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E-HEALTH, FITNESS TRACKERS AND WEARABLES – USE AMONG SWISS STUDENTS

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ABSTRACT

Health and fitness supported by technology has evolved into a trend. Given the progress of fitness tracker devices and apps, the popularity of this technology has now extended far beyond the early adopters in the quantified-self community. Furthermore, in society, health has become a lifestyle and status symbol. There are reports of increasing numbers of people exercising regularly. Manufacturers such as Apple have taken notice of this trend. The recently launched Health Kit and Health app for iOS 8 underlines this fact. The increase in the number of youngsters and young adults adopting vegetarian or vegan diets emphasises the importance of the topic. To the knowledge of the authors no study covering this topic and target group exists to date. Therefore we conducted a study focusing on the Greater Zurich Area covering the target group of youngsters and young adults to help to close this research gap.

1 INTRODUCTION

Gadgets such as the Fitbit are becoming more common. These gadgets can be used to monitor vitals and thus, can help to keep track of vitals, such as heart rate, while counting the number of steps a person takes during the day. A term that needs to be introduced in conjunction with health apps and tracking devices is the “quantified-self”. People “... who track many kinds of data about themselves” (Choe et al. 2014, p.1143) are called “quantified-selves” (Choe et al. 2014, p.1143) and form the quantified-self community. With advances in wearables moving from a techie gadget or accessory to a retail product, the

quantified-self movement – people that monitor, for example, their vitals and share this data with their peers within the community – has been fuelled by these advances. This trend is not limited to the United States. According to Swan, the quantified-self movement is becoming prominent outside the US, where 60 per cent of adults are tracking their health-related parameters, such as weight, rendering this movement mainstream (Swan 2013, p.86).

For the reasons mentioned previously, we would like to take an in-depth look at the use of devices that keep track of vitals or monitor individual's sleep among the target group of students in Switzerland, with a focus on the Greater Zurich Area, as to the author's knowledge, studies covering this area, in addition to the target group of youngsters and young adults, are still to be conducted.

2 THEORY

Studies show that in the Kanton¹ of Zurich (Switzerland), 9% of people between 15 and 74 years old exercise daily, 47% exercise more than once a week and 16% exercise exactly once within a week (Lamprecht et al. 2014, p.6). Exercising rarely can be reported for five per cent of participants and 23% do not engage in physical exercise at all (Lamprecht et al. 2014, p.6). Since 2003, the number of people exercising more than once a week has increased from 41% to 46% (Lamprecht et al. 2014, p.7). Simultaneously, the number of people not exercising at all has increased from 21% to 23%. Analysing data as far back as 1978 shows quite a steep increase in people exercising more than once a week between the years 1994 and 2008, with an upward trend up to the year 2014 (Lamprecht et al. 2014, p.8). Differences in the level of physical exercise can be seen among groups according to education, and income, as - in general - more highly educated and affluent people show higher levels of activity (Lamprecht et al. 2014, p.15). The most important reason for exercising reported is improving health (59%), followed by being in nature (55%), the joy of exercise (54%) and having fun (53%) (Lamprecht et al. 2014, p.16). Official organisations recommend regular exercise more than once a week for juveniles and young adults (BASPO 2013, p.2).

It is unnecessary to elaborate on the positive effects of regular physical activity, including reducing costly chronic diseases, such as heart disease, type 2 diabetes, excessive weight, including obesity, and even cancer (BASPO 2013, p.15; WHO 2006b, p.6; WHO 2006a, p.ix).

Knowing about the benefits of regular physical activity and the products on sale is critical and therefore, a short note on media usage is appropriate. Media usage of youngsters has changed and they have moved away from newspapers (BFS 2007, p.20) to electronic media, especially mobiles, with high levels of surfing behaviour (Ipsos OTX MediCT 2012, p.41). Mobile phones are used more frequently to obtain information, in addition to watching television (Ipsos OTX MediCT 2012).

The trend of the quantified-self movement is not new and, according to Millington, it dates back to Williams (1974), as the quantified-self can be seen as an advancement of Williams's "mobile privatization" (Millington 2014, p.480). Furthermore, Millington assumes that "the post-web future may already have arrived" (Millington 2014, p.479). In this future, platforms are said to replace web browsers. This statement is substantiated by the vast range of apps that have been produced, in addition to those that are being developed.

¹ Switzerland is subdivided into 26 Kantons, analogous to the US being composed of 50 states.

The topic of e-Health has been discussed in research for a long time and some major issues have already been identified by Lymberis (2003), with an overview of critical issues in e-Health research provided in Atienza et al. (2007). Sensitive patient and user information, the user interface, technical challenges in exchanging data securely, in addition to an ethical and legal dimension (Lymberis 2003, p.273) are examples of aspects that play a role in research concerning health devices. This leads to the question of the advantages and motives for using such devices.

The short message service (SMS) channel has been used for interventions in the past. For an overview of studies, see Fjeldsoe et al. (2009), which reports successful interventions despite the effects being initially short-term in nature (Fjeldsoe et al. 2009, p.165). Furthermore, interactivity, in addition to tailored communication, play an important role (Fjeldsoe et al. 2009, p.171). The up-to-date approach that has the potential to incorporate both aspects mentioned previously is the smartphone app. According to Abroms et al. (2011), apps are promising tools when it comes to improving people's health. Furthermore, Lupton (2014) emphasises that, "digital health technologies are playing an increasingly important role in health care, health education and voluntary self-surveillance, self-quantification and self-care practices" (Lupton 2014, p.1). A recent study by Middelweerd et al. (2014) on apps that aim to change health-related behaviour, such as nutrition or physical activity by monitoring these aspects, gives an overview of prices and functionality, in addition to methods used to change user behaviour. Feedback and monitoring are by far the most used behaviour-changing techniques, with an average of five techniques reported in one app (Middelweerd et al. 2014, p.8). The Web has been the subject of studies on interventions and is reported to have positive effects on the efficacy of interventions (Wantland et al. 2004). It is therefore no surprise that various studies report the benefits of using fitness apps for losing weight and improving fitness. Weight loss (Carter et al. 2013; Stephens & Allen 2013), smoking cessation (Abroms et al. 2011) and other topics with a medical focus are only one application domain of tracking devices. A further domain is where these devices are used for leisure purposes, such as monitoring vitals during sport and even sexual activities (see Lupton (2014) and Guse et al. (2012) for the latter in addition to Bull et al. (2012) for a study on social media regarding this topic). Both studies mention that applications can be seen less from a medical point of view but as entertainment, education and fun, which is the case in the quantified-self movement. A combination of education and entertainment would be interesting for the target group of digital natives, and researchers, such as Guse et al. (2012), analysed this target group regarding interventions via different communication channels. The authors of Breton et al. developed a classification of apps related to weight control by categorising them as follows: a) diet, physical activity and weight journals, b) dietary advice journals and c) weight trackers (Breton et al. 2011). Feedback seems to play an important role (Turner-McGrievy & Tate 2011) and authors identified that theoretical concepts or missing informed content (Breton et al. 2011, p.523) should be improved in future apps. After considering the advantages, we would like to elaborate on the question concerning the risks that may arise with the use of apps and fitness trackers.

Data provided by users is valuable in itself, but more data from fitness tracker devices – referred to by (Rahman et al. 2013, p.1) as implicit information – can be of great interest for companies (e.g., life insurance). The latter information is far more valuable and therefore, poses a greater risk if this information is leaked or falls into the hands of or is directly attacked by malicious individuals. Steel et al. (2013) have taken an in-depth look at what personal data is worth and developed a calculator that enables individuals to compute the worth of their personal data (Steel et al. 2013). Lymberis sees data security, in addition to user acceptance and awareness, as issues within the industry of "smart health

wearables” (Lymberis 2003, p.272). This points out the value with respect to the importance of data, in addition to the perspective of customers on these issues. Particularly sensitive information, such as information linked to people’s health, can be extremely valuable. Furthermore, from a marketing perspective, where habitual purchase decisions may be altered when a big life change occurs, such as the birth of a child, information on female customers being pregnant may be of great advantage and valuable to firms because they can specifically target these customers. A prominent and successful example is the case of Target. The company was able to predict the expectancy of a child well in advance by analysing the information obtained through previous purchases, or purchasing behaviour (see Siegel & Davenport (2013) for further details). However, there is an ethical dimension to the use and collection of such data, prohibiting in some cases the use of such information because it may lead to customers disapproving of this use of data. This may pose a potential risk to companies gathering and using potentially sensitive information. Lupton underlines this point by stating that, “... there are significant ethical and privacy implications emerging from the use of these apps, and the data they produce” (Lupton 2014, p.1). Data gathered from fitness tracking devices can be seen as sensitive information and may therefore bear a potential risk because the use of the data may be disapproved of by customers, or even worse, be leaked onto the Internet if there are technical or human errors. These errors may result from hard-to-control customer behaviour, such as users choosing a weak password or uploading the data by mistake into a cloud service with public access.

The design process and priorities of wearable devices further add to these risks as, according to Zhou and Piramuthu, security and privacy are not primary concerns in the design of wearable fitness trackers (Zhou & Piramuthu 2014, p.1). The authors state that in the world of wearable fitness trackers, accuracy of measurement is paramount (Zhou & Piramuthu 2014) and refer to the example of Fitbit using a cleartext login, in addition to the HTTP web protocol rather than the secure HTTPS version for data transfer between the device and the web portal where data is stored and used for visualisation purposes. Solutions have been proposed by (Rahman et al. 2013), but risks, such as binding stolen trackers, remain and are classified as serious (Zhou & Piramuthu 2014, p.4).

As this paper does not intend to analyse further the technical details but emphasise the perspective of customers, we would like to continue with the method used to obtain insights into customers’ perceptions concerning the aspects mentioned previously.

3 METHOD

In order to obtain an overall picture of health tracking devices, in addition to the use of such devices and apps among Swiss students, we conducted both desk research and a consecutive online survey.

The online questionnaire based on current literature and theory. The online survey was divided into the following sections: demographics; general questions regarding tracking devices and attitudes regarding the quantified-self, in addition to sports activity level; questions concerning fitness apps; questions regarding fitness tracking devices; attitudes towards incentives, such as discounts on insurance; questions concerning outcomes, such as self-reported, word-of-mouth behaviour; self-reported impact on health; intention to use, with respect to the intent to continue using the device or apps; and finally, satisfaction with fitness trackers, their quality, value for money and the precision of measurement they provide.

Standard demographic variables, such as gender and age, were included. As some studies report regional differences (Lamprecht et al. 2014, p.10), we included the region in a question regarding the Kanton (see Chapter 2 for a short explanation of the term) from

which the participants originate. As it may be significant if people are early adopters, we included the importance of having the newest products, in addition to the importance of design, both operationalised using a five-point Likert scale.

Furthermore, we asked participants how important they rate the measurement of blood pressure, heart rate, body temperature, and the monitoring of their sleep, all on a five-point Likert scale. Given the fact that exercising has an especially positive effect on health if it is carried out regularly (BASPO 2013; WHO 2006b), we included measurements concerning the regularity of exercise.

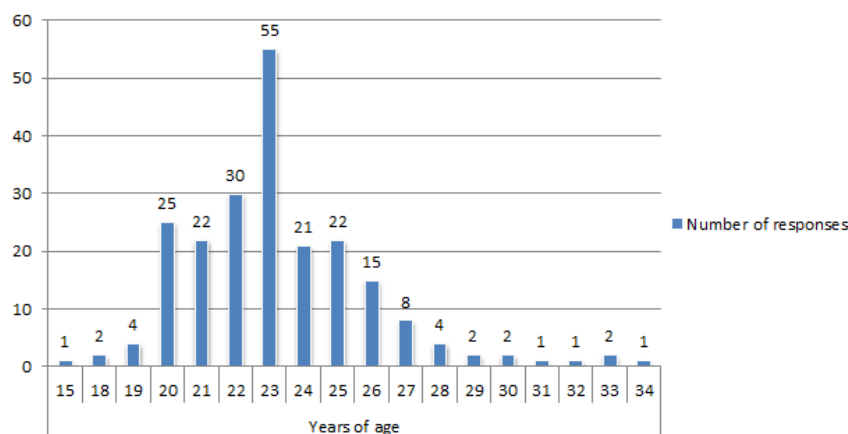
Participants were asked further about the use of apps and tracking devices. Within these two question groups, we elaborated on the types of devices they use, the duration of use, the reasons for use and non-use and how they learned about the device or app. Furthermore, we wanted to explore the outcomes of using the devices and apps, and therefore included questions about this aspect. These questions are further split into questions about outcomes regarding health, in addition to outcomes concerning participants' sporting activities. Finally, we asked users how satisfied they were with the range of products on sale, the quality of products, the value for money the devices and apps offer and their measurement accuracy.

4 FINDINGS

The age of the participants ranged from 15 to 34 years old (see Figure 1), resulting in an average age of 23.24. Male and female participants are quite evenly split, with 44% females and 56% males. A chi-square test revealed no significant differences with regard to the distribution of gender. However, differences were found according to the region from which the students originate. With 114 participants originating from the Kanton of Zurich, this 52.3% were constituted of the absolute and relative majority of all participants in the study. Furthermore, Kantons with more than 10 participants were Thurgau (31, 14.2%) and Schaffhausen (27, 12.4%). All other Kantons had between one and nine participants and are excluded from further analysis.

The participants showed high levels of exercising habits, with 20 (10%) participants exercising daily. A total of 137 (67%) exercised more than once a week, 32 (16%) reported a weekly schedule, 5 (2%) a monthly schedule and only one person reported a “no sports” level of exercise.

Figure 1: Age distribution



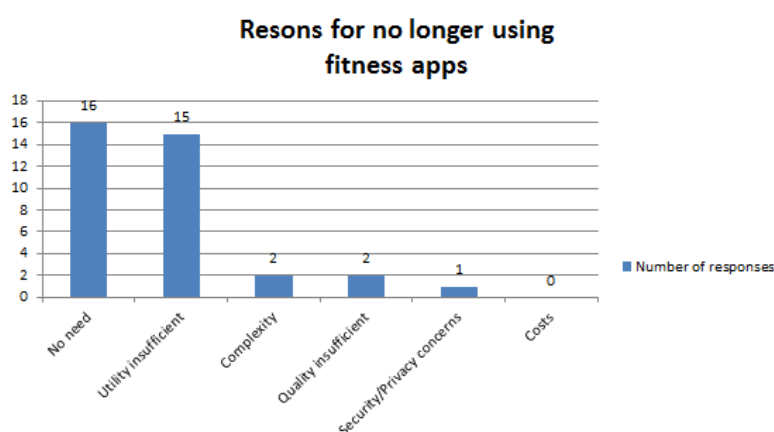
To gather insights on customer's attitudes concerning different aspects of the tracker devices, we asked them about the importance of the product attributes of design, the feature of measuring the heart rate and the importance of the function of monitoring sleep. In Table 1 we further reported the test results for the question concerning general satisfaction with the products on sale and the importance of the feature of monitoring sleep. The importance of product features and satisfaction with their attributes all significantly differed from the scale's indifference value of three (see Table 1 for details). Product design was by far the most important aspect, in addition to the functionality of measuring the heart rate, closely followed by quality. Word of mouth and the ability to monitor sleep differed significantly from the scale's value of indifference. In general, satisfaction with the range of fitness devices on sale was significantly above the value of indifference.

Attribute / functionality	N	Mean	S.D.	S.E.	Sig.
Product design (importance)	206	3.77	.913	.064	< .000
Heart rate functionality (importance)	199	3.44	1.191	.084	< .000
Quality (satisfaction)	88	3.43	.855	.091	< .000
WOM intention concerning fitness trackers	109	3.37	1.111	.106	< .001
Monitoring sleep (importance)	196	3.36	1.192	.085	< .000
Fitness devices / offers on sale (satisfaction)	89	3.29	1.014	.107	= .008

Table 1: T-test (deviation from the mean value 3.0)

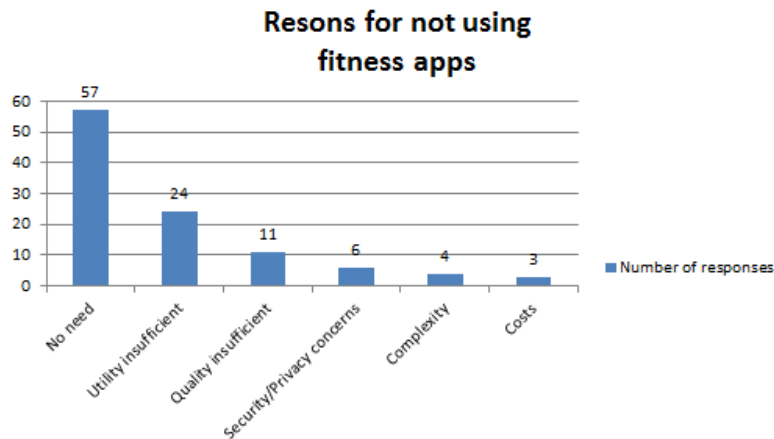
The use of fitness apps was reported to be virtually a fifty-fifty split, with 105 (51%) of participants reporting not using a fitness app compared to 101 (49%) that were using one. Of those who were using a fitness app, 44 mentioned Runtastic, 19 MyFitnessPal, 8 iOS Health, 6 Fitness Point, 5 Strava Cycling and 5 Workout Trainer, with only one person mentioning GoogleFit. A total of 26 people reported using a fitness app once. The reasons for not using the app again were as follows: 16 reported that they have no need, 15 reported that the utility was insufficient, 2 mentioned complexity, 2 mentioned quality and one person stated that security and privacy concerns were the reason for no longer using the app (see Figure 2). The majority of respondents (58%) reported having used the app within the range of one to 4 weeks, with 8 participants using it for up to 14 days and 7 for a further two weeks.

Figure 2: Reasons for no longer using fitness apps



Among the non-users, 57 reported not having the need to use the app, 24 cited insufficient utility, 11 quality, 6 security or privacy issues, 4 complexity and 3 the costs of not using fitness apps (see Figure 3). Next, we would like to consider fitness tracking devices.

Figure 3: Reasons for non-use

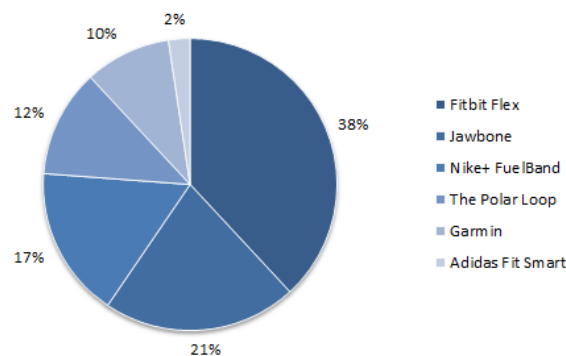


A total of 51 respondents (26%) reported using a fitness tracking device compared to 144 (74%) non-users. Of those not having used a tracker, 93 (51%) had no need, 36 (20%) mention insufficient utility, 25 (14%) claimed that awareness is too low, 11 (6%) stated quality, 5 (3%) complexity, and 4 (2%) and 3 (1%) stated that emissions and material feel are reasons for not using a fitness tracking device, respectively. Furthermore, 79 (41%) report discounts on health insurance, 58 (30%) discounts on insurance in general and 56 (29%) rebates on fitness club memberships as incentives that would convince them to wear and use fitness tracking devices.

After considering the apps and devices used, we would like to observe the behaviours reported in connection with fitness tracking devices and the devices used by customers.

Asking the participants which media channel they remember hearing about fitness trackers led 30 (51%) to reporting friends, 10 (17%) social media, 8 (13%) blogs and the remaining participants from various channels, such as brochures or television, advertisements. Regarding the question of which devices was most popular (see Figure 4), the Fitbit Flex (38%) is named first followed by Jawbone (21%) and Nike+ FuelBand (17%). The remaining mentions by a limited number of users were the Polar Loop, Garmin and Adidas Fit Smart.

Figure 4: Fitness tracker



Respondents were asked if the use of their fitness tracker influenced their sports activities, with a majority of 42 participants (62%) answering no, compared to 30 (38%) reporting an influence. Of the 42, 15 (36%) reported a positive effect on the regularity of their training, 13 (31%) claimed a performance improvement and 6 (14%) stated that their training had become more efficient because of the use of the device. Only 3 (7%) reported an improvement of their vitals.

Furthermore, only 13 (19%) shared the opinion that their health has improved by wearing the device, compared to 58 (81%) that report any health-related improvement.

A more detailed analysis reveals that 30% think that their diet improved, 26% state an improvement in appearance, 22% report an improvement in their vitals and 22% lost weight. With regard to participants' satisfaction with the choice of tracking devices on offer in the market, 9 (3.7%) report being very satisfied, 31 (12.8%) report being satisfied, 30 (12.4%) report a neutral position, 15 (6.2%) report being dissatisfied and only 4 (1.7%) report being very dissatisfied with what the market has to offer. The result for satisfaction with the products on sale is a mean of 3.29.

Similarly, the satisfaction with quality also achieves a high level, as 9 (3.7%) state that they are very satisfied, 31 (12.8%) are satisfied, 38 (15.7%) report a neutral rating, 9 (3.7%) are dissatisfied and only 1 (0.4%) person is very dissatisfied. With regard to the satisfaction with quality, a mean of 3.43 is reported.

A more neutral attitude is reported for value for money. Five (2.1%) are very satisfied, 23 (9.5%) are satisfied, 33 (13.6%) have a neutral attitude, 16 (6.6%) are dissatisfied and 11 (4.5%) are very unsatisfied with the value for money ratio of the products. This results in a mean of 2.94 for the satisfaction with value for money.

The satisfaction with the accuracy of measurement shows a slightly higher rating, but are nevertheless indifferent. Four (1.7%) report that they are very satisfied, 26 (10.7%) report that they are satisfied, 34 (14%) provide a neutral rating, 17 (7%) report that they are unsatisfied and 8 (3.3%) are very dissatisfied with the accuracy of measurement of the devices. The mean for this question is 3.01.

Discussion

Two of the positive outcomes of using a tracking device are linked to each other. Participants reported an increase in the regularity of training and therefore, it is no surprise that they stated that their performance improved simultaneously. We therefore conclude that the use of fitness tracking devices has a positive effect due to the measurement (quantification), in addition to visualisation of the regularity of participants' training that in return improves their performance. Self-reported effects on the health of respondents contained contradictions and we would like to claim that both positive effects should have an impact on health. A possible explanation for self-reports not being able to measure this effect is the fact that the average age of participants was low compared to the population in general and therefore, presumably healthier. Drawing from this argument and with the well-established link between exercise and health, the authors claim that using health tracking devices has a positive effect on the health of individuals. Many non-users did not discern any use of the devices and a high number of people that discontinued using the device reported the same reason for doing so. A challenge for marketers is the communication of the usefulness of tracking devices and apps because consumers are sceptical about the benefits of these devices. Targeting opinion leaders to increase word of mouth and presence on the Web (blogs, social media) would fit the media usage of customers. They rely heavily on these referrals in the evaluation process, where the desire with respect to the intention to use leads to a subsequent purchase being made. Therefore, a targeted strategy aimed at influencers that generates a buzz within this community would be a feasible approach to promoting health tracking devices and apps.

5 LIMITATIONS

The sample was dominated by participants from the Greater Zurich Area with a focus on people originating from the Kanton of Zurich. Therefore, there may be limitations for generalising these results to other regions. The authors do not consider this to be as a large limitation, provided these results are used in the German-speaking part of Switzerland within the Greater Zurich Area, but these results should be verified in the western part of Switzerland. Further, the results should be interpreted with caution for the Alps region because there may be greater cultural differences that could bias these results.

A second point we need to mention is that the sample is a student sample. Furthermore, participation was not compulsory. Therefore we expect a self-selection bias to be present. An indicator for this could be the high level of sports activities found within the sample. Thus, results may change if variables such as income rise. Hence, caution should be exercised if results are to be applied to other target groups, such as those where people are of a higher age or less active.

6 FURTHER RESEARCH

A large field for further research can be identified regarding the result that the majority of participants not using apps or devices do not discern a specific need to do so. With regard to this matter, future studies could shed light on the underlying reasons for people not recognising any utility in apps or tracking devices, even though they exhibit a high level of physical exercise and are potentially within the target group of people buying such devices or using health apps.

The question of why self-reported effects on health were not reported, even though participants reported a more regular exercise habit and an increase in physical performance points to a path for further research. The latter two aspects are known to have a positive effect regarding costly chronic conditions, such as heart disease, diabetes or excessive weight (WHO 2006a, p.6). Therefore, a more detailed questionnaire concerning this aspect could illuminate this topic.

The scope of this study did not allow for a detailed analysis of the risks and how they are perceived by users of tracking devices and apps, but this would be an interesting topic as we observe quite low levels regarding privacy and security concerns.

Further research is needed, especially if the devices are to be applied to a domain where sensitive information is transferred, such as the case of health care (Zhou & Piramuthu 2014, p.5), as technical and psychological aspects of consumers remain a field of research.

7 CONCLUSION

First and foremost, we can report a positive effect of apps and tracking devices on the regularity of exercise. Not surprisingly, this has a positive effect concerning users' physical performance. Apart from these two important outcomes, there are some important device attributes that need to be mentioned because they are highly relevant to buyers. Design was by far the most important aspect to buyers of tracking devices, followed by a heart measuring ability, which is, to date, missing in most devices. This can be considered as a practical implication or feasibility for manufacturers of tracking devices for conducting further market research, or even implementing such a feature while simultaneously monitoring quality. A second practical implication for marketers is the fact that many respondents learned about trackers and apps by word –of mouth. Others relied heavily on the use of the Internet, including social media, to become informed about apps and health

tracking devices. We therefore suggest that marketing campaigns consider this consumer behaviour in their future activities and actions.

The most prominently mentioned and used app is Runtastic, followed by MyFitnessPal and we are keen to observe how iOSHealth performs for early adopters that are already using the app. In the Greater Zurich Area, Fitbit Flex, followed by Jawbone's UP, dominates the market among youngsters and young adults. Participants in general are satisfied with the products on sale, with regard to their quality. Less satisfaction was reported regarding the measurement accuracy.

BIBLIOGRAPHY

Abroms, L.C. et al., 2011. iPhone apps for smoking cessation: a content analysis. *American journal of preventive medicine*, 40(3), pp.279–85. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3395318&tool=pmcentrez&rendertype=abstract> [Accessed December 4, 2014].

Atienza, A.A. et al., 2007. Critical issues in eHealth research. *American journal of preventive medicine*, 32(5 Suppl), pp.S71–4. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2720032&tool=pmcentrez&rendertype=abstract> [Accessed December 17, 2014].

BASPO, 2013. *Gesundheitswirksame Bewegung - Grundlagendokument*, Magglingen.

BFS, 2007. *Pressevielfalt Schweiz*, Bern.

Breton, E.R., Fuemmeler, B.F. & Abroms, L.C., 2011. Weight loss-there is an app for that! But does it adhere to evidence-informed practices? *Translational behavioral medicine*, 1(4), pp.523–9. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3717669&tool=pmcentrez&rendertype=abstract> [Accessed November 12, 2014].

Bull, S.S. et al., 2012. Social media-delivered sexual health intervention: a cluster randomized controlled trial. *American journal of preventive medicine*, 43(5), pp.467–74. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3479665&tool=pmcentrez&rendertype=abstract> [Accessed December 17, 2014].

Carter, M.C. et al., 2013. Adherence to a smartphone application for weight loss compared to website and paper diary: pilot randomized controlled trial. *Journal of medical Internet research*, 15(4), p.e32. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3636323&tool=pmcentrez&rendertype=abstract> [Accessed December 17, 2014].

Choe, E.K. et al., 2014. Understanding quantified-selfers' practices in collecting and exploring personal data. *Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14*, pp.1143–1152. Available at: <http://dl.acm.org/citation.cfm?doid=2556288.2557372>.

- Fjeldsoe, B.S., Marshall, A.L. & Miller, Y.D., 2009. Behavior change interventions delivered by mobile telephone short-message service. *American journal of preventive medicine*, 36(2), pp.165–73. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19135907> [Accessed November 14, 2014].
- Guse, K. et al., 2012. Interventions using new digital media to improve adolescent sexual health: a systematic review. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine*, 51(6), pp.535–43. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23174462> [Accessed December 17, 2014].
- Ipsos OTX MediCT, 2012. *Our Mobile Planet: Switzerland - understanding the mobile consumer*,
- Lamprecht, M. et al., 2014. *Sport Kanton Zürich 2014 - Studie über das Sportverhalten und die Sportbedürfnisse der Züricher Bevölkerung*, Zürich.
- Lupton, D., 2014. Quantified sex: a critical analysis of sexual and reproductive self-tracking using apps. *Culture, health & sexuality*, (December), pp.1–14. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24917459> [Accessed December 14, 2014].
- Lymberis, a., 2003. Smart wearables for remote health monitoring, from prevention to rehabilitation: current R&D, future challenges. In R. Summers et al., eds. *4th International IEEE EMBS Special Topic Conference on Information Technology Applications in Biomedicine, 24-26 April 2003*. Birmingham, United Kingdom: IEEE, pp. 272–275. Available at: <http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=1222530> [Accessed December 14, 2014].
- Middelweerd, A. et al., 2014. Apps to promote physical activity among adults: a review and content analysis. *The international journal of behavioral nutrition and physical activity*, 11(1), p.97. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25059981> [Accessed July 29, 2014].
- Millington, B., 2014. Smartphone Apps and the Mobile Privatization of Health and Fitness. *Critical Studies in Media Communication*, 31(5), pp.479–493. Available at: <http://www.tandfonline.com/doi/abs/10.1080/15295036.2014.973429> [Accessed December 5, 2014].
- Rahman, M., Carbutar, B. & Banik, M., 2013. Fit and Vulnerable: Attacks and Defenses for a Health Monitoring Device. Available at: <http://arxiv.org/abs/1304.5672> [Accessed December 14, 2014].
- Siegel, E. & Davenport, T.H., 2013. *Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die*, New Jersey: Wiley. Available at: https://books.google.ch/books?id=_cB-DryeACcC.
- Steel, E. et al., 2013. How much is your personal data worth? *Financial Times Online*. Available at: <http://www.ft.com/intl/cms/s/2/927ca86e-d29b-11e2-88ed-00144feab7de.html#axzz3LrjvS83r>.

- Stephens, J. & Allen, J., 2013. Mobile phone interventions to increase physical activity and reduce weight: a systematic review. *The Journal of cardiovascular nursing*, 28(4), pp.320–9. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3681804&tool=pmcentrez&rendertype=abstract> [Accessed October 9, 2014].
- Swan, M., 2013. The Quantified Self: Fundamental Disruption in Big Data Science and Biological Discovery. *Big Data*, 1(2), pp.85–99. Available at: <http://online.liebertpub.com/doi/abs/10.1089/big.2012.0002> [Accessed July 21, 2014].
- Turner-McGrievy, G. & Tate, D., 2011. Tweets, Apps, and Pods: Results of the 6-month Mobile Pounds Off Digitally (Mobile POD) randomized weight-loss intervention among adults. *Journal of medical Internet research*, 13(4), p.e120. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3278106&tool=pmcentrez&rendertype=abstract> [Accessed December 17, 2014].
- Wantland, D.J. et al., 2004. The effectiveness of Web-based vs. non-Web-based interventions: a meta-analysis of behavioral change outcomes. *Journal of medical Internet research*, 6(4), p.e40. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1550624&tool=pmcentrez&rendertype=abstract> [Accessed September 17, 2014].
- WHO, 2006a. *Physical activity and health in Europe: evidence for action*, Copenhagen.
- WHO, 2006b. *The Solid Facts - Promoting physical activity and active living in urban environments*, Copenhagen.
- Williams, R., 1974. *Television: Technology and cultural form*, London: Fontana.
- Zhou, W. & Piramuthu, S., 2014. Security/privacy of wearable fitness tracking IoT devices. In *2014 9th Iberian Conference on Information Systems and Technologies (CISTI)*. Barcelona: IEEE, pp. 1–5. Available at: <http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6877073> [Accessed December 14, 2014].