RESEARCH ARTICLE

PREVALENCE AND BARRIERS OF PHYSICAL ACTIVITY OF UNDERGRADUATE PHYSICAL THERAPY STUDENTS AT UMM AL-QURA UNIVERSITY IN SAUDI ARABIA

Moayad Subahi

BSc PT, MSc, PhD, Physiotherapy Department, Faculty of Applied Medical Science, Umm Al-Qura University, Mecca, Saudi Arabia.

……....

Manuscript Info	*Abstract*

………………………. ………………………………………………………………

Objective: The aim of this study was to evaluate the level of physical activity (PA) and barriers to PA of undergraduate physiotherapy students at Umm Al-Qura university in Saudi Arabia.

Methods: Data were collected from undergraduate physical therapy students at Umm Al-Qura University, Saudi Arabia. The cross-sectional study used the well-known self-administeredInternational Physical Activity Questionnaire (IPAQ) to measure the amount and intensity of PA an individual participates in per week, which was statistically analyzed with SPSS into low, moderate and high physical activity. In addition, a pre-designed survey was used to assess the barriers to PA and categorized according to the International Classification of Functioning, Disability and Health (ICF), and Behaviour Change Wheel (BCW).

Results: Two hundred undergraduate students were enrolled in the study, from the 2nd, 3rd and 4th college year. The results showed that physical activity level was high 38%, and moderate 40% among physiotherapy students. In addition, 56% were having a healthy BMI, and only 21% were overweight. The most reported barriers were the bad weather, lack of time, lack female gyms and not being a lifestyle.

Conclusion: The study demonstrated that undergraduate students are aware of the importance of physical activity as most of the studied participants were high to moderately active. Whereas the reported barriers could be used for future interventions to promote PA of college students.

……....

Introduction:-

The global demand to promote physical activity (PA) in the community has been well acknowledged in the literature[1,2]. Physical activity has enormous benefits on physical and mental health, as it reduces the risk of obesity, heart disease, and type 2 diabetes and improves mental health state[3–5]. In addition, physical inactivity is known to significantly increase the risk of non-communicable diseases in high-income countries[6]. It is estimated that physical inactivity accounts for 9% of global premature mortality, or more than 5.3 million deaths each year[6]. Therefore, in its most recent report, the World Health Organization (WHO) set a 2030 target of a 15% relative decrease in the prevalence of physical inactivity among adults and adolescents worldwide. WHO advises adults aged between 18–64 to do at least 150 min of moderate-intensity aerobic physical activity during the week, or at least 75 min of

Corresponding Author:- Moayad Subahi
Address**:-** BSc PT, MSc, PhD, Physiotherapy Department, Faculty of Applied Medical Science, Umm Al-Qura University, Mecca, Saudi Arabia.

613

vigorous-intensity aerobic PA throughout the week[7]. However, studies have shown that the guidelines were not met worldwide, especially in Arab countries[8–11]. In particular, the literature shows that Saudi Arabia's population is considered physically inactive[12].

Previous studies demonstrated that the level of PA was not sufficient among students throughout the world[3,13,14]. In Saudi Arabia, the literature shows that the population is considered physically inactive[15], hence, the young adults may demonstrate similar results.Astudyof the prevalence of physical inactivity among238 males and 138 females fromMajmaah university,found that the percentage of physical inactivity was 51.1% amongst the students[16].Similarly, a study of the prevalence of physical inactivity of medical students at Al-Jouf University found that among 283 medical students, the majority of the students were inactive (60.1%)[17]. Only 38.2% of the students performed vigorous physical activity, 21.9% moderate-intensity physical activity and 33.2% walking activities. The study also highlighted the main barriers to PA, which were lack of time, money, facilities, safety and motivation.

A recent study was carried out to evaluate the PA level of college 375 female college students in Saudi Arabia[18]. The results showed that 70% of participants did not meet the WHO recommendation of 150 min per week of moderate activity, while around 62% of participants did not meet the WHO recommendation of 75 min per week of vigorous activity. In addition, the study found that most participants (91%) spent more time in walking activity compared to moderate (66%) and vigorous activity (57%) for at least 10 min at a time over a period of 7 days. A study in 2019 was carried out to evaluate the PA pattern before and after college enrolment[19]. 417 college students from King Abdulaziz Universitycompleted the questionnaire. The results shows that there was a pattern of a significant decrease after enrollment in college, as the most common reason for not practicing exercise was time restriction, while the most common reason for practicing exercise was to improve body shape. Hence, it is evident that college students are experiencing lack of PA due to several barriers identified in the literature.

Several studies have explored the barriers and facilitators to PA, to understand people's behaviour and to create effective behaviour change strategies. For example, a systematic review of the barriers to PA in Saudi Arabia found that lack of time, inappropriate walking places, lack of facilities and resources especially for females, urbanization, traffic, hot weather and lack of social support, were some reasons that limit the PA levels of the Saudi population[20]. Similarly, a large number of studies have explored the barriers and facilitators to PA in the Saudi population, in which they had similar results [21–23]. For instance, Al Salim et al[13] explored the barriers to PA in college students in Saudi Arabia with Barriers to Being Active Quiz. The results shows that male and female students were physically inactive due to lack of time, lack of energy and fear of injury. Interestingly, female students reported more barriers compared to males, which are lack of resources, social influence, lack of willpower, and lack of skill. Agreeing with the previous study, a recent study in-depth interviewed 12 females living in the east midlands in Saudi Arabia[24]. The barriers identified were the lack of supportive facilities, cultural traditions, and lack of time. Furthermore, Subahi et al[25] exploration of the barriers to PA in Saudi Arabia, revealed that lack of supporting families, responsibilities, privacy concerns, were major barriers to female in engaging in PA. Clearly, there are several identified barriers to PA in Saudi Arabia with more difficulties for female, which may agree with the previous literature that suggests that PA behaviour can be influenced by culture and societies[26,27].

However, despite the evidence of the benefits ofPA, none of the previous studies was conducted on undergraduate physiotherapy students at Umm Al-Qura University. Therefore, the aim of this study was to evaluate the level of PA of physiotherapy students at Umm Al-Qurauniversity in Saudi Arabia.

Research question:
What is the prevalence and barriers to physical activity of physical therapy students at Umm Al-Qura University in Saudi Arabia?

Methods:-
Participants:
The study participants were undergraduate physiotherapy students at Umm Al-Qura university, Makkah, Saudi Arabia. The current study is cross-sectional, and a random sample was recruited from the students at the second, third and fourth year of undergraduate physiotherapy program. Each subject was given an information sheet and a written informed consent to participate in this study. The participants were informed that the study would be published, but no personal identification would be used, and all data would be anonymized.

Questionnaire:
The questionnaire used to evaluate physical activity was thea self-administeredInternational Physical Activity Questionnaire (iPAQ)[28]. The IPAQ is used for screening the PA level in the population, which aim to determine the amount and intensity of PA an individual participates in per week. The questionnaire includes 7 items that consider the four domains: leisure-time PA, domestic and gardening activities, work-related activities, and transport-related activities. The results are separate scores for walking, moderate intensity, and vigorous intensity in each of these domains. Then, the scores were calculated as metabolic-equivalent (MET) per minutesper week. Afterward,students were assigned to 3 different categories of physical activity level (low, moderate, and high) [29].

The validity and reliability of the questionnaire is well-established in the literature. Several studies indicated that the iPAQ is reliable and valid measure of PA[30–33]. Furthermore, the Arabic version of the questionnaire will be used since the study participants are Arabic speakers. Hence, the Arabic version was recognised to be valid and reliable to assess PA level[34,35]. In addition, body mass index (BMI) was calculated from self-reports of height and weight.BMI is defined as the ratio between the subject's weight (expressed in kg) and the square of the height (expressed in meters)[36].

Barriers survey:
A survey was developed from the literature that identified barriers to PA globally and in Saudi Arabia. The first list included 33 barrier which were then checked for duplicates. Afterwards, 24 barriers were included in the final survey as they were evident in the literature and can be applied to the Saudi culture. The final draft of the barriers were combined according to its category that were derived fromthe International Classification of Functioning, Disability and Health (ICF)[37] andBehaviour Change Wheel(BCW)[38].A simple and easy to use formats have been used in order to make it applicable in the clinical practice with shortest time needed. Therefore, the first draft included four categories: Physical and mental health factors, Family and social factor, Culture factors and Environment and economic factors. These categories included 24 barriers to PA derived from the literature, and an open question to add non-listed barriers.

Ethics:
Ethical approval was gained from the Local Committee for Biological and Medical Ethics to Conduct a Scientific Research at Umm Al-Qura University (KWMF221022).

Data Analysis:
Statistical analysis was performed using SPSS (Statistical Package for Social Sciences, version 28) software for Windows. Descriptive statistics are presented as mean, minimum and maximum values and standard deviation(Table 1).Continuous data such as BMI and Physical activity (total METs per week) were analyzed with independent t-testwith the level of significance set at $p < 0.05$ andexpressed as mean and standard deviation.The independent t-test was used to compare physical activity level and BMI between male and female students. One way ANOVA was used to compare means between the three groups of school year (2nd, 3rd, 4th year). Data from categorical variables such as Physical activity category, BMI category and barriers to PA were analyzed with frequency measures and expressed as percentages. Participants with missing data were eliminated.

Results:-
A total of 200 subjects were enrolled in the study (Table 1).Ninety-six male and 104 female students from the 2nd,3rd and 4th college years were included. The majority of students were from 2ndyear, accounting for 46.5%, while 20.5% of the participants were 3rd year students and 33% were at 4th college year.

An independent t-test was used to compare PA levels and BMI between male and female students (Table 2).Beginning with PA levels, the statistical analysis revealed that there was no significant difference in total Mets per week (P=0.344), as the male students had a mean of 2235.10 Mets/week (SD= 2089.60), while the female mean=1980.21Mets/week (SD=1709.92). Regards the BMI, the analysis shows that there was a significant difference between male and female students (P=0.000), as the malemean BMI was 24.45 (SD= 5.06), and female mean BMI was 21.34 (SD=3.73).One way ANOVA test was used to compare PA levels and BMI between 2nd, 3rd and 4th year students (Table 3). The statistical analysis shows no significant difference between students in BMI (P=0.500) or PA levels (P=0.403) based on school-year.

Categoricalresults:
Physical activity level:
Regarding the physical activity level, a descriptive frequency statistic was used to determine the percentage of physical activity level category, the students were categorized as low, moderate and highly active based on the total METs per week based on the IPAQ guideline. Therefore, the percentage of students who were high physically active was 38%, moderately active 40% and low active 22% (Figure 1).

A descriptive frequency statistic was also used to present percentages of physical activity categories for each school year. Firstly, the second year students, only 16.1% of the students were physically low active, while thepercentage of moderate and high physically active were41.9% and 41.9%, respectively.

Regarding the third-year students, the results were similarly distributed, as the percentage of low active were 34.1%, moderately active 34.1% and highly active 31.7%. Finally, the fourth-year students physical activity level showed that majority of students were moderately active (40.9%), while 30.4% were highly active and 22.7% were physically low active.

Body Mass Index:
Regarding the BMI category, a descriptive frequency statistic was also used to determine the percentage of BMI category for the participants. Hence, the data shows that most of the participants were categorized as having healthy BMI (56%), while 17.5% were underweight, 21% were overweight and 5.5% were categorized as Obese (Figure 2).a descriptive frequency statistic was also used to present percentages of BMI categories for each school year.

Starting with second year physical therapy students, the BMI data shows thatthe majority of second year students were categorized as healthy (56%), while 18% were underweight, 19% were overweight and only 7% were categorized as obese. Regarding the third-year students, BMI resultsalso shows that the majority of third year students were categorized as healthy (56%), whereas 22% were underweight, 20% were overweight and 2% were obese.At last,BMI resultsof fourth-year students shows similar results as the majority of students were categorized as healthy (56%), while 14% were underweight, 24% were overweight and only 6% were categorized as obese.

Barriers to PA:
The data shows that the most reported barriers to PA were the bad weather (90%), lack of time (83%), lack of female gyms (57%) and costs of gyms (63%). Moreover, several barriers were reported to be a major reason to be physically low active such as lack of education (30%), not a lifestyle or priority (43%), conservative clothes for female (25%), lack of access to resources (43%), urbanization (22%). The other barriers were less reported by the study participants such as previous experience (10%), transport (9%), availability of training partner (14%), limited knowledge of the importance of PA (5%) and personality (11%).

Discussion:-
The present study aimed to evaluate PA levels of undergraduate physiotherapy students at Umm Al- Qura University in Saudi Arabia using the IPAQ questionnaire. The results showed that the majority of the students (78%) were either moderately or highly physically active, while only 22% were physically low active. These results are encouraging and suggest that physiotherapy students at Umm Al-Qura University are aware of the importance of PA and are likely to be engaged in physical activity as a part of their daily routine **.**

Comparing our study results with previous studies, a study conducted among health care professionals found a prevalence of physical inactivity of 34.8%, which is relatively higher than the prevalence found in our study[39]. On the other hand, the highest prevalence of physical inactivity was reported among the public, which was 65.2%, which is significantly higher than the prevalence found in our study[39]. These findings suggest that physiotherapy students at Umm Al- Qura University have a better level of PA than the public and healthcare professionals.

Another study conducted among adult people in Saudi Arabia reported similar findings regarding PA levels[35]. The study used the IPAQ questionnaire to assess PA levels among adult people in Saudi Arabia and found that 59.4% of the participants were either moderately or highly physically active, while 40.6% were physically inactive. Although the prevalence of physical inactivity was higher in the study compared to the present study, both studies suggest that a significant proportion of adult people in Saudi Arabia are physically inactive. The findings highlight the need for interventions to promote PA and healthy lifestyle behaviors among adult people in the region.Moreover, the present

study found difference in PA levels between male and female students, which is consistent with previous studies[40,41]. However, the current study found that male students had a significantly higher BMI than female students, which is also consistent with previous studies[13,40]. These findingshighlight the importance of promoting healthy lifestyle behaviors among female students, including PA, healthy diet among male students.

The present study analyzed PA levels based on the school year, and the results showed that the percentage of physically active students was similar across all three years of the program. However, the percentage of low PA level was higher in the third year compared to the second and fourth years students. This finding suggests that there may be a need for interventions to promote physical activity among third-year students to maintain their physical activity levels .The current study also analyzed the BMI of the students and found that the majority of the students had a healthy BMI, while a small percentage of students were underweight, overweight, or obese. These findings are consistent with previous studies that have shown a high prevalence of overweight and obesity among university students[40]. Therefore, it is important to promote healthy lifestyle behaviors, including PA and healthy eating habits, among university students to prevent overweight and obesity.

Regarding the survey results, the current findings indicate that the most reported barriers were the bad weather, lack of time, lack of female gyms and costs of gyms. These findings are consistent with the previous literature[15,18,25,42], which may indicate that a national strategy is needed to tackle these barriers especially with females, through building more female gyms, reducing the costs of gyms subscription, flexible schedules and education of the importance of PA.

Limitations:
The IPAQ questionnaire used is limited to individual perception, interpretation of the question and recall bias, as it could underestimate [43–45] or overestimate [45–47]PA. additionally, the developed barriers to PA survey may have several limitations as well, in which it may lead to bias by guiding the responses of the participants[48,49].

Conclusion and Implications:-
In conclusion, the study demonstrated that undergraduate students are aware of the importance of PA as most of the studied participants were high to moderately active and are likely to be engaged in PA as a part of their daily routine. However, there is still a need for interventions to promote PA and healthy lifestyle behaviors among low active participants. By increasing their PA levels, physical therapy students can serve as positive role models and better understand the benefits and challenges of PA. Also prioritizing PA, physical therapy students can not onlyimprove their health and well-being, but also better serve their future patients.

Acknowledgment:-

Tables:-
Table 1:- Descriptive statistics of the study participants.

Variable	Total (n= 200) Mean ± SD	Male (n=96) Mean ± SD	Female (n= 104) Mean ± SD
Age (years)	20.89 ± 4.21	21.59 ± 5.98	20.27 ± 1.06
Height (cm)	164.07 ± 9.18	171.02 ± 7.32	157.92 ± 5.54
Weight (kg)	61.96 ± 16.33	71.63 ± 16.27	53.38 ± 10.63
BMI (%)	22.80 ± 4.66	24.45 ± 5.06	21.34 ± 3.73

Table 2:- Independent t-test results comparing between male and female students.

Variable	Male Mean ± SD	Female Mean ± SD	Sig (P > .05)
BMI	24.45±5.06	21.34±3.73	0.000
Physical activity (total Mets per week)	2235.10±2089.60	1980.21±1709.92	0.344

Table 3:- one way ANOVA results comparing between students based on school-year.

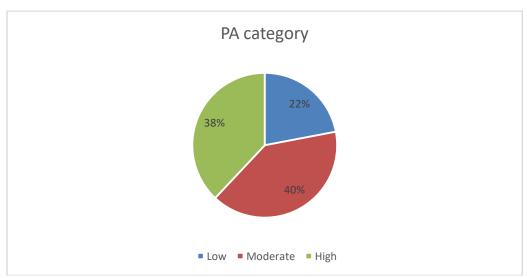| Variable	F	Sig (P > .05)
BMI	.70	.500
Physical activity (total Mets per week)	.91	.403

Figures:

Figure 1:- Physical activity level of undergraduate physical therapy students.
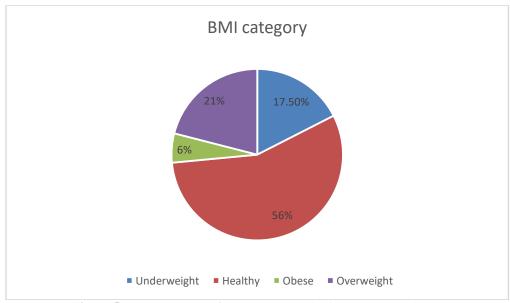

Figure 5:- BMI category of undergraduate physical therapy students.

Reference List:-

1.   Eckstrom E, Neukam S, Kalin L, Wright J. Physical Activity and Healthy Aging. Clin Geriatr Med. 2020;36(4):671-683. doi:10.1016/j.cger.2020.06.009
2.   National Health Service UK. Physical Activity Guidelines for Older Adults.; 2019. https://www.nhs.uk/live-well/exercise/physical-activity-guidelines-older-adults/
3.   American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 9th ed. Lippincott Williams & Wilkins.; 2017.

4.   Myers J, McAuley P, Lavie CJ, Despres JP, Arena R, Kokkinos P. Physical Activity and Cardiorespiratory Fitness as Major Markers of Cardiovascular Risk: Their Independent and Interwoven Importance to Health Status. Prog Cardiovasc Dis. Published online 2015. doi:10.1016/j.pcad.2014.09.011

5.   Kamada M, Kitayuguchi J, Lee IM, et al. Relationship Between Physical Activity and Chronic Musculoskeletal Pain Among Community-Dwelling Japanese Adults. J Epidemiol. 2014;24(6):474-483. doi:10.2188/jea.JE20140025

6.   Lee IM, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. Lancet. Published online 2012. doi:10.1016/S0140-6736(12)61031-9

7.   WHO WHO. Physical activity.

8.   General Authority for Statistics. Housing Survey.; 2015. https://www.stats.gov.sa/sites/default/files/ar-g-serv-2015-makkah.pdf

9.   Al-Nozha MM, Al-Hazzaa HM, Arafah MR, et al. Prevalence of physical activity and inactivity among Saudis aged 30-70 years: A population-based cross-sectional study. Saudi Med J. Published online 2007. doi:20060992' [pii]

10.   Sisson SB, Katzmarzyk PT. International prevalence of physical activity in youth and adults. Obes Rev. Published online 2008. doi:10.1111/j.1467-789X.2008.00506.x

11.   Alqahtani BA, Alenazi AM, Alhowimel AS, Elnaggar RK. The descriptive pattern of physical activity in Saudi Arabia: analysis of national survey data. Int Health. Published online 2020:1-8. doi:10.1093/inthealth/ihaa027

12.   World Health Organization. Saudi Arabia Diabetes Country Profiles.; 2016.

13.   Al Salim ZA. Barriers to Physical Activity Participation Among University Students in Saudi Arabia. Inf Sci Lett. 2023;12(1):353-360. doi:10.18576/isl/120130

14.   Chen W, Hammond-Bennett A, Hypnar A, Mason S. Health-related physical fitness and physical activity in elementary school students. BMC Public Health. Published online 2018. doi:10.1186/s12889-018-5107-4

15.   Al-hazzaa HM. Physical inactivity in Saudi Arabia revisited: A systematic review of inactivity prevalence and perceived barriers to active living. IJHS J. 2018;12(6).

16.   Deyab A, Abdelrahim SA, Almazyad I, Alsakran A, Almotiri R, Aldossari F. Physical inactivity among university students, Saudi Arabia. Int J Curr Res Med Sci. 2019;5(9):1-7. doi:10.22192/ijcrms.2019.05.09.001

17.   Abdel-Salam D, Abdel-Khalek E. Pattern and Barriers of Physical Activity among Medical Students of Al-Jouf University, Saudi Arabia. J High Inst Public Heal. 2016;46(2):41-48. doi:10.21608/jhiph.2016.20080

18.   Aljehani N, Razee H, Ritchie J, Valenzuela T, Bunde-Birouste A, Alkhaldi G. Exploring Female University Students' Participation in Physical Activity in Saudi Arabia: A Mixed-Methods Study. Front Public Heal. 2022;10(March):1-15. doi:10.3389/fpubh.2022.829296

19.   Alkhateeb SA, Alkhameesi NF, Lamfon GN, et al. Pattern of physical exercise practice among university students in the Kingdom of Saudi Arabia (before beginning and during college): A cross-sectional study. BMC Public Health. 2019;19(1):1-7. doi:10.1186/s12889-019-8093-2

20.   Al-Hazzaa HM. Physical inactivity in Saudi Arabia revisited: A systematic review of inactivity prevalence and perceived barriers to active living. Int J Health Sci (Qassim). 2018;12(6):50-64. http://www.ncbi.nlm.nih.gov/pubmed/30534044%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC6257875

21.   Correa VC, Lugo-Agudelo LH, Aguirre-Acevedo DC, et al. Individual, health system, and contextual barriers and facilitators for the implementation of clinical practice guidelines: A systematic metareview. Heal Res Policy Syst. Published online 2020. doi:10.1186/s12961-020-00588-8

22.   Amin TT, Suleman W, Ali A, Gamal A, Wehedy A Al. Pattern, Prevalence, and perceived personal barriers toward physical activity among adult Saudis in Al-Hassa, KSA. J Phys Act Heal. 2011;8(6):775-784. doi:10.1123/jpah.8.6.775

23.   Alqahtani AS, Baattaiah BA, Alharbi MD, Khan F, Aldhahi MI. Barriers and facilitators affecting physical activity among adults in Saudi Arabia during COVID-19 quarantine. Health Promot Int. Published online 2021:1-13. doi:10.1093/heapro/daab191

24.   Almaqhawi A. Perceived barriers and facilitators of physical activity among Saudi Arabian females living in the East Midlands. J Taibah Univ Med Sci. 2022;17(3):384-391. doi:10.1016/j.jtumed.2021.11.002

25.   Subahi M. An Evaluation of Physical Fitness and Physical Activity to Support Therapeutic Exercise Prescription for Individuals with Knee Osteoarthritis in Saudi Arabia: A Mixed-Methods Study. Cardiff University; 2021.

26.   Al-Eisa ES, Al-Sobayel HI. Physical activity and health beliefs among saudi women. J Nutr Metab. 2012;2012. doi:10.1155/2012/642187

27.   Al-Hazzaa HM, Al-Nakeeb Y, Duncan MJ, et al. A cross-cultural comparison of health behaviors between Saudi and British adolescents living in urban areas: Gender by country analyses. Int J Environ Res Public Health. 2013;10(12):6701-6720. doi:10.3390/ijerph10126701

28.   Mehta SP, Jarvis A, Standifer D, Warnimont C. International physical activity questionnaire. Crit Rev Phys Rehabil Med. 2018;30(2):125-127. doi:10.1615/CritRevPhysRehabilMed.2018026180

29.   International Physical Activity Questionniare Group. International physical activity questionnaire short last 7 days self-administered format for use with young and middle aged adults. Res Q Exerc Sport. 2002;71(August):3. www.ipaq.ki.se

30.   Tomioka K, Iwamoto J, Saeki K, Okamoto N. Reliability and validity of the international physical activity questionnaire (IPAQ) in elderly adults: The Fujiwara-kyo study. J Epidemiol. Published online 2011. doi:10.2188/jea.JE20110003

31.   Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-Country reliability and validity. Med Sci Sports Exerc. 2003;35(8):1381-1395. doi:10.1249/01.MSS.0000078924.61453.FB

32.   Oyeyemi AL, Oyeyemi AY, Adegoke BO, et al. The short international physical activity questionnaire: Cross-cultural adaptation, validation and reliability of the Hausa language version in Nigeria. BMC Med Res Methodol. Published online 2011. doi:10.1186/1471-2288-11-156

33.   the International Physical Activity Questionnaire (IPAQ). Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) – Short and Long Forms. Ipaq. Published online 2005.

34.   Alfadhel SA, Vennu V, Alnahdi AH, et al. Cross-cultural adaptation and validation of the Saudi Arabic version of the Knee Injury and Osteoarthritis Outcome Score (KOOS). Rheumatol Int. 2018;38(8):1547-1555. doi:10.1007/s00296-018-4072-7

35.   Al-Hazzaa HM. Health-enhancing physical activity among Saudi adults using the International Physical Activity Questionnaire (IPAQ). Public Health Nutr. 2007;10(1):59-64. doi:10.1017/S1368980007184299

36.   Wells JCK, Fewtrell MS. Measuring body composition. Arch Dis Child. 2006;91(7):612-617. doi:10.1136/adc.2005.085522

37.   World Health Organization. International Classification of Functioning, Disability and Health (ICF). Published 2001. Accessed January 9, 2021. https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health

38.   Michie S, Atkins L, West R. The Behaviour Change Wheel. A Guid to Des Interv 1st ed Gt Britain Silverback Publ. Published online 2014.

39.   Banday A, Want F, Alris F, Alrayes M, Alenzi M. A Cross-sectional Study on the Prevalence of Physical Activity Among Primary Health Care Physicians in Aljouf Region of Saudi Arabia. Mater Socio Medica. 2015;27(4):263. doi:10.5455/msm.2015.27.263-266

40.   Al-Rethaiaa AS, Fahmy AEA, Al-Shwaiyat NM. Obesity and eating habits among college students in Saudi Arabia: A cross sectional study. Nutr J. 2010;9(1):1-10. doi:10.1186/1475-2891-9-39

41.   Michie S. Eating and physical activity behaviours: a framework for interventions. Ucl. 2012;(June). https://www.nutrition.org.uk/attachments/656_9. Prof Susan Michie_Eating and physical activity behaviours.pdf

42.   Squires A. Methodological challenges in cross-language qualitative research: A research review. Int J Nurs Stud. Published online 2009. doi:10.1016/j.ijnurstu.2008.08.006

43.   Rush EC, Valencia ME, Plank LD. Validation of a 7-day physical activity diary against doubly-labelled water. Ann Hum Biol. Published online 2008. doi:10.1080/03014460802089825

44.   Maddison R, Ni Mhurchu C, Jiang Y, et al. International physical activity questionnaire (IPAQ) and New Zealand physical activity questionnaire (NZPAQ): A doubly labelled water validation. Int J Behav Nutr Phys Act. Published online 2007. doi:10.1186/1479-5868-4-62

45.   Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. Int J Behav Nutr Phys Act. Published online 2008. doi:10.1186/1479-5868-5-56

46.   Koebnick C, Wagner K, Thielecke F, et al. Validation of a simplified physical activity record by doubly labeled water technique. Int J Obes. Published online 2005. doi:10.1038/sj.ijo.0802882

47.   Mahabir S, Baer DJ, Giffen C, et al. Comparison of energy expenditure estimates from 4 physical activity questionnaires with doubly labeled water estimates in postmenopausal women. Am J Clin Nutr. Published online 2006. doi:10.1093/ajcn/84.1.230

48.   Yan T. Consequences of asking sensitive questions in surveys. Annu Rev Stat Its Appl. 2021;8:109-127. doi:10.1146/annurev-statistics-040720-033353

49.   Story DA, Tait AR. Survey Research. Anesthesiology. 2019;130(2):192-202. doi:10.1097/ALN.0000000000002436.