Vol. 10(5), pp. 31-36, July 2018
DOI: 10.5897/IJNAM2016.0207
Article Number: 238827C57981
ISSN: 2141-2332

http://www.academicjournals.org/IJNAM

ACADEMIC JOURNALS
expand your knowledge

International Journal of Nutrition and Metabolism

Full Length Research Paper

Wearable nutrition and dietetics technology on health nutrition paradigm shift in low and middle income countries

Ernest Tambo[1,2]* and Jeanne Yonkeu Ngogang[1,3]

[1]Department of Biochemisry and Pharmaceutical Sciences, Higher Institute of Health Sciences, Université des Montagnes, Bangangté, Cameroon.
[2]Africa Disease Intelligence and Surveillance, Communication and Response (Africa DISCoR) Institute, Yaoundé, Republic of Cameroon.
[3]Service de Biochimie, Centre Hospitalier Universitaire (CHU), Yaoundé, Cameroon.

Received 16 January, 2016; Accepted 9 September, 2016

Real-time, effective and affordable nutrition and dietetics wearable technology and sensors are emerging field with immense opportunities and benefits to the global nutrition challenge. As a powerful public health nutrition game changer, it requires more research and development support in tackling food security and nutrition safety challenges and evidence in local and global priorities needs worldwide. Such revolution real time, home, work and hospital-based rapid, accurate and cost-effective self-detection and diagnosis of direct or indirect causes or diet deficiency or excess are much needed for generating evidence-based information and knowledge for individual and vulnerable group nutritional and dietary mitigation and lifestyle adaptation through wearable sensors and technology. Importantly, they foster national decision making nutrition policy and guidelines, programs and interventions can best practices in self-management, healthier lifestyle and increasing life expectancy, productivity and wellness. However, urgent political commitment and financial investment is needed in building and sustaining dietary and nutrition wearable and implantable technologies and devices of research and development. These can enhance evidence-based, coherent and coordinated nutrition and dietary programs and strategies to a targeted group or illness, vital in addressing malnutrition and under-nutrition public health burden amongst African children. Moreover, enhancing balanced dietary and nutrition promotion and awareness, education and best practices culture in improving sustained lifestyle adaptations in people living with HIV (PLWHIV) and diabetes or overweight or stroke patients. Diseases, building wearable consumers' health and fitness prognosis, prospective digital nutrition, dietetic data and database or nutrition informatics platforms. These provide a paradigm shift in engaging participatory communication amongst public consumers, dietetic and nutritionist professionals in improving quality interventions, management and outcomes. Furthermore, fostering and sustaining new ideas and solutions including the quest for food and nutrition enlightenment, knowledge and resilience. However, assessment and understanding of nutritional and dietary needs, and potential opportunities in functional health benefits and resource development in personalized accessibility and availability of needed resources to encourage positive behavior, diet and nutrition changes is needed in monitoring current and future healthy generations.

Key words: Nutrition, dietetic, public health, wearable sensors, digital technology, Africa, low and middle income countries (LMICs).

INTRODUCTION

Global food security, nutrition and dietary related public health diseases and burden still account for an essential component of the total burden in low and middle income countries (LMICs), especially in Africa. It represents a complex diversity and interplay between clinical and epidemiological burden and nutritional maternal and children challenges of persistent communicable and rising non-communicable diseases (Allison et al., 2015). Hence, approximately 842 million people worldwide, representing 12% of the global population suffered from malnutrition, under-nutrition, hunger and diet related deficiencies between 2011 and 2013.

Today, industrial revolution with production of foods for economic gain, obesity epidemics related to unhealthy eating habits and over-nutrition in both developed and developing countries continues to exacerbate the rising in chronic diseases such as cardiovascular disease, cancer and premature aging populations (Allison et al., 2015; Khoury et al., 2013). Also, the situation is complex by low food production and shortage, poverty, inadequate food distribution, supply disruptions, food waste, government policies that inhibit trade and negatively affect farmers and growth of biofuels. The growing use of some agricultural technology and products (that is, pesticides) and climate change impacting on environmental and extent price volatility situation have potential to worsening famine, hunger and starvation in LMICs mainly in Africa (Allison et al., 2015; Khoury et al., 2013; Sun et al., 2010). Adequate and safe food and nutrition supply is one of the fundamental responsibilities and right of citizenry of each government, nation and global community. Yet, addressing the global nutrition situation is that of fasting and feasting to chronic stunting and obesity picture from childhood to premature ageing with millions of people at increased risk of developing diet-related chronic diseases such as cardiometabolic diseases, kidney disease, cancer and diabetes, etc (Khoury et al., 2013; Tambo et al., 2016a).

On the other hand, malnutrition and undernutrition or diet related deficiencies are estimated at 3.5 million deaths annually, largely preschool and infant children, pregnant and lactating women and elderly in LMICs (Allison et al., 2015). Africa population continues to grow at 2 to 3% per annum and expected to double to 2 billion people by 2025. This results in rapid urbanization and food consumption patterns that require food and nutrition safety, efficient technologies and immense opportunity in agro businesses and related fields in tackling the growing nutrition transition and increasing nutritional health associated with diseases diagnostics and treatment packages (Allison et al., 2015; Zhu et al., 2015).

The public health nutrition wearable and implantable sensors approach provides a new perspective in human or animal nutrition and dietary. It leads to reliable and effective breakthroughs in nutrition and health interdisciplinary approaches and solutions in tackling the ever-growing local and global nutrition challenges (Allison et al., 2015; Zhu et al., 2015). These challenges are worsened by the increasing demographic and population, climate and environmental changes, and health systems, weak integrated policy, management and administration bottlenecks (Allison et al., 2015; Khoury et al., 2013; Evenson et al., 2015). Modern convenient and cost-effective wearable sensors can be used to educate, track and predict energy level and advice on interventions or activities required to improve the excess or deficiency and possibly on short and long-term adaptation changes from plant-derived or animal-derived sources in achieving appropriate and balanced choices and quantities of unique fruit and vegetable phytochemical/micronutrient categories and needs (Evenson et al., 2015; Johnson-Glenberg et al., 2014; Granado-Font et al., 2015).

The effectiveness of wearable devices and fitness trackers, and mobile application on healthy life and care delivery outcomes such as weight loss and maintenance have been documented in developed countries (Khoury et al., 2013; Tambo et al., 2016; Zhu et al., 2015; Johnson-Glenberg et al., 2014). Nutritional and dietary wearable technology revolution has a critical role and importance in contributing to nutritional and food challenges paradigm shift in Africa and other LMICs (Kelly et al., 2015). It provides real time, home, work and hospital-based rapid, accurate and cost-effective detection, and diagnosis of nutrition/energy or diet deficiency or excess is much needed. It also supports the generation of quality evidence-based information and knowledge for individual, vulnerable group to national decision-making nutrition policy and guidelines, programs and interventions towards healthier lifestyle and increasing life expectancy, more productivity and wellness (Tambo et al., 2016a; Kelly et al., 2015). Hence, real time and objective, fit for purpose and flexible applications of smart wearable or implantable sensors approaches and strategies are urgently needed in providing clues into effective fitness and feeding behavior best practices. Yet, the nature and extent of its applications in community require further research in establishing wearable sensors on nutrition safety in increasing food production value and shelf-life usefulness and effectiveness in LIMCs and worldwide (Kelly et al., 2015; Shuger et al., 2011).

This paper provides insights into adoption and

*Corresponding author. E-mail: tambo0711@gmail.com.

applications of dietetics and nutrition smart wearable or implantable technology and sensors approaches, and strategies in increasing evidence-based public health nutrition education, public awareness and in improving fitness and clinical nutrition management. Also, it provides opportunity for lifestyle monitoring and attitudes to food intake or energy consumption/loss in reducing the rising trends of obesity related cardiovascular diseases; it is also a timely remedy to malnutrition or under-nutrition consequences in revamping health, poverty alleviation, productivity and economic growth, and sustainable development in LIMCs.

DIETETICS AND NUTRITION TECHNOLOGIES AND SMART SENSORS NEEDS

Novel nutrition smart wearable or implantable technologies and sensors can contribute to shaping the research and development in food, nutrition and dietary policies, guidelines and measures. These should be defined jointly as a unique platform of policy-makers, nutritionists, dietetics and other research scientists, clinicians, and other public health professionals (Ayres et al., 2011). Local, national, regional and international health organizations including food and pharmaceutical firms partnerships and networking engagement and investment in collective research and development, collective harmonization and standardization of solutions adoption and implementation are crucial. These insights are critical in developing smart biosensors approaches and tools in tackling these obesity and malnutrition challenges and issues, conducting preclinical studies, monitoring safety assessments and knowledge translation into public wearable products or medical devices research policy, prognosis/diagnosis, care and service delivery (Ayres et al., 2011; Popkin, 2014; Monsivais and Johnson, 2012).

The increasing and growing burden of obesity related cardiometabolic diseases and nutrition related deficiencies, calls for paradigm shift viewing the importance of smart technologies and devices as a game changer. Tackling the nutritional deficiencies and related consequences on growth, development, education, work, health and economic are considerably enormous in LMICs and specially in Africa (Allison et al., 2015; Ayres et al., 2012). Smart wearable sensors detection and therapeutic are used in exploring from personalized to community-based nutritional approach to prevention and treatment of chronic nutritional and related disease and improving existing conventional and complementary nutrition therapies in relation to lifestyle, biochemical and genetics of individual/community and environmental influences (Allison et al., 2015; Popkin, 2014). Promoting healthy nutrition, disease and ageing is paramount in improving and maintaining physical and mental function from conception, childhood to older age (Allison et al., 2015; Monsivais and Johnson, 2012; Tambo et al., 2016c). This has been undoubtedly major current and future challenges on the importance role of nutrition specifically in most vulnerable groups, in LMICs in growth and development, prevention and control of diseases (Allison et al., 2015; Monsivais and Johnson, 2012).

The importance of determining nutrition smart technologies and smart sensors needs is paramount toward evidence-based early detection and cost-effective nutrition approaches and interventions in response to global nutrition challenge. Additionally, efficient and appropriate food policy and measures could support the reduction of obesity, malnutrition and unhealthy diet amongst vulnerable communities in LMICs. Essentially, nutritional and dietary standards school or faith-based educational curriculum upgrading and awareness, monitoring is core to self-management, enhanced productivity and wellbeing (Pelletier et al., 2013). Thus, early nutrition detection sensors in informing, educating on appropriate and reliable prevention and control/regulation tactics to less or excessive energy intake or unbalanced diets provide new continuous detection and monitoring tools needs for both vulnerable populations, professionals and related stakeholders (Katzmarzyk et al., 2014; Keadle et al, 2014). These are real time and practical opportunities to acquire knowledge on the gains of nutritional wearable sensors functions and applications implementations, skilled advice, collaborative nutrition and dietary such as adherence to their patient, inter-sectoral and multidisciplinary healthcare approach and service delivery (Sun et al., 2010; Tambo et al., 2016; Johnson-Glenberg et al., 2014; Sylvia et al., 2014).

Furthermore, they include nutrition approach immune inflammation and regulation such as people living with HIV/AIDS, growing obesity or overweight and diabetes pandemic, diet associated diseases and disparities such as rickets, kwashiorkor and marasmus, impaired vision, stunted growth and development, poor education performance, acute to chronic malnutrition in LMICs (Allison et al., 2016; Evenson et al., 2015; Kelly et al., 2015). Integrative technology and medicine approach can ease one to identify the underlying causes of associated nutritional influences and consequences and promptly evidence in informing response packages or interventions; examples are applications of individualized powerful modulators nutritional interventions in inflammatory and immune-related diseases, medical nutrition therapy and advanced nutrigenomics (Allison et al., 2015; Johnson-Glenberg et al., 2014; Shuger et al., 2011; Sylvia et al., 2014).

POLICY AND PLATFORM IN DIETETICS AND NUTRITION TECHNOLOGIES AND SENSORS

Over decades, health and economic of most LMICs specially Africa continues to be impeded with the persistence and resurgence of public health consequences related to food and nutrition challenges and poverty facing all ages. Mainly, limited resources and

low allocation in agriculture in quality food production and increasing westernized life style in urban towns in LMICs settings including Africa have led to food insecurity, unhealthy eating and fast food health impact that requires innovative and evidence-based solutions (Sun et al., 2010; Zhu et al., 2015; Schaefer et al., 2014). Strategic political commitment, leadership and investment are needed in building integrated, effective and robust digital nutrition and health approaches and strategies. These can include nutrition and dietetic data and database or nutritional health informatics platforms, wearable and digital nutritional devices and tools awareness and literacy, coordinated mechanisms in engaging and monitoring the activities of all stakeholders (Schaefer et al., 2014; Kuriyan et al., 2014). Collective and participatory dialogue and communication amongst the public consumers, dietetic and nutritionist professionals on the needs of smart digital nutrition and dietary sensors in improving the quality food intake and energy consumption, malnutrition or obesity informed interventions and fitness programs, appropriate and balanced management and quality outcomes (Shuger et al., 2011; Kuriyan et al., 2014). Nevertheless, addressing and reinforcing operational and flexible wearable and implantable sensors or devices data privacy, safety and security need to be ensured at all times.

In contemporary age, the need for real-time accurate, automatic and personalized dietary and nutrition deficiencies and disorders is very important. Early smart wearable or implantable sensors detection and monitoring acceptability, uptake and applications that can guide in self-education and clinical support systems to health professionals mainly nutritionists and dietetics is vital in tackling the growing threats and epidemics of man-made and natural human and environment challenges and impacts on health (Khoury et al., 2013; Sun et al., 2010; Shuger et al., 2011; Sylvia et al., 2014; Kuriyan et al., 2014). Recent advances in robotics and digital technology represent a paradigm shift of learning and knowledge acquisition, perceptual/cognitive behavior and attitude for smart wearable robotics devices in nutrition and diet monitoring and evaluation. Also included are body sensor network for providing self-individual/personalized and community wireless monitoring platforms that are pervasive, intelligent and context-nutrition education and smart awareness on energy balance, fitness and medical advice or programs (Sylvia et al., 2014; Patel et al., 2012).

RESHAPING NUTRITION AND DIETARY OPPORTUNITIES AMONGST VULNERABLE POPULATIONS IN LMICs

Evidence-based knowledge from wearable nutrition or implantable technology and devices on clinical and non-clinical nutrition and dietary policy and in public health nutrition therapy support and management are needed in meeting the food and nutrition deficiencies and needs of vulnerable populations (Louisa et al., 2014; Kuriyan et al., 2014; Shyamal et al., 2012). Also, in promoting nutrition industry and pharmaceutical as well as professionals' inspiration, professionalism and enthusiasm for advanced nutritional sciences and service delivery (Doherty et al., 2013). Understanding contextual nutritional indicators for healthy nutrition, fitness and food security development framework can be the most effective and holistic approach in tackling under and over nutrition. This is necessary using wearable or implantable devices coupled with digital technology to change the course of malnutrition, undernourishment, obesity related cardiometabolic diseases, population fitness and income related public health burden monitors in slowing the rising chronic diseases epidemics in Africa and worldwide (Allison et al., 2015).

Developing safe, effective and accessible smart wearable or implantable sensors or device systems in nutrition, imaging and sensing and robotics in prompt clinical management and monitoring technologies have great potentials in reshaping the future of public healthcare nutrition for both developing and developed countries (Johnson-Glenberg et al., 2014; Granado-Font et al., 2015; Kelly et al., 2015; Yilmaz et al., 2010). These require focused leadership and investment capitalizing on scientific and technological innovations but with a strong emphasis on clinical translation and precise patient or group benefits and global nutrition positive impacts (Khoury et al., 2013; Sun et al., 2010; Zhu et al., 2015; Evenson et al., 2015; Johnson-Glenberg et al., 2014; Kelly et al., 2015; Sylvia et al., 2014; Kuriyan et al., 2014).

Yet, food and nutrition security is a complex public health that relies on smart national/regionalpolicy and approaches in addressing hunger, malnutrition, infectious and chronic diseases and rural poverty challenges as well as future impact of climate change on agriculture across continents (Allison et al., 2015; Sylvia et al., 2014; Stumbo et al., 2010). It also depends on several factors including greenhouse gas and ozone emissions, water scarcity mitigation and adaptation, water availability and soil, but also changing demographics, population growth needs and demand, renewable energy and policy regulation.

Improving wearable or implantable sensors implementation advantages and benefits through genuine reforms and policies; in leveraging on scientific and technology in nutrition, cooperation and collaboration in technology transfer and exchanges, engagement of public-private sectors partnerships can enable farmers and partners in LMICs (Allison et al., 2015; Sylvia et al., 2014; Patel et al., 2012). Revamping food production investment in increasing agricultural productivity, careful uses of natural resources, promoting resilience and adaptations of farmers towards sustainable and effective

nutrition and dietetics market based approaches and expansion of sufficient food accessibility and availability to vulnerable populations at all levels is essential (Allison et al., 2015; Sylvia et al., 2014; Kuriyan et al., 2014).

Bridging dietetics and nutrition information and communication technologies with healthcare management is imperative by increasing raising global awareness of the need to improve food security, environmental sustainability and economic opportunity. Accelerating sustainable investment in agriculture to ensure that all vulnerable populations have sufficient access to affordable healthy foods and diets that are environmentally sustainable is urgent. Integration of principles guiding best practice and functional medical nutrition therapy; clinical application of the nutrition care process (detecting, diagnosing, tracking or tracing, responding, monitoring, and evaluating) toward restoring function for an individual balanced nutritional and dietary status; focusing on precision dietary and nutrition formula unique for an individual and community response in nutritional imbalances on either or both chronic disease or infectious immunosuppressive diseases pathophysiology in preventing chronic disease emergence. Evidence-based and adequate management are requisite implementation that is needed in improving nutrition genetics and medical nutrition therapy (Allison et al., 2015; Johnson-Glenberg et al., 2014; Monsivais et al., 2012; Stumbo et al., 2010; Tambo et al 2016b). The forefront of diet and nutrition wearable devices includes research and development in imaging, sensing and smart robotic assessment and interpretation in addressing evidence in nutrition and health challenges to physiological, biochemical, environment, socioeconomic and climate changes advocacy and mitigation (Hughes et al., 2010; Davenport, 2015; Piwek L et al 2016).

There is an urgent need for nutrition and dietary smart wearable or implantable detectors and monitors at all ages and at all levels in understanding and monitoring the risk factors of chronic diseases, impact on health and pathophysiological progression. Importantly, monitoring excess energy accumulation in deep tissues, care and treatment adverse reactions are necessary in providing pharmacovigilance and eco-toxicity information and data. These are useful in evidence-based decision making good dietetic and nutrition practice policy in health, agriculture, environmental and climate changes in reinforcing in community settings and ultimately strengthening global food security and nutrition.

CONCLUSION

Real-time, effective and affordable dietetics and nutrition wearable or implantable sensors and technologies are emerging field with immense benefits and powerful game changer in public health nutrition in LMICs mainly in Africa. Increasing the importance of nutrition and dietetic sensors and technology applications in health, digital nutrition awareness, nutritional gamification and fitness instructional and exercise is vital in promoting food and nutrition education, electronic nutrition data and database for healthier life and wellbeing has been recognized. Political commitment and financial investment from Food Agricultural Organization (FAO), World Food Program (WFP), World Health Organization (WHO), Non-Government Organizations (NGOs), The World Bank, Africa Development Bank (ADB) and other private stakeholders is vital in strengthening food and nutrition technologies and wearable devices research and development. Promoting nutrition education and lifestyle adaptation awareness for health, support building of digital nutrition database platforms and communication is needed amongst public consumers, dietetic and nutritionist professionals. As most efficacious vehicles in building and sustaining a balanced, coordinated and fine-tune dietary and nutrition resilience culture, evidence-based decision making approaches and interventions, and best practices in healthier lifestyle and increasing life expectancy in strengthening global food security and nutrition.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

Thanks to the anonymous reviewers. This paper received no funding support.

REFERENCES

Allison DB, Bassaganya-Riera J, Burlingame B, Brown AW, le Coutre J, Dickson SL, van Eden W, Garssen J, Hontecillas R, Khoo CS, Knorr D (2015). Goals in Nutrition Science 2015–2020. Front Nutr. pp. 2:26

Ayres EJ, Greer-Carney JL, McShane PE, Miller A, Turner P (2012). Nutrition informatics competencies across all levels of practice: A national delphi study. J. Acad. Nutr. Diet. 112(12):2042-2053

Davenport A (2015). Portable and wearable dialysis devices for the treatment of patients with end-stage kidney failure: Wishful thinking or just over the horizon?. Pediatr. Nephrol. 30(12):2053-2060.

Doherty AR, Kelly P, Kerr J, Marshall S, Oliver M, Badland H, Hamilton A, Foster C (2013). Using wearable cameras to categorise type and context of accelerometer-identified episodes of physical activity. Int. J. Behav. Nutr. Phys. Act. 10:22.

Evenson KR, Goto MM, Furberg RD (2015). Furberg. Systematic review of the validity and reliability of consumer-wearable activity trackers. Int. J. Behav. Nutr. Phys. Act. pp.12:159.

Granado-Font E, Flores-Mateo G, Sorlí-Aguilar M, Montaña-Carreras X, Ferre-Grau C, Barrera-Uriarte ML, Oriol-Colominas E, Rey-Reñones C, Caules I, Satué-Gracia (2015). Effectiveness of a Smartphone application and wearable device for weight loss in overweight or

Hughes DC, Andrew A, Denning T, Hurvitz P, Lester J, Beresford S, Borriello G, Bruemmer B, Moudon AV, Duncan GE (2010). BALANCE (Bioengineering Approaches for Lifestyle Activity and Nutrition Continuous Engagement): Developing New Technology for Monitoring Energy Balance in Real Time. J. Diabetes Sci. Technol. 4(2):429-434.

Johnson-Glenberg MC, Savio-Ramos C, Henry H (2014). Alien Health:

A nutrition instruction exergame using the Kinect Sensor. Games Health J. 3(4):241-251.
Katzmarzyk PT, Barlow S, Bouchard C, Catalano PM, Hsia DS, Inge TH, Lovelady C, Raynor H, Redman LM, Staiano AE, Spruijt-Metz D (2014). An evolving scientific basis for the prevention and treatment of pediatric obesity. Int. J. Obes. 38(7):887-905.
Keadle SK, Shiroma EJ, Freedson PS, Lee IM (2014). Impact of accelerometer data processing decisions on the sample size, wear time and physical activity level of a large cohort study. BMC Public Health. 14:1210
Kelly P, Thomas E, Doherty A, Harms T, Burke Ó, Gershuny J, Foster C. (2015). Developing a Method to Test the Validity of 24 Hour Time Use Diaries Using Wearable Cameras: A Feasibility Pilot. PLoS One. 10(12):e0142198.
Khoury MJ, Lam TK, Ioannidis JP, Hartge P, Spitz MR, Buring JE, Chanock SJ, Croyle RT, Goddard KA, Ginsburg GS, Herceg Z (2013). Transforming epidemiology for 21st century medicine and public health. Cancer Epidemiol. Biomark. Prev. 22(4):508-516.
Kuriyan R, Griffiths JK, Finkelstein JL, Thomas T, Raj T, Bosch RJ, Kurpad AV, Duggan C (2014). Innovations in nutrition education and global health: the Bangalore Boston nutrition collaborative. BMC Med. Educ. 14:5.
Monsivais P, Johnson DB (2012). Improving nutrition in home child care: are food costs a barrier? Public Health Nutr. 15(2):370-376
obese primary care patients: protocol for a randomised controlled trial. BMC public health 15:531.
Patel S, Park H, Bonato P, Chan L, Rodgers M (2012). A review of wearable sensors and systems with application in rehabilitation. J Neuroeng Rehabil. 9:21.
Pelletier DL, Porter CM, Aarons GA, Wuehler SE, Neufeld LM (2013). Expanding the frontiers of population nutrition research: new questions, new methods,and new approaches. Advances in Nutrition: Int. Rev. J. 4(1):92-114.
Piwek L, Ellis DA, Andrews S, Joinson A (2016) The Rise of Consumer Health Wearables: Promises and Barriers. PLoS Med.13(2):e1001953.
Popkin BM (2014). Nutrition, Agriculture and the Global Food System in Low and Middle Income Countries. Food Policy. 47:91-96.
Schaefer SE, Marta Van Loan J (2014). A Feasibility Study of Wearable Activity Monitors for Pre-Adolescent School-Age Children. Prev. Chronic Dis. 11:E85.
Shuger SL, Barry VW, Sui X, McClain A, Hand GA, Wilcox S (2011). Electronic feedback in a diet- and physical activity-based lifestyle intervention for weight loss: a randomized controlled trial. Int. J. Behav. Nutr. Phys. Act. 8:41.
Stumbo PJ, Weiss R, Newman JW, Pennington JA, Tucker KL, Wiesenfeld PL, Illner AK, Klurfeld DM, Kaput J (2010). Web-enabled and improved software tools and data are needed to measure nutrient intakes and physical activity for personalized health research. J. Nutr. 140(12):2104-2115.
Sun M, Fernstrom JD, Jia W, Hackworth SA, Yao N, Li Y, Li C, Fernstrom MH, Sclabassi RJ (2010). A Wearable Electronic System for Objective Dietary Assessment. J. Am. Diet. Assoc. 110(1):45.
Sylvia LG, Bernstein EE, Hubbard JL, Keating L, Anderson EJ (2014). A Practical Guide to Measuring Physical Activity. J. Acad. Nutr. Diet. 114(2):199-208.
Tambo E, Madjou G, Khayeka-Wandabwa C, Tekwu EN, Olalubi OA, Midzi N, Bengyella L, Adedeji AA, Ngogang JY (2016a). Can free open access resources strengthen knowledge-based emerging public health priorities, policies and programs in Africa? F1000 Res. 5:853.
Tambo E, Madjou G, Mbous Y, Olalubi OA, Yah C, Adedeji AA, Ngogang JY (2016b).Digital health implications in health systems in Africa. Eur. J. Pharm. Med. Res. 3(1):91-93.
Tambo E, Madjou G, Ngogang JY (2016c). Wearable Sensors and Healthcare Informatics Solutions in Non-Communicable Diseases (Ncds) Prevention and Management in Africa. J. Health Med. Inform. 7:218.
Yilmaz T, Foster R, Hao Y 2010). Detecting vital signs with wearable wireless sensors. Sensors 10(12):10837-10862.
Zhu Z, Liu T, Li G, Li T, Inoue Y (2015). Wearable Sensor Systems for Infants. Sensors (Basel) 15(2):3721-3749.