker Accessed 2018/08/17.

Noah, J.A., Spierer, D.K., Jialu, G. & Bronner, S. (2013). Comparison of steps and energy expenditure assessment in adults of Fitbit tracker and Ultra to the Actical and indirect calorimetry. *Journal of Medical Engineering and Technology*, 37(7), 456–462.

Pressman, A. (2017). *Fitbit adds social feed to keep users motivated*. http://fortune.com/2017/01/05/fitbit-social-feed-motivated/ Accessed 2017/03/28.

Price, D. (2017). *Moov HR sweat review*. http://www.techadvisor.co.uk/review/activity-trackers/moov-hr-sweat-review-3657460/ Accessed 2019/09/17.

Rettner, R. (2014). *How well do fitness trackers monitor heart rate?* http://www.livescience.com/44170-fitness-tracker-heart-rate-monitors.html Accessed 2016/11/06.

Roe, J., Salmon, J. & Twiggs, J. (2016). Objective measure of activity level after total knee arthroplasty with the use of the 'Fitbit' device. *Orthopaedic Journal of Sports Medicine*, 4(2).

Shin, G., Jarrahi, M.H., Fei, Y., Karami, A., Gafinowitz, N., Byun, A. & Lu, X. (2019). Wearable activity trackers, accuracy, adoption, acceptance and health impact: A systematic literature review. *Journal of Biomedical Informatics,* 93. https://doi.org/10.1016/j.jbi.2019.103153 Accessed 2019/07/16.

Shinde, A.M., Gresham, G.K., Hendifar, A.E., Li, Q., Spiegel, B., Rimel, B., Walsh, C.S., Tuli, R., Piantadosi, S. & Figlin, R.A. (2017). Correlating wearable activity monitor data with PROMIS detected distress and physical functioning in advanced cancer patients. *Journal of Clinical Oncology*, 35(15).

Statista (2018a). *Wearables: Worldwide.*

https://www.statista.com/outlook/319/100/wearables/worldwide#market-users Accessed 2018/06/10.

Statista (2018b). *Wearables: South Africa*. https://www.statista.com/outlook/319/112/wearables/south-africa#market-users Accessed 2018/06/10.

Statistics South Africa (2017). *Statistical release P0302: 2017 mid-year population estimates.* http://www.statssa.gov.za/publications/P0302/P03022017.pdf Accessed 2018/06/16.

Steinert, A., Haesner, M. & Steinhagen-Thiessen, E. (2017). Activity-tracking devices for older adults: comparison and preferences. *Universal Access in the Information Society*, 17(2), 411-419.

Stuart, S.C. (2016). *Hands on: Swarovski's fashionable slake deluxe activity crystal tracke*r. https://www.pcmag.com/news/347775/hands-on-swarovskis-fashionable-slake-deluxe-activity-crys Accessed 2018/08/27.

Techopedia (2018). *Activity tracker*. https://www.techopedia.com/definition/32502/activity-tracker Accessed 2018/06/16.

Van Heerden, I. (2016). *Different types of fitness trackers*. https://tectogizmo.com/different-types-of-fitness-trackers/ Accessed 2018/08/27.

Wang, J.B., Cataldo, J.K., Ayala, G.X., Natarajan, L., Cadmus-Bertram, L.A., White, M.M., Madanat, H., Nichols, J.F. & Pierce, J.P. (2016). Mobile and wearable device features that matter in promoting physical activity. *Journal of Mobile Technology in Medicine*, 5(2), 2–11.

Yang, Y., Schumann, M., Le, S. & Cheng, S. (2018). Reliability and validity of a new accelerometer-based device for detecting physical activities and energy expenditure. PeerJ, 6. doi:10.7717/peerj.5775 Accessed 2019/07/16.