

Assessing the Estimated Total Daily Energy Expenditure and Related Physiological Variables of Wolaita Sodo University 2nd Year Sport Science Students

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Abstract: The purpose of this research was to assess the estimated total daily energy expenditure and related physiological variables of Wolaita Sodo University 2nd year sport science students. To achieve this purpose a total of 40 students (20 male and 20 female) were selected as sample size by using stratified sampling technique. The stratification is based on gender. Even though 40 participant students were selected as study subjects, full data was only obtained from 30 (15 male and 15 female) students. Descriptive research design is used to achieve the purpose of the study. The variables which were part of this study were anthropometric measurements, exercise heart rate, contact hour per week, average time spent harder than normal breathing and certain selected physiological variables (BMI, BMR, TDEE, MHR and RHR) related to the study. It was found that the selected participants had a mean age \pm SD and height of 20.80 ± 0.86 , 20.47 ± 0.52 $1.67 \pm 0.08m$ and $1.58\pm 0.04m$ for males and females respectively. Again the mean \pm SD score of their weight before one year and current weight was $59\pm 7.45kg$ and $57.67\pm 7.98kg$ irrespective of their gender. The mean body mass index \pm SD, basal metabolic rate, total daily energy expenditure, maximum heart rate and resting heart rate for males were 22.00 ± 2.65 , 1597.47 ± 139.12 , 2555.67 ± 222.71 , 193.13 ± 0.74 and 67.73 ± 10.33 respectively. On the contrary the mean body mass index \pm SD, basal metabolic rate, total daily energy expenditure, maximum heart rate and resting heart rate for females were 21.40 ± 1.53 , 1344.60 ± 50.34 , 2151.47 ± 80.55 , 193.53 ± 0.52 and 74.40 ± 9.01 respectively. The results obtained in this study proved that there was significant difference in the weight of participants before one year and their current weight. It also showed that participant students are expending a large amount of energy daily through exercise which forces them to feel tired at the end of each practical courses.

Key words: Total daily energy expenditure and Physiological variables

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I. Introduction

The energy that human body requires to maintain its organic and vital functions is obtained by the oxidation of macronutrients from foods. Total energy expenditure (TEE) can be split in three components: maintenance or resting energy expenditure (REE); energy expenditure for the processing of ingested food or diet-induced energy expenditure (DEE); and activity-induced energy expenditure (AEE). Food intake affects energy expenditure through effects on all three components of TEE. A change in food intake affects energy expenditure primarily through its effect on DEE, where DEE is about 10% of the total amount of energy ingested for an average diet as mentioned above. Thus, increasing intake increases TEE through an increase in DEE and vice versa. In addition, food intake affects REE and AEE as a function of energy balance where effects of overfeeding are different from energy restriction (Westerterp, 2016).

There are several methods for estimating TDEE such as indirect calorimetry (IC) and direct calorimetry (DC), bioelectrical impedance (BIA), doubly labeled water (DLW), predictive equations, and others. Most of these methods have been widely used in human studies for different clinical applications. Indirect calorimetry and doubly labeled water are considered more accurate methods, but expensive. On the other hand, even though other methods present limitations, they are convenient and less expensive, and can be used with some caution (Pinheiro *et al*, 2011). Here in this research the researcher is decided to use the Harris Benedict Equation for BMR and multiply it with physical activity factor depending on the intensity of exercise that students are doing per week to estimate the total daily energy expenditure of students in the specified university and department. It is commonly accepted that sport science students at university level expend relatively high levels of energy daily in the form of exercise primarily through the requirements of academic achievement as there are a lot of practical courses they undertake.

There is little research or no research work done on measuring energy expenditure of sport science students at university level in Ethiopia and that is why the researcher is intended to conduct this research as a means to close this gap. Thus the main objective of this research study was to assess the estimated total daily energy expenditure and related physiological variables of Wolaita Sodo University 2nd year sport science students. The specific objectives were to assess the estimated energy expenditure and related physiological variables, to assess the level of energy expenditure and to provide possible recommendation for the curriculum reviewing committee as a feedback to improve the course breakdown per semester.

II. Materials And Methods

The Study Design

This study used descriptive research design method as a means to assess the energy expenditure and related physiological variables of 2nd year Wolaita Sodo University sport science students. The physiological variables discussed and described are exercise heart rate, resting heart rate, BMR, MHR and THR. These physiological variables will be used in one way or another to calculate TDEE of individual participant students by using Harris Benedict Equation.

Sample Size and Sampling Techniques

From a total population of 58 students the researcher took 40 students (20 male and 20 female) as sample size by using stratified sampling technique. The stratification is based on gender. The need for stratification is that the calculation of energy expenditure is usually considering gender and the amount of energy expended daily is different by gender. So analysis should be done for male and female separately and in order to get equal number of participants in each gender stratified sampling technique is the best and of course it is followed by simple random sampling technique. Even though 40 (20 male and 20 female) participant students were selected as study subjects, full data was only obtained from 30 (15 male and 15 female) students. The rest 10 students did not completed the data collection procedure due to personal reasons and were cancelled as study subject. So data of 30 (15 male and 15 female) students were subject to data analysis.

Methods of Data Analysis

The statistical analysis was performed with IBM SPSS Statistics version 25. Analysis consisted of descriptive statistics to express the results in terms of frequency, percentage and mean \pm standard deviation were done. Independent t-test for exercise heart rate and physiological variables were also performed to clearly observe the significance difference if any exists between the two genders. Paired sampled t-test is done only for one variable i.e. for weight to compare if there is a significance difference between weight before one year and current weight of the participants due to exercise. A P -value < 0.05 was seen as significant.

III. Result and Discussion

Table 1: Demographic and anthropometric characteristics of the study participants

Variables	Males [n=15]	Female [n=15]	P-value
Gender: No (%)	15(50%)	15(50%)	
Age: Mean \pm SD	20.80 \pm 0.86	20.47 \pm 0.52	.209
Height: Mean \pm SD	1.67 \pm 0.08	1.58 \pm 0.04	.001
Weight before one year: Mean \pm SD [N=30]	59 \pm 7.45		.030
Current weight: Mean \pm SD [N=30]	57.67 \pm 7.98		

As depicted in the above table 1, concerning the demographic characteristics of the study participants, 15(50%) of them were males and the rest 15(50%) were females. In addition the mean age \pm SD of the study participants were 20.80 \pm 0.86 and 20.47 \pm 0.52 for males and females respectively. This indicates that equal number of students in terms of gender were participants of this study which can assure that the results of the study cannot be influenced by gender. Concerning their age there is no statistical difference between males and females ($p > .05$). This is the fact that students are at the same educational level and their age is also tending become the same.

Concerning their anthropometric measurement the mean height \pm SD score of the participants were 1.67 \pm 0.08m, 1.58 \pm 0.04m for males and females respectively. Again the mean \pm SD score of their weight before one year and current weight was 59 \pm 7.45kg and 57.67 \pm 7.98kg respectively for both genders cumulatively. Generally males were taller ($p < .05$) than their female counter parts. When we compare their weight before one year with their current weight the result tell us that students were slightly losing their weight ($p < 0.05$) due to the fact that the amount of energy they expend do not match with the amount they are taking in. This is in line with the findings of J. Ellis *etal* (2012 who found out that energy intake was significantly lower than energy expenditure in university students. This scenario would be even worse in the case of sport science students as they are always doing exercise due to the course nature.

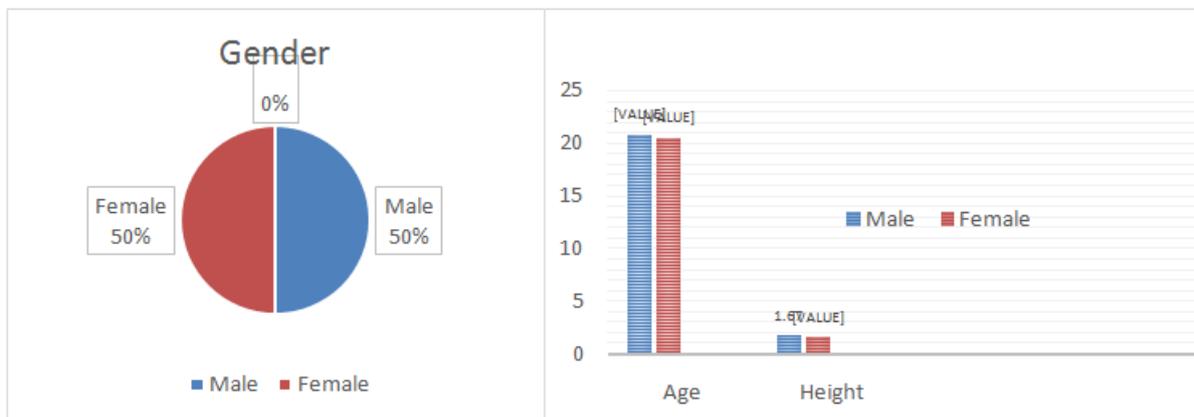


Figure 1: Gender and anthropometric characteristics of participants

Table 2: Contact hour per week for each of the four practical courses

Courses	Males and Female [n=30]: Mean±SD
Apparatus Gymnastics	2.00±0.00
Racket Game	2.00±0.00
Basket Ball	2.00±0.00
Hand Ball	2.00±0.00

The above table 2 is describing about contact hour per week of the participant students for each of the four practical courses and as it can be seen students were having a 2 times contact per week for a single course and totally they had 8 training per week for all of the above four practical courses in which they spend a minimum of one hour per contact per course. This tells us how sport science students are expending energy through exercise in each of the days and this energy should have to be replaced by eating a balanced food. Unfortunately sport science students in the specified university were not getting special treatment in terms of food. They were treated in the same manner with other department students irrespective of how much energy they are spending per week which may lead to negative energy balance.

Table 3: Feeling After Practical Class

Alternatives	Males and Female [n=30]: Frequency	Percentage
Happy	3	10
Tired	24	80
Energetic	3	10
No change	-	-
Total	30	100

As described in the above table 3, participant students were asked to tell about the feeling they experience after each of the practical classes and accordingly 3(10%) of them said they are happy and 24(80%) of them replied that they feel tired while the rest 3(10%) of them said they feel energetic. From this we can conclude that the majority of the students were feeling tired after practical class which strengthens the idea that they are expending large amount of energy through exercise and this energy should be replaced immediately by eating a proper amount of food in terms of quality and quantity.

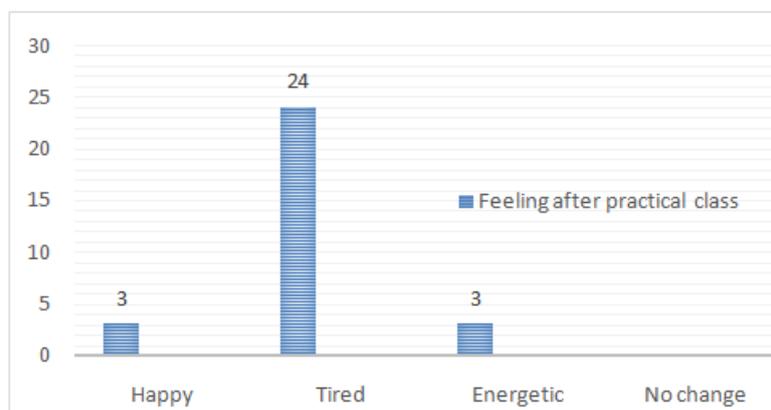


Figure 2: Feeling after practical class of participants

Table 4: Average time spent harder per class for each of the four practical courses

Courses		Alternatives				Total
		<10min.	11-20min.	21-30min.	>30min.	
Apparatus Gymnastics	No (%)	3(10)	12(40)	10(33)	5(17)	30(100)
Racket Game	No (%)	1(3)	11(37)	10(33)	8(27)	30(100)
Basketball	No (%)	-(-)	5(17)	16(53)	9(30)	30(100)
Handball	No (%)	-(-)	3(10)	6(20)	21(70)	30(100)

The estimated average time spent by participant students in a level higher than normal breathing is depicted in the above table 4 and accordingly 3(10%), 12(40%), 10(33%) and 5(17%) of the participants were spending <10min., 11-20min., 21-30min. and >30min. respectively in apparatus gymnastics practical class while 1(3%), 11(37), 10(33%) and 8(27%) of the student participants spent <10min., 11-20min., 21-30min. and >30min. respectively in Racket Game. On the other hand 5(17%), 16(53%) and 9(30%) student participants in Basketball and 3(10%), 6(20%) and 21(70%) participants in Handball spent 11-20min., 21-30min. and >30min. respectively. Generally majority of participant students are participating in exercise that bring their breathing rate above normal for about 20minute and above per session per practical course and when we are comparing the courses this situation is even more in basketball and handball. The reason for this is that these two practical courses are given in field setting and students are expected to cover and move a large surface area which forces them to breathe more and off course makes them to expend more energy. It's from this phenomena and the above analyzed data that the researcher is convinced to estimate the intensity of exercise as at least medium and label PA (physical activity factor) for the calculation of TDEE (total daily energy expenditure).

Table 5: Average exercise heart rate for each of the four practical courses

Courses	Males [n=15]; Mean±SD	Female [n=15]; Mean±SD	P-value
Apparatus Gymnastics	94.27±14.99	100.60±7.37	.153
Racket Game	92.27±9.67	103.07±18.68	.057
Basketball	126.80±16.68	135.13±18.96	.212
Handball	130.13±20.96	123.20±29.40	.463

Table 5 is all about describing the average exercise heart rate of study participants in each of the four practical courses. Thus the mean exercise heart rate ±SD for males were 94.27±14.99bpm, 92.27±9.67bpm, 126.80±16.68bpm and 130.13±20.96bpm in apparatus gymnastics, racket game, basketball and handball respectively. On the other hand the mean exercise heart rate ±SD for females were 100.60±7.37bpm, 103.07±18.68bpm, 135.13±18.96bpm and 123.20±29.40bpm in apparatus gymnastics, racket game, basketball and handball respectively. The Levene's Test for Equality of Variances was also done to find out whether a difference in exercise heart rate exists or not between male and female participants and accordingly there is no statistical difference between male and female in each of the four practical courses in terms of exercise heart rate because of P>0.05.

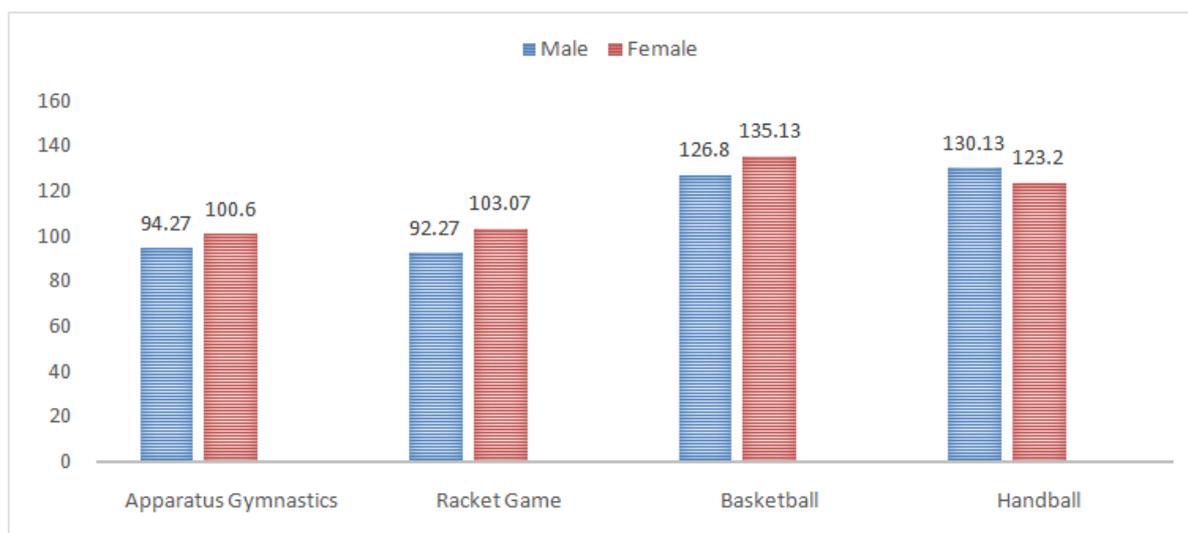


Figure 3: Average exercise heart rate of participants for each practical courses

Table 6: Physiological variables of the participants

Variables	Males [n=15]; Mean±SD	Female [n=15];Mean±SD	P-value
BMI	22.00±2.65	21.40±1.53	.454
BMR	1597.47±139.12	1344.60±50.34	.000
TDEE	2555.67±222.71	2151.47±80.55	.000
MHR	193.13±0.74	193.53±0.52	.098
RHR	67.73±10.33	74.40±9.01	.070

As shown in the above table 6, the mean body mass index ±SD, basal metabolic rate, total daily energy expenditure, maximum heart rate and resting heart rate for males were 22.00±2.65, 1597.47±139.12, 2555.67±222.71, 193.13±0.74 and 67.73±10.33 respectively. On the contrary the mean body mass index ±SD, basal metabolic rate, total daily energy expenditure, maximum heart rate and resting heart rate for females were 21.40±1.53, 1344.60±50.34, 2151.47±80.55, 193.53±0.52 and 74.40±9.01 respectively. Based on the Levene's Test for Equality of Variances there is no statistical difference (P>0.05) between males and females with regard to body mass index, maximum heart rate and resting heart rate. On the other hand males had higher BMR and TDEE (P<0.05) than their female counterparts.

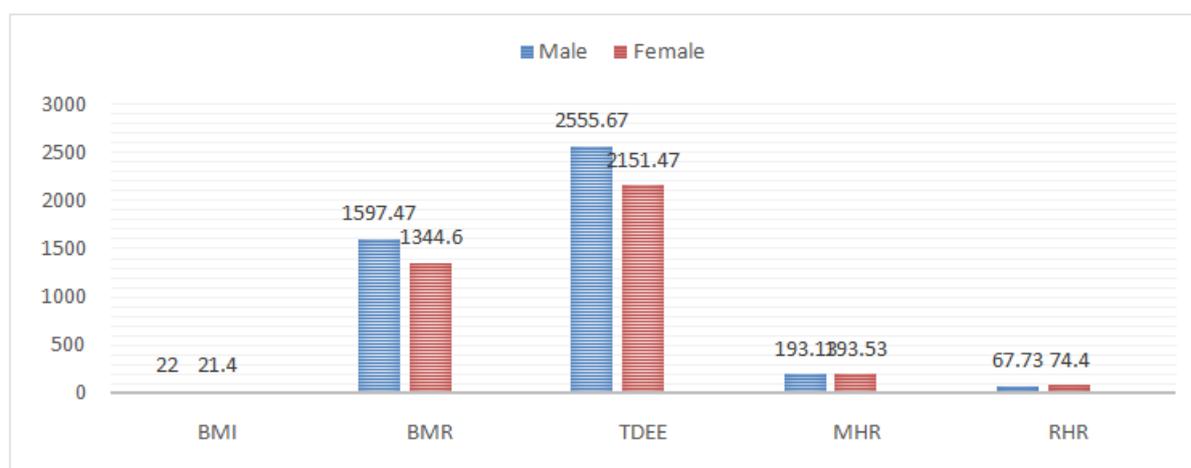


Figure 4: Physiological variables of the participants

IV. Conclusion

Within the limitations and delimitations of the study, the following conclusions were drawn:

- Concerning their age there is no statistical difference between males and females (p>.05).
- Males were taller (p<.05) than their female counterparts.
- The result tells us that students were slightly losing their weight (p<0.05) due to the fact that the amount of energy they expend does not match with the amount they are taking in.
- Students were having a 2 times contact per week for a single course and totally they had 8 training times per week for all of four practical courses
- The majority 24(80%) of the students were feeling tired after practical class
- The majority of participant students are participating in exercise that brings their breathing rate above normal for about 20 minutes and above per session per practical course and this situation is even more in basketball and handball
- There is no statistical difference between male and female in each of the four practical courses in terms of exercise heart rate because of P>0.05.
- There is no statistical difference (P>0.05) between males and females with regard to body mass index, maximum heart rate and resting heart rate but males had higher BMR and TDEE (P<0.05) than their female counterparts.

Reference

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