

Combating COVID-19 Lockdown Inactivity in the African Population: Use of Cultural Practices and One Health Approach

***Moses M.O.¹, Emikpe A.O.², Moses M.K.³, and Emikpe B.O.⁴**

¹Department of Sport and Exercise, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

²Department of Nursing, Faculty of Allied Health Sciences, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

³Distance Learning Programme, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

⁴School of Veterinary Medicine, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Summary: A novel pulmonary illness caused by coronavirus 2019 (COVID-19) of unknown origin was first reported in China. This disease has claimed over a million human lives worldwide. This pandemic respiratory disease spread through droplets on surfaces and community spread. Government of different countries adopted a total lockdown to reduce human to human contact and keep families safe from the disease. This compulsory movement restriction reduces physical activity of individuals which could pose cardiovascular risk to physically inactive African population. This brief states the various cultural and one health approaches that could be adopted to increase physical activity within the home setting. Literature search using PubMed, Scopus and google scholar and views of one health personnel in the promotion of physical activity at home during the compulsory lockdown were sought for to identify some simple approaches and gaps that need to be researched on. The overview identified culturally related indoor physical activities in Africa such as ampe or tente that could enhance health. It encouraged dog walking, tending backyard farm and catering for indigenous chicken and small ruminants as means of increasing physical activity. Counselling was proffered by nurses to increase health promotion activities such as setting reminders for physical activities and routine house chores. This submission bring to bear indigenous, flexible and simple measures to combat boredom, promote cardiovascular health by increasing physical activity during the compulsory lockdown currently being experienced in Africa, a known cardiovascular risk, physically inactive population.

Keywords: *Physical activities, COVID 19, Lockdown, indigenous approach*

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*Address for correspondence: Banabis2001@yahoo.com

Manuscript Accepted: May, 2020

INTRODUCTION

A lower respiratory tract febrile illness (novel coronavirus, pulmonary illness, coronavirus disease 2019 (COVID-19)) of unknown origin was reported in a cluster of patients in Wuhan City, Hubei Province of China in December, 2019. COVID-19 has been declared as a pandemic health condition (Gates, 2020). As at April 11, 2020, records showed that over 1,518,518 individuals were affected and 88,495 human lives claimed worldwide by the deadly disease (Hosseiny *et al.*, 2020). Headache, persistent pain or pressure in the chest, dry cough, confusion, fever, diarrhea, myalgia, excessive drowsiness, and dyspnea were presently identified clinical indicators of COVID-19 where multi-organ failure and fatal pulmonary contribution has arisen from most infected people (Zahra *et al.*, 2020). Although, the developed

world has the enormous ratio of COVID-19 cases and death rate compared to developing countries, its threatening crisis would be disproportionately hit the former (UNDP, 2020).

Africa reported the first case of COVID-19 in Egypt on 14 February, 2020. Presently, 45 countries (approximately 60.0%), including power house of African countries, have reported COVID-19 cases where confirmed cases has risen above 9,147 and more than 413 deaths (WHO, 2020). The exponential growth of COVID-19 infection suggests that soonest it would reach every country in Africa which might put the continent at indescribable health risk.

Several pragmatic measures/guidelines/approaches were presented by standard international health regulatory bodies such as WHO and OSHA to curtail its spread globally including frequent hand washing with soap under running water for at least 20

seconds, maintaining more than 2 metres (6 feet) physical (social) distance, avoidance of eyes, nose and mouth touching, respiratory hygiene practices including covering coughs and sneezes, those having fever, cough and difficulty in breathing to seek medical care early, avoiding close contact with people who are sick, staying home if sick, staying informed by recognizing personal risk factors and following advice given by healthcare provider (OSHA, 2020). The envisaged approaches in this submission were considered under lockdown and physical activities, culturally related indoor physical activity in Africa as complement of health, pets as a tool to increase physical activity, backyard farming and home nursing perspectives.

This study employed thematic review method where current literature search on peculiar issues were conducted. Database search platforms of Pubmed, Scopus, AJOL and Google scholar were consulted. Search terms used included “culturally related” and “indoor physical activity” or “indoor exercise” or “games”. Information (data) from titles, abstracts and main body of articles were analysed. Opinions of exercise physiologists, experts in veterinary medicine and nurses were gathered through teleconferencing for 30minutes per day for a week, connected and integrated together.

Lockdown and physical activities

Apart from the above guidelines, most threatened countries-China, Spain, USA, Italy, South Africa, Ghana, Nigeria, etc., pronounced partial or total lockdown (an emergency protocol that prevents people from leaving home) on its citizens to curtail the spread of the virus. The lockdown was not only made compulsory but enforced militarily on recalcitrant citizens. Critical analysis of the ‘lockdown’ protocol suggests that sedentary (inactive) citizens were made to stay healthy in doors safe thereby reducing the exposure to the virus as recommended by World health Organization (OSHA, 2020). Activities that would appeal to most of the inactive citizens in African countries will be sleeping, playing inactive games and watching of video/films significantly. These activities are regarded as insufficient physical activity (not meeting the WHO recommendations on physical activity for health (WHO, 2010) which may have deleterious effects on their health and wellbeing.

Those who are active will at least remain active by dancing to favourite music, engaging in garden works where available and do some work outs within the compound where available which might not be sufficient if not monitored while vast majority will persistently be inactive. Although the sample population of the report considered was 10-19 years, its findings showed that boys in Sub-Saharan Africa region has the second highest prevalence of insufficient activity (83.9% [82.3–85.0]) while girls

from the central Asia, Middle East, and north Africa regions has the second highest prevalence (89.9% [88.6–90.9]) (Guthold et al., 2020). The physical activity behaviours of the generation may reflect that of their parents. Studies have shown significant correlations between parental support and child physical activity level (Guthold et al., 2020).

Although sleeping, hypothesized as one of the major activities that families/individuals during the ‘lockdown’, has positive effects on the mechanisms defense of the body systems and inflammatory response’s magnitude and characteristics (Tan *et al.*, 2019); improves memory recall, regulates metabolism, and reduces mental fatigue, repairs tissue, synaptic homeostasis, and immune-inflammatory control (Chennaoui *et al.*, 2019), it adversely contributes to weight gain when caloric consumption is greater than energy expenditure. Furthermore, other earlier hypothesized physically inactive activities also play major roles in weight gain.

It has been established that weight gain >2% is an indicative defensive connotation with cardiovascular diseases (CVD) and an expressive opposing suggestion with increased mortality (Strelitz *et al.*, 2019). There is the need to scientifically admit, to be best of authors’ knowledge, that African continent has vast citizens who are physically inactive, overweight, obese and at risk of CVD. Another perspective is with those who would engage in sitting activities due to the ‘lockdown’ that would expose them to low back pain either acute or chronic. Low back pain (LBP) has the potential of signaling CVD. This submission is presented in line with studies where chronic LBP had higher prevalence of myocardial infarction and coronary heart disease even when controlled for genetics and early shared environment (Fernandez *et al.*, 2016). The envisaged inactivity suggest a need to critically look inward for cultural practices and other one health measures that could be put in place to avoid public health problems during and post COVID-19 periods.

Cultural Physical Activity in Africa as complement of Health

There is evidence of many culturally related leisure time physical activities among African countries (Thind *et al.*, 2015). Culturally related indoor games vary in names like Senet (Egypt)/Ayo olopon (Nigeria)/Kigogo (Kenya)/Oware (Ghana)omweso (Uganda), Igisoro (Rwanda), Enkeshui (Kenya), Kudoda (Zimbabwe), Nyama-nyama-nyama (Kenya), and Nngapi / Bao (Tanzania) appear to provide perceptions of physical activity conception patterns in African setting.

The conceptualizations of African culturally related indoor games (not for festivals) practically are passive in nature rather than active which could suggest insight of native and emotional intelligence

(Oyibo *et al.*, 2018). Physical activity is an effective measure for preventing diseases in children and adolescents across all ethnic and socioeconomic subgroups (Ahmadinejad *et al.*, 2014). The playing patterns of the few active indoor games, like Stockings (across Africa), Bojuboju and Talowa ninu ogba naa (Nigeria) and *Tente* (Nigeria)/*Ampe* (Ghana), present health enhancing opportunities.

Generally, the health benefits of being physically active, although depend on intensity and duration among other things, include reduction in the risk of chronic cardiovascular diseases, symptoms such as myocardial infarction (within 6 months), coronary heart disease associated with related chest pain, heart valve disorder, cardiomyopathy, stroke, hypertension, obesity, arthritis, and diabetes (Rhodes *et al.*, 2017). Analyzing specific health benefits of each of all the culturally related indoor physically active games may be challenging but attempt is currently on to scientifically assess the usefulness of *ampe* (Ghana) or *tente* (Nigeria) in increasing physical activity, the scientifically analysed health benefits which are scarce in literature. Given its mechanism of execution, *ampe* is not difficult to learn, requires readily available natural surface and a presence of at least two individuals. Recent experimental study conducted among school children showed that *ampe* exercise programme significantly decreased waist circumference, hip circumference, waist-to-hip ratio, percent body fat, blood pressure, and heart rate in school children (Moses *et al.*, 2020). *Ampe* can be executed both indoor and outdoor to reduce the risk of cardiovascular diseases, has potentials that could boost psychological stressors and enhance wellbeing of all irrespective socio-economic status during lockdown.

Pets as a tool to increase physical activity for Health

The lockdown in Africa has brought family together and emphasis is on what can be done within the home setting to promote physical activity. One of such is the use of pets in increasing physical activities.

It is a known fact that mutual benefits and robust relationship between people and animals termed human-animal interaction had been the focus of many researchers with very few highlighting the psychological, physiological, and social benefits (Walsh, 2009) of such interaction especially in an African setting. The enhancement of some physiological traits through this interaction such as walking dogs has been identified among children with resultant good outcome on social benefits at old age (Bergroth *et al.*, 2012). This clearly showed that a history of dog ownership often benefit such owners in later life than during youth. Reports also showed that dog walkers at baseline were 1.65 times active physically than non-dog owners (Thorpe *et al.*, 2006) with resultant better social and psychological benefits. Various reports abound in developed countries of

community-dwelling older dog owners having greater motor fitness and walk more, with resultant higher social function than never owners. Dog walking had been identified to increase walking time for older persons and help maintain motor fitness and social activities, regardless of family support or financial resources. Caring for a dog might be an effective health promotion strategy to increase dog walking, physical activity and facilitate social participation among older adults (Taniguchi *et al.*, 2018).

Information on dog walking abound in literature particularly in Western countries as a feasible approach for increasing physical activity especially for the household that owned dog which are 23% of UK (Bergroth *et al.*, 2012) and 35.1 % of Ghana (Tasiame *et al.*, 2019). This is important because large proportions of the population in many developing countries are not sufficiently active for health benefits (Guthold *et al.*, 2020). In Sub-saharan Africa, even before the lockdown, 83.9% of boys and 89.9% of girls are not sufficiently active (Sorek *et al.*, 2018). To achieve recommended level of physical activity in adults, effort should be tailored towards the use of dogs for briskly walking for at least 30 minutes each day. It has also been established that the dog-owner relationship has the potential to enhance health by reducing stress to a greater degree than if walking alone or with a person and attributed to effects on parasympathetic neural activity (Westgarth *et al.*, 2014).

Many reports also showed that the exercise levels of dogs correlate well with their owners' activity levels which are inversely associated with obesity. This evidences in the literature showed clearly that dog walking should be an approach to reduce boredom, physical inactivity during this COVID 19 lockdown especially in an African setting. Though there are various religious and cultural issues that influence dog walking and especially dog ownership as opined by Suluku *et al.*, (2019), but embracing this simple activity within the home will no doubt increase the rate of physical activity

Backyard farming and Health

Apart from dog walking, tending household or backyard farming has been identified as a means of increasing physical activity especially tending vegetable garden and caring for indigenous small ruminants and poultry varieties. Backyard ruminant and poultry farming is gaining prominence because 70% of the poultry and small ruminant production are raised in the rural and some urban households. The care for the animals is often by children and women who sell them for immediate cash need or for religious ceremonies. During this COVID19 lockdown period, catering for these domestic animals will reduce physical inactivity or boredom often associated with this time. The scientific evidence of the level of

reduction of physical activity using this approach in the African population has not been fully elucidated. This approach has been practiced in various communities in Australia with tremendous increase in physical activity and interaction within the community (Kingsley *et al.*, 2009). The economic gains associated with backyard poultry production was well marked during this period when demand for their demand and eggs increased as coronavirus shopping frenzy empties supermarkets in US. Though this simple approach can be adopted especially for those that have backyard, while those with no facilities could make do with dog walking.

Role of Nurses in health promotion at Home

Sedentary behaviour which is common during this period is any activity involving sitting, reclining or lying down with resultant low energy expenditure. This unhealthy behaviour if left uncurbed will likely increase the risk of individuals to chronic health conditions such as cardiovascular diseases, obesity, type 2 diabetes, deep vein thrombosis and mental health disorders. Cardiovascular diseases and diabetes mellitus constitute more than half of non-communicable diseases in sub-Saharan Africa (Hamid *et al.*, 2019) and this may get worse considering the current rate of inactivity individuals are being subjected to. Prior to this time, Africa had a high prevalence of obesity, hypertension and diabetes which usually go undiagnosed and resulted into preventable death.

The WHO recommends a minimum of 150 minutes period of physical activity or an equivalent of 75 minutes of vigorous activities per week or a combination of both to stay healthy. However restrictions of this nature on movement and social distancing may not make this achievable unless conscious efforts are made by individuals to remain physically fit because remaining physically fit enhances healthy living and longer lives (Wolfson *et al.*, 2019).

Physical activity is health promoting and disease preventing. It promotes mental alertness of individuals as it has been linked to improved immune system and weight maintenance. For physical activity to produce the desired results as enumerated, it must be done regularly, consistently and preferably in a family group. Sedentary living and poor dietary habit of individuals during this lockdown can have deleterious effects on cardiovascular health which may lead to early death (Kandola *et al.*, 2020). This makes the need for improved physical activity very imperative for adults and children during Covid-19 lockdown.

The role of nurses in the prevention of cardiovascular diseases among the populace during this period is that of health promotion which is aimed at enabling and encouraging people to increase control over and improve their health. Provision of health

teaching on COVID 19 to increase individuals' awareness can be done in form of short but educative video clips as well as encouraging people to seek for correct and accurate information from appropriate media. This will serve to give them relief from preventable psychological stress. People who are already on treatment for chronic diseases are encouraged to maintain their health through strict compliance to their medications. Zhai and Baran, (2019) recommended walking round the house at intervals, doing household chores, moving round the house to receive calls, taking a break during television commercials and setting reminders to stand up every thirty minutes in order to remain physically active. These conscious efforts in turn improve concentration and reduce behavioural problems even in children.

Nurses' role in the prevention of sedentary living also include promotion of physical activity such as providing dietary advice on appropriate nutrition, encouraging active play among children and sustaining physical activity in both children and adults to promote physical and mental wellbeing. Enhancement of behavioural change counselling among the populace and persuading them to make appropriate decisions that support a healthy lifestyle in order to cope with the current challenges of COVID19 is equally important.

Conclusion

This overview clearly identified some cultural and one health approaches that could be adopted to increase physical activity within the home setting. They include cultural dances and exercise known in Africa such as ampe, ten-ten, it also encouraged indigenous chicken and small ruminant as source of increasing physical activity while dog walking and tending backyard vegetable garden was identified as some activities which can be intensified to increase physical activities especially for youth and old adults. Some health promotion activities such as reminders to walk couple with routine house chores that demand for some physical activity were also advised. This bring to bear indigenous, flexible and simple measures to combat boredom and increase physical activities during the compulsory lockdown currently being experienced in Africa, a known Cardiovascular Risk Physically inactive population.

Already known facts

- African population is a physical inactive population
- Sedentary life style results in cardiopulmonary risks
- The lockdown is a challenge to adequate physical activity

This review adds

- Ingenious approach such as use of cultural dance and exercise

- Dog walking should be encouraged in the African population to increase physical activity
- Tending backyard farming and simple routines within the home should be employed

Authors' contributions; All authors (MOM, AOE, MKM and BOE) contributed to the study's design. MOM, AOE, MKM and BOE drafted the manuscript. Other authors (MOM and BOE) critically revised the manuscript and provided valuable inputs. All authors (MOM, AOE, MKM and BOE) read and approved the final version of the manuscript.

Acknowledgements

We appreciate the approached families that gave information on their physical activity. We are thankful to the experts for their voluntary participation.

REFERENCES

Ahmadinejad Z, Alijani N, Mansori S, Ziaee V. Common sports related infections: a review on clinical pictures, management and time to return to sports. *Asian J Sports Med.* 2014; 5(1):1–9. doi: 10.5812/asjms.34174.

Bergroth E, Remes S, Pekkanen J, Kauppila T, Buchele G, Keski-Nisula L. Respiratory tract illnesses during the first year of life: Effect of dog and cat contacts. *Pediatrics.* 2012; 130:211–220. <https://doi.org/10.1542/peds.2011-2825>

Chennaoui M, Léger D, Gomez-Merino D. Sleep and the GH/IGF-1 axis: Consequences and countermeasures of sleep loss/disorders. *Sleep Med Rev.* 2019; 49(1):101223.

Fernandez M, Ordoñana JR, Hartvigsen J, Ferreira ML, Refshauge KM, Sánchez-Romera JF, Pinheiro MB, Simpson SJ, Hopper JL, Ferreira PH. Is chronic low back pain associated with the prevalence of coronary heart disease when genetic susceptibility is considered? a co-twin control study of Spanish Twins. *PLoS One.* 2016; 11(5):e0155194. doi: 10.1371/journal.pone.0155194.

Gates B. Responding to Covid-19—A Once-in-a-Century Pandemic? *N Engl J Med.* 2020; Feb 28. doi: 10.1056/NEJMp2003762.

Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 16 million participants. *The Lancet Child & Adolescent Health.* 2020; 4(1):23-35.

Hamid S, Groot W, Pavlova M. Trends in cardiovascular diseases and associated risks in sub-Saharan Africa: a review of the evidence for Ghana, Nigeria, South Africa, Sudan and Tanzania. *Aging Male.* 2019; 22(3):169-176. <https://doi.org/10.1080/13685538.2019.1582621>

Hosseiny M, Kooraki S, Gholamrezanezhad A, Reddy S, Myers L. Radiology perspective of coronavirus disease 2019 (COVID-19): lessons from severe acute respiratory syndrome and Middle East respiratory syndrome. *Am J Roentgenol.* 2020; 214: 1078-1082. 10.2214/AJR.20.22969

Kandola A, Stubbs B, Koyanagi A. Physical multimorbidity and sedentary behavior in older adults: Findings from the Irish Longitudinal Study on Ageing (TILDA). *Maturitas.* 134:1-7. <https://doi.org/10.1016/j.maturitas.2020.01.007>

Kingsley JY, Townsend M, Henderson-Wilson C. Cultivating health and wellbeing: members' perceptions of the health benefits of a Port Melbourne community garden. *Leis. Stud.* 2009; 28(2):207-219. <https://doi.org/10.1080/02614360902769894>

Moses MO, Afrifa D, Asamoah MA, Sarpong P, Sarpong E, Appiah PO, Akoto F. “Ampe” exercise programme has positive effects on anthropometric and physiological parameters of school children: a pilot study. *Ethiop J Health Sci.* 2020; 30(1):143-146. doi: 10.4314/ejhs.v30i1.18

Occupational Safety and Health Administration (OSHA). COVID-19: Control and Prevention. 2020. Available from <https://www.osha.gov/SLTC/covid-19/controlprevention.html>. Accessed on 11/04/2020

Oyibo K, Orji R, Vassileva J. Developing culturally relevant design guidelines for encouraging physical activity: a social cognitive theory perspective. *J. Healthc. Inform. Res.* 2018;2(4):319-352.

Rhodes RE, Janssen I, Bredin SS, Warburton DE, Bauman A. Physical activity: Health impact, prevalence, correlates and interventions. *Psychol Health.* 2017;32(8):942-975.

Sorek G, Shaklai S, Meyer S, Katz-Leurer M. Autonomic cardiac control response to walking and executive cognitive task in adolescents with acquired brain injury and typically developed controls. *Brain Inj.* 2018;32(6):770-775. <https://doi.org/10.1080/02699052.2018.1450993>

Strelitz J, Ahern AL, Long GH, Hare MJL, Irving G, Boothby CE, Wareham NJ, Griffin SJ. Moderate weight change following diabetes diagnosis and 10 year incidence of cardiovascular disease and mortality. *Diabetologia.* 2019; 62(8):1391–1402. <https://doi.org/10.1007/s00125-019-4886-1>

Suluku R, Nyandeboh JP, Moiforay S. One Health approach to control brucellosis in Sierra Leone. In *Bacterial Cattle Diseases 2019 March 11*. IntechOpen. doi: 10.5772/intechopen.82378

Tan HL, Kheirandish-Gozal L, Gozal D. Sleep, sleep disorders, and immune function. In: Fishbein A., Sheldon S. (eds). *Allergy and Sleep*. Springer, Cham, 28 June 2019. doi https://doi.org/10.1007/978-3-030-14738-9_1

Taniguchi Y, Seino S, Nishi M, Tomine Y, Tanaka I, Yokoyama Y, Amano H, Kitamura A, Shinkai S. Physical, social, and psychological characteristics of community-dwelling elderly Japanese dog and cat owners. *PLoS One.* 2018;13(11):e0206399. <https://doi.org/10.1371/journal.pone.0206399>

Tasiame W, Johnson S, Burimuah V, Akyereko E, Amemor E. Dog population structure in Kumasi, Ghana: a missing link towards rabies control. *Pan Afr Med J.* 2019;33:13. doi: 10.11604/pamj.2019.33.13.18284.

Thind H, Goldsby TU, Dulin-Keita A, Baskin ML. Cultural beliefs and physical activity among African-American adolescents. *Am. J. Health Behav.* 2015;39(2):285-294.

Thorpe RJ, Simonsick EM, Brach JS, Ayonayon H, Satterfield S, Harris TB, Garcia M, Kritchevsky SB. Dog ownership, walking behavior, and maintained mobility in late life. *J Am Geriatr Soc.* 2006; 54:1419–1424. <https://doi.org/10.1111/j.1532-5415.2006.00856.x>

United Nations Development Programme (UNDP, 2020). Covid-19: Looming Crisis in developing countries

- threatens to devastate economies and ramp up inequality. Available from https://www.undp.org/content/undp/en/home/news-centre/news/2020/COVID-19_crisis_in_developing_countries_threatens_to_devastate_economies.html Accessed on 11/04/2020
- Walsh F. Human-animal bonds I: The relational significance of companion animals. *Fam. Process.* 2009; 48(4):462–480. <https://doi.org/10.1111/j.1545-5300.2009.01296.x>
- Westgarth C, Christley RM, Christian HE. How might we increase physical activity through dog walking? A comprehensive review of dog walking correlates. *Int J Behav Nutr Phy.* 2014;11(1):83. <https://doi.org/10.1186/1479-5868-11-83>
- WHO Africa. COVID-19 pandemic expands reach in Africa. April 10, 2020. Available from <https://www.afro.who.int/news/covid-19-pandemic-expands-reach-africa>. Accessed on 11/04/2020
- WHO. Global Recommendations on Physical Activity for Health. Geneva: World Health Organization, 2010.
- Wolfson J, Stovitz SD, Blair SN, Sui X, Lee DC, Shrier I. Decomposing the effects of physical activity and cardiorespiratory fitness on mortality. *Global Epidemiology.* 2019; 1:100009. <https://doi.org/10.1016/j.gloepi.2019.100009>
- Zahra Syeda M, Diabakte K, Geng X, Ji F, Ouyang L, Pan S, Fu Z, Li Y, Jia F, Chen Z, Li W. The ongoing epidemic of 2019 novel coronavirus (SARS-CoV-2): Infection and fatality trends in Wuhan, Hubei and across China. SSRN. 2020 (2/13/2020). Available from SSRN: <http://dx.doi.org/10.2139/ssrn.3542152>
- Zhai Y, Baran PK. Urban park pathway design characteristics and senior walking behavior. *Urban for Urban Gree.* 2017; 21:60-73. <https://doi.org/10.1016/j.ufug.2016.10.012>.
- Oladipo G. S., Paul C. W. (2009) Anthropometric comparison of cephalic indices between the Urhobo and Itsekiri ethnic group of Nigeria, *Global Journal of Pure and Applied Sciences*,15(1): 65–67.
- Oladipo, G. S., Anugweje, K. C., Bob-Manuel, I. F. (2014). Dolicocephalization in cephalic indices of adult Yorubas of Nigeria. *Journal of Anthropology*, 2014.
- Oladipo, G. S., Okoh, P. D., Hart, J. S. (2010). Anthropometric study of some craniofacial parameters: Head circumference, nasal height, nasal width and nasal index of adult Ijaws of Nigeria. *Asian Journal of Medical Sciences*, 2(3), 111-113.
- Porter J.P. (2004). The average African American male face: an anthropometric analysis. *Archives of Facial Plastic Surgery*, 6(2), 78-81.
- Sanger T.J., Sherratt E., McGlothlin J.W., Brodie E.D, Losos J.B., Abzhanov A. 2013. Convergent evolution of sexual dimorphism in skull shape using distinct developmental strategies. *Evolution*, 67(8), 2180-2193.
- Singh, I. P., Bhasin, M. K. (2004). *A manual of biological anthropology*. Delhi: KamlaRaj Enterprises. Pg 178-179
- Sohail A.S.M., Bhattacharya P. (2008). *Detection of facial feature points using anthropometric face model. In Signal Processing for Image Enhancement and Multimedia Processing.* Springer US. 189-200.
- Sudke G.B., diwan Chhaya V. (2012). Multivariate analysis for sexual dimorphism of skull. *Human Evolution*, 12(8), 779-786.
- Teck S.R.S., Smith J.D., Chan A.S. (2000). Comparison of the aesthetic facial proportions of southern Chinese and white women. *Archives of Facial Plastic Surgery*, 2(2), 113-120.
- Umar M.B.T., Ojo A.S., Asala S.A., Hambolu, J.O. (2011). Comparison of cephalometric indices between the Hausa and Yoruba ethnic groups of Nigeria. *Research Journal Medical Science*, 5(21): 83-89.
- Waters M.C. (2000). Immigration, intermarriage, and the challenges of measuring racial/ethnic identities. *American Journal of Public Health*, 90:1735–1737.
- Yokota M. (2005). Head and facial anthropometry of mixed-race US Army male soldiers for military design and sizing: A pilot study. *Applied Ergonomics*. 36:379–383.