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Original Article

Relationship between somatotype categories and musculoskeletal discomforts among Nigeria school students: A case study of selected secondary schools in Lagos State

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Abstract

BACKGROUND AND AIM: Dimethyl There are rare study on the impact of somatotype on musculoskeletal discomfort in young and adolescence students. This aim of this study was to investigate the association between musculoskeletal discomforts and somatotype (body form) of students in secondary schools.

METHOD: A cross sectional study of total sample size of 640 students from age 10 to17 was taken across privately operated schools and government operated schools, and were categorised into age group of 10-11, 12-13, 14-15 and 16-17. Anthropometry data of the students was collected using International Society for Anthropometric Analysis of Kinanthropometry (ISAK) model and Musculoskeletal discomfort (pain) level was taking using Numeric Rating Scale for Pain (NRPS) which ranges from No Pain to Severe Pain. The student's somatotype category was determined using the Heath Carter method and the frequency for the pain analysed. A Descriptive Statistics and Chi-Square (χ^2) Test Analysis was done between the two categorical variables to ascertain association and it significance. Statistical significant set at $p< \alpha=0.05$.

RESULTS: The results shows variation in frequency of pain outcome for students across age groups and schools, however, in totality the frequency of students that reported no pain is low compared to other categories of pain. There is noticeable difference in the frequency somatotype categories of students in private school and public schools across age groups. The ectomorph in private school is high (117) as compare to public school (97), the mesomorph is 95 and 111 for private school and public school respectively while endomorph is 106 and 114 for both school category. The Pearson Chi-Squared test Analysis shows an association between somatotype categories and pain outcome, and there is statistical significance.

CONCLUSION: Based on the results of the analysis, we therefore conclude that, Somatotype of any category does have association with any form musculoskeletal discomforts being experience by students. Other factors may also be an influence to the discomforts either internal or environmental.

Keywords:
Somatotype, Musculoskeletal Discomfort, Anthropometry, Secondary Schools

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INTRODUCTION

Various factors has been contributing to the musculoskeletal discomforts (pains) in young and adolescence individuals. Musculoskeletal pain can be defined as the consequences of repetitive exertion, moderate use of the musculoskeletal system, and work-related musculoskeletal disorders (Harithasan *et al.* 2022).

Among the factors considered are individual factors, although the term may mean different things to different practitioners, policy makers, and researchers (Cole and Rivilis, 2004). Musculoskeletal conditions continue to be a substantial setback for public health with studies on this aspect being a subject of interest by many researchers (Ibrahim *et al.* 2015). Consequently, there was a vicious cycle of discomfort, limited daily physical and leisure time activities, and increased stress (*Leirós-Rodríguez et al. 2020*).

Moreover, environmental factors or the non-ergonomic environment, such as prolonged static postures or loading, may cause physical stress, leading to muscle strain, joint imbalance, and soft tissue impairments (*Ekpenyong et al. 2013*). In the educational context, optimizing the organization of work and study environments for both teachers and students is essential for maximizing productivity and minimizing the risk of musculoskeletal

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discomfort (Rudolf and Griffith, 2009). Additionally, it may affect students' academic performance (*Nahit et al. 2003*).

Musculoskeletal Discomfort (pain) can be categorized by the affected tissue, and can include:

Muscle pain: This feel like a deep ache or sharp pains, and can be caused by injuries, overuse, infections, or tumors. Muscle cramps and spasms are common.

Bone pain: This can feel like dull and achy, or sharp and intense if it is a fracture.

Joint pain: This feel like stiffness, aching, soreness, burning, throbbing, or grating. Joint pain can be constant or come and go, and often gets better with rest.

Tendon and ligament pain: This can be caused by strains, sprains, or overuse. Tendons and ligaments are tissue bands that connect bones and joints.

Other types of musculoskeletal pain include: Chest pain and Nerve compression pain.

Musculoskeletal pain can range from mild to severe, and can be short-term or long-term. It is very common, and virtually everyone experiences it at least once in their lives.

The somatotype technique is the most complete methodology to assess the physical characterization of both body morphology and composition. This technique also allows determining the body morphology and composition associated with a specific health condition, sports or aesthetic issues (Khasawneh, 2015). Somatotype refers to the classification of human bodies based on their physical characteristics and composition. This concept, developed by American psychologist William H. Sheldon in the 1940s, identifies three primary body types: ectomorph, mesomorph, and endomorph. Each type has distinct features and tendencies that can influence physical abilities and preferred activities.

However, these past studies come short of highlighting the association between somatotype and musculoskeletal discomforts (pain), with this in focus, the study aim to establish somatotype as one of the significant factor of musculoskeletal discomfort (pain) among young and adolescent students.

MATERIALS AND METHODS

Ethical approval was obtained from CMUL Ethics Committee (CMUL/HREC/06/24/1502) and Lagos State Ministry of Basic and Secondary Education (MB&SE/PPR&S/R&S-EMIS/01/34/VI/300). Informed consent was obtained from all participants, and measures were taken to ensure the confidentiality of collected data.

Study Sample Size

Multistage Sampling Technique was adopted with Simple Random Sampling at each stage. A total of 640 students were analyze from age 10 to 17, further group into four (10-11, 12-13, 14-15, and 16-17) age groups.

Study Design

This study was a cross sectional research among secondary school students in selected Private and Government operated Schools Lagos State, Nigeria.

Instruments and Measurements

Anthropometric dimensions were measured with a portable anthropometer with the exception of the standing height (stature) and weight which was measured with a stadiometer. The instruments is listed below:

- Lufkin Executive Tape: An instrument that measure the circumference of the body in cm.
- SLIMGUIDE® caliper: An instrument that measure the skinfolds of the body in mm.
- Stadiometer: An instrument that measure the body height (cm) and weight (kg) at a time.

The body anthropometry measurements follows the International Society for Anthropometric Analysis of Kinanthropometry (ISAK) recommendation

- Body Height / Stature (cm): The vertical distance from the floor to highest point of the head (vertex).
- Body Weight / Mass (kg): Body mass is the quantity of matter of the body when weighed in a standard gravitational field.
- Triceps Skinfold (mm): The point on the posterior surface of the arm, in the midline, at the level of the Mid-Acromiale-Radiale landmark.
- Subscapular (mm): The site 2cm along a line running laterally and obliquely downwards from the subscapulare landmark at a 45^{o} angle.
- Supraspinale (mm): The point where an imaginary line from the iliospinale to the anterior axillary border intersect with the horizontal line of the superior border of the ilium at the level of the iliocristale.
- Medial Calf Skinfold (mm): The Medial calf skinfold is taken at the Medical calf skinfold site.
- Biepicondylar Humerus Breadth (cm): The distance measured between the medial and lateral epicondyles of the humerus.
- Biepicondylar Femur Breadth (cm): The distance measured between the medial and lateral epicondyles of the femur

- Arm Circumference (cm): The Arm (flexed and tensed) girth (circumference) is the maximum girth of the right upper arm which is raised anteriorly to the horizontal with the forearm flexed at 90° to the upper arm. The measurement is made perpendicular to the long axis of the arm.
- Calf Circumference (cm): The maximum girth of the calf at the level of the Medial calf skinfold site. It is measured perpendicular to the long axis of the leg.
  (Norton, 2018).

The ratios are;

- Body Mass Index (BMI): This the ratio of body mass (kg) over squared of stature (m).

$$\frac{\text{Body mass (kg)}}{[\text{Stature (m)}]^2}$$

- Height Weight Ratio (HWR): This is the ratio of stature (cm) over the cube root of body mass (kg).

$$\frac{\text{Stature (cm)}}{\sqrt[3]{\text{Body mass (kg)}}}$$

The somatotype values were determined using Heath Carter method and it categorization were ectomorph, mesomorph and endomorph. The determination of the categories is stated below:

Endomorph: Relative Fatness

A = triceps + subscapular + supraspinale skinfolds

B= (170.18 / height) (Adjustment coefficient for height)

Adjusted sum X = A.B

Endomorph= - 0.7182 + 0.1451 (X) - 0.00068 (X^2) + 0.0000014 (X^3)

Mesomorph: Muscular

Mesomorph = (0.858 HB + 0.601 FB +0.188 CAG + 0.161 CCG) - (0.131 H) + 4.5

HB: Humerus breadth (cm), FB: Femur breadth (cm), CAG: Arm circumference during flexion – Triceps skinfold /10, CCG: Maximal calf circumference – Calf skinfold /10, H: Height (cm)

Ectomorph: Relative Leanness

Height and weight are calculated in cm and kg, respectively. Height is divided by the cube root of weight to calculate HWR (HWR=height/cube root of weight). Ectomorph is calculated based on HWR value using one of the formulas below:

IF HWR ≥ 40.75, Ectomorph = 0.732× HWR– 28.58

IF 38.25 < HWR < 40.75, Ectomorph = 0.463× HWR– 17.63

IF HWR ≤ 38.25, Ectomorph = 0.1

Pain assessment was done by the researcher and Numerical Rating Scale for Pain (NRPS) was used for rating the intensity. The NRPS is a widely used tool for pain assessment and provides a subjective, measure of pain intensity (Hawker *et al.*, 2011, chen *et al.*, 2018). The rating ranges from zero (No Pain) to ten (Severe Pain), and the frequency was tabulated.

Statistical Analysis

The data analysis was carried out using SPSS v25.0. A Descriptive Analysis and Pearson Chi-Square (χ^2) Test Analysis was carried out between the two categorical variables (Somatotype Category and Pain Outcome) to ascertain the association and statistical significant set at $p< \alpha=0.05$.

RESULTS

Table 1 highlighted the frequency of pain identified by the students. No pain has the higher frequency (25) in age group 10-11at privately operated school (private school), while Mild pain has the highest frequency (27) in same age group at government operated school (public school). While no pain was higher in age group 12-13 for privately operated school (private school), severe pain have the highest frequency in same age group for government operated school (public school). Government operated school (public school) have severe pain as highest frequency in age group 14-15, while mild pain has the highest frequency in same age group for privately operated school (private school). Moderate pain has more frequency in age group 16-17 for both schools.

In Table 2, there are more of ectomorph in age group 10-11 for privately operated school (private school) while there are more of endomorph in same age group for government operated school (public school). While there are more of endomorph in privately operated school (private school) for age group 12-13, there are more of mesomorph in same age group for government operated school (public school). In age group 14-15, there is more endomorph than other category in government operated school (public school), while ectomorph is more than other category in same age group for privately operated school (private school). Ectomorph is more in both privately operated school (private school) and government operated school (public school) at same age group 16-17. In total, while the somatotype varies across age group for privately operated school (private school) with ectomorph being highest, endomorph have the highest in the somatotype category for government operated school (public school) across all age group followed by mesomorph and ectomorph respectively.

Table 3 display the frequency of somatotype categories against the pain outcome of students. The pain outcome varies accordingly for somatotype categories in both schools.

Table 4 show the results of the chi-squared test of the somatotype category and the pain outcome of all students. It is shown from the table that the chi squared test statistics (χ^2 Value) is 15.582, degree of freedom (df) is 6 and the p-value is 0.016.

In **Table 5,** the chi squared test statistics (χ^2 Value) of both private and public school is 14.237 and 9.245, with same degree of freedom (6), and p-value of 0.027 and 0.160 respectively.

Table 1. Frequency of Pain outcome as identified on students based on schools and age group

			Pain Outcome			
Schools	N	Age Group	No Pain	Mild Pain	Moderate Pain	Severe Pain
Private School	318	10 – 11	25	22	17	16
		12 – 13	27	16	25	15
		14 – 15	20	23	18	17
		16 – 17	19	20	21	17
Public School	322	10 – 11	16	27	17	20
		12 – 13	18	17	19	23
		14 – 15	19	20	14	29
		16 – 17	15	21	24	23

Table 2. Frequency of Somatotype Category for students based on schools and age group

			Age Group				
Schools	N	Somatotype Category	10 - 11	12 - 13	14 - 15	16 - 17	Total
Private School	318	Ectomorph	33	24	27	33	117
		Mesomorph	25	29	26	15	95
		Endomorph	22	30	25	29	106
Public School	322	Ectomorph	25	23	20	29	97
		Mesomorph	27	28	28	28	111
		Endomorph	28	26	34	26	114

Table 3. Frequency of Somatotype Category and Pain outcome of students based on schools

			Pain Outcome				
School Category	N	Somatotype Category	No Pain	Mild Pain	Moderate Pain	Severe Pain	Total
Private School	318	Ectomorph	32	24	31	30	117
		Mesomorph	22	25	33	15	95
		Endomorph	37	32	17	20	106
Public School	322	Ectomorph	18	29	20	30	97
		Mesomorph	20	22	30	39	111
		Endomorph	30	34	24	26	114

Table 4. Chi-squared test for Somatotype Categories and Pain Outcome

	χ^2 Value	df	p-value
Somatotype Categories and Pain Outcome	15.582	6	0.016

Table 5. Chi-squared test for Somatotype Categories and Pain Outcome based on schools

		Pearson Chi-Square			
School Category	N		χ^2 Value	df	p-value
Private School	318	Somatotype Categories and Pain Outcome	14.237	6	0.027
Public School	322	Somatotype Categories and Pain Outcome	9.245	6	0.160

DISCUSSION

This study aimed to examine the relationship and association between somatotype and musculoskeletal discomfort (pain) among young and adolescence. The frequency of pain outcome as identified by the researcher on the students and the categorisation of their somatotype after analysis was tabulated. It was discovered from the results that the students majority of the students has complain of discomfort (pain) as assessed by the researcher across schools and age group as shown in Table 1. Generally, there is variation in the frequency of the pain outcome as assessed by the researcher across age groups and school.

Additionally, the somatotype categories of the students was also tabulated based on schools and age groups. In private school, there are relatively more ectomorph students (117) than mesomorph (95) and endomorphs (106) across age group. However, in public school, endomorph is slightly higher (114) than mesomorph (111) in frequency but much higher than ectomorph (97) across age group. This study might document the somatotype categories of secondary schools students in Lagos state in alignment with Leko *et al*. (2023) which also documented the report on the somatotype distribution for children and adolescent in the south-south region of Nigeria with particular reference to children and adolescents in Port-Harcourt. This results as shown in Table 2 point toward the fact that, there is noticeable difference in the body form of students attending private schools and public schools in Lagos State and this may be influenced by various factors.

Furthermore, Pearson Chi-Square Analysis was carried out on the two categorical variables (Somatotype Categories and Pain Outcome) to ascertain it association, the Chi-Square test (χ^2 Value) is 15.582 which is higher than the table value of 12.59 at degree of freedom (df) 6. Also the p-value (0.016) is lesser than α=0.05. Following the decision rule, this study reject the null hypothesis to accept the alternative hypothesis and conclude that there is an association between somatotype and musculoskeletal discomfort (pain) as well as statistical significance. Adopting various health and fitness exercises based on the somatotype categories of the students could help in solving the musculoskeletal discomforts (pain) among students. This aligned with the study of Khasawneh (2015), which revealed that the Endomorph somatotype contributed effectively to constant balance and agility, while Mesomorph and Ectomorph somatotypes contributed effectively to dynamic balance and agility among students.

Investigating further, the Pearson Chi-Square Analysis was deployed for the two categorical variables (Somatotype Categories and Pain Outcome) based on schools, the Chi-Square test (χ^2 Value) is 14.237 and 9.245, p-value of 0.027 and 0.160, and degree of freedom (df) of 6 for both private and public school respectively. Based on the results, the study reject the null hypothesis to accept the alternative hypothesis and conclude that there is an association between somatotype and musculoskeletal discomfort (pain) as well as statistical significance for private schools students and otherwise for public secondary school students.

Conclusion: Based on the results of the analysis, we therefore conclude that, Somatotype of any category does have association with musculoskeletal discomforts (pain) being experience by the students. Other factors may also be an influence or cause of musculoskeletal discomforts (pain) as well. Factors that can internal or environmental. Further studies is recommended to be carried out on these factors.

Conflict of interest

None from the authors

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