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Correlation between Bmi, Spinal Mobility and Core Strength in Young Adolescence

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ABSTRACT
AIM: To find out the correlation between BMI and spinal mobility and its strength in young adult people. **OBJECTIVES:** • To assess correlation between BMI and cervical mobility. • To assess the correlation between BMI and thoracic mobility. • To assess the correlation between BMI and lumbar mobility. • To assess the correlation between BMI and spinal muscles strength Approach of the study: Current practice doesn't recognize the influence of innate, physiological, human asymmetry on postural disorders secondary to spinal mobility. to understand the correlation between bmi and spinal mobility is extremely important because it gives an accurate baseline for understanding predisposing factors for development of postural spinal disorders which likely reach structural dysfunction. PURPOSE: to seem at the prevalence of all adolescent spinal deformities in step with the extent of their severity similarly as their possible association to BMI and body height Impact of bmi over spinal mobility could also be a keystone to progress quality of life . to border musculoskeletal model with relation to bmi , spinal mobility and core strength. Progresses the patient toward functional strength, respiratory competence, and upright alternating reciprocal activity. **MATERIALS AND METHODS:** the knowledge for this study were derived from a university and particular faculty willing subjects. As per the information collection sheet the themes are evaluated , Logistic regression models were accustomed assess the correlation between BMI and spinal mobility. type of study: sampling , study design: A cross-sectional prevalence study,Prospective study design,Demographic data assessment by physical measures,Duration of study: 3 months(12th jul 2021 to 25th oct 2021),Place of study: Krishna institute of bioscience, karad , Study population: Both males and females **OUTCOME MEASURES:** • body mass index classification • spinal mobility measures • measurment of joint motion • classification of core strength **RESULTS:** the study were conducted on 70 subjects .all of them categorize as per the end result measures and evaluate all of them in correlation between BMI and Spinal mobility. The prevalence of spinal deformities was significantly greater among the underweight male and female patients ($p<.001$). Increased BMI had a protective effect for developing spinal deformities. the probabilities ratios for severe spinal deformities were greater compared with mild spinal deformities within the underweight groups. the possibility for developing spinal deformities increased significantly with height for both genders ($p<.001$). **CONCLUSION:** Correlation between BMI and spinal mobility was found . Below normal BMI is related to severity of spinal deformities, whereas above-normal BMI apparently features a protective effect. Body height is additionally positively associated with the severity of spinal deformities.

KEYWORDS: cervical mobility, thoracic mobility, lumbar mobility, spinal muscles strength, BMI-Body Mass Index, Core Muscle

I. INTRODUCTION

Human asymmetry arises from our innate anatomy and physiology and exerts significant influence on human posture and movement. Ideal or neutral posture results from relative musculoskeletal balance of our asymmetrically organized body. Right-side dominance is the functional result of physiological asymmetry.[1]
The movement of the respiratory diaphragm and the pelvic diaphragm (pelvic floor muscles) is synchronized during breathing[1]. The pelvis is a primary structure that facilitates gait. The synergistic activity of these two diaphragms links respiration and gait[5]

Gait requires integrated muscle activity, different on two sides of the body, in order to stay erect on one leg as the other advances the body through space.[6] In the context of human asymmetry, right-side stance phase and left-side swing phase will be most competent.[1]

Biomechanical dysfunction begins in the sagittal plane[12]. This right rotational orientation of the lower spine and pelvis is enhanced by the gravitational shift of the body over the right leg due to the weight of the liver on the right side of the body.[1] In the human body, loss of balanced musculoskeletal function precipitates and reinforces overuse of dominant postures and patterns because of the underlying structural bias toward right stance, influenced by organ placement, weight distribution, and muscle attachment "neutral posture" defines as the stance that is attained when the "joints are not bent and the spine is aligned and not twisted". [21]When the body is in its ideal or neutral alignment, diaphragmatic respiratory mechanics are optimized. Neither of these muscle groups exists in their neutral or rest position, eg. The lumbar paraspinals have shortened and tightened, and the abdominal muscles have become overlengthened and weak[1]

Movement into any direction will require compensation by other muscles or will not be accomplished. Compensatory muscle activity is less efficient, energy demands increase, and stress accumulates on poorly aligned joints.[5]

Respiration is a key component of posture. When the diaphragm is compromised, it not only causes inefficient breathing patterns but also becomes a key contributor to the persistence and progression of postural disorders, including hyper lumbar lordosis, kyphosis, forward head posture, and changes in ribcage symmetry as seen in scoliosis.[6]

The three layers of lateral abdominals: transverse abdominis, internal, and external obliques, taken together, insert cephalically on the costal cartilage of ribs 5–12 and caudally on the ipsilateral iliac crest. These lateral abdominal muscles link the ribcage and pelvis, and they are critical components of posture and respiration.[3]

In altered state, when the diaphragm contracts, it pulls the lumbar spine forward and reinforces anterior ribcage elevation. Having lost efficiency as a respiratory muscle, the diaphragm now functions more as a postural extensor muscle promoting progressive lumbar lordosis.[10]

Humans almost universally exhibit right-dominant postural and movement patterns resulting from physiological asymmetry. Preferential standing on the right leg and increased breathing efficiency of the right hemidiaphragm are major contributors to this fundamental bias. Additionally, 90% of the population is right-handed, a defining characteristic of humans.[1]

Right arm swing, consistent with right reach activity, promotes left trunk rotation to balance lumbar spine and pelvis right orientation, present in right unilateral stance. However, it is important to emphasize that handedness does not define side dominance. Lateral abdominals assist the hamstring's postural activity to maintain a neutral pelvis position. Concurrently, lateral abdominal and hamstring lengths are determined by pelvic position due to their respective pelvic insertions.[3]

II. MATERIALS AND METHODS

1.Subjects

A convenience sample of 70 subjects were recruited for this study (n = 60 females and 10 males). Their ages ranged from 18 to 25 years old. Subjects were excluded if they had any lower limb or back injury that prevented the subject standing for the duration of data collection, any vestibular problems that prevented the subject maintaining normal balance for the duration of data collection or a known allergy to self-adhesive stickers when in contact with the skin. Ethical approval was granted by Krishna institute of physiotherapy , karad.

2. Instrumentation

A. A goniometer is an instrument that measures the available range of motion at a joint. The art and science of measuring the joint ranges in each plane of the joint are called goniometry. If a patient or client is suffering from decreased range of motion in a particular joint, the therapist can use a goniometer to assess what the range of motion is at the initial assessment, and then make sure the intervention is working by using the goniometer in subsequent sessions.

Red Flags

Cervical Myelopathy
Neoplastic Conditions
Upper Cervical Ligamentous Instability
Vertebral Artery Insufficiency
Inflammatory or Systemic Disease
Cervical Fracture

METHODOLOGY

- Type of study: Random sampling
- Study design: A cross-sectional prevalence study.

Prospective study design

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Demographic data assessment by physical measures

- Duration of study:
3 months(12th jul 2021 to 25th oct 2021)
- Place of study: Krishna institute of medical science, karad.
- Sample size N=Z²×pq
d²
- **Study population**: Both males and females

INCLUSION CRITERIA
- YOUNG ADULTS AGE GROUP -18Yr-25Yr
- Male and female
- Underweight , Normal, Obese people
- Medical conditions – DM, HTN,PCOS etc.
- Dominance right or left

EXCLUSION CRITERIA
- Psychologically imbalance adults
- Resent trauma / accidents
- Cardiopulmonary disorders
- Benign and malignant tumor
- Chronic pain / LBP

MATERIALS
- Pen
- Data collection sheet
- Consent form
- Pencil
- Long scale
- Measuring tape
- Weight machine
- Surgical marke
- Yoga mat
- Stool
- Covid precaution measures (sanitizer, Face mask , Disinfectant spray, hand gloves)
- Camera for picture collection

OUTCOME MEASURES:
BODY MASS INDEX CLASSIFICATION BY WHO
SPINAL MOBILITY MEASURES
CLASSIFICATION OF CORE STRENGTH

DEMOGRAPHIC VARIABLES IN THE STUDY

VARIABLES		TOTAL NUMBER OF PARTICIPANTS =71													
BMI	UNDERWEIGHT (15)			NORMAL (30)			OVERWEIGHT (14)			OBESE TYPE 1 (08)			OBESE TYPE 2 (04)		
GRADING	N			N			N			N			N		
CERVICAL MOBILITY	8	7	0	17	11	0	9	6	0	1	7	0	2	2	0
THORACIC MOBILITY	12	3	0	15	13	0	6	8	0	2	6	0	0	4	0
LUMBAR MOBILITY	8	5	2	19	4	5	8	2	5	4	4	0	1	0	3
SPINAL STRENGTH	10	0	5	14	0	14	9	1	5	6	1	1	3	0	1

Correlation between BMI and Cervical mobility

BMI	CERVICAL MOBILITY	
	NORMAL	REDUCE
UNDERWEIGHT	53%	47%
NORMAL	61%	39%

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OVERWEIGHT	60%	40%
TYPE 1 OBESE	13%	88%
TYPE 2 OBESE	50%	50%

CORRELATION BETWEEN BMI AND THORACIC MOBILITY

BMI	THORACIC MOBILITY	
	NORMAL	REDUCE
UNDERWEIGHT	80%	20%
NORMAL	54%	46%
OVERWEIGHT	40%	53%
TYPE 1 OBESE	25%	75%
TYPE 2 OBESE	0%	100%

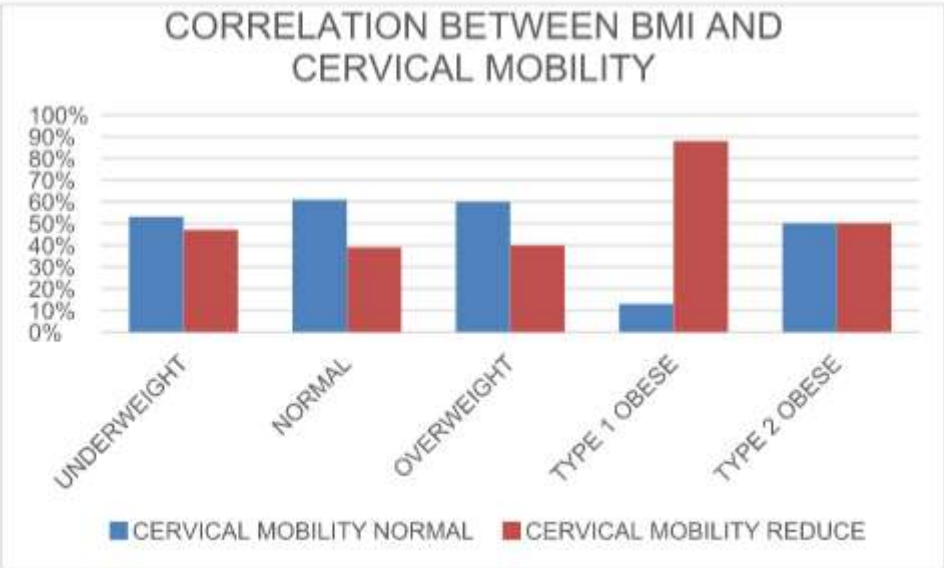
CORRELATION BETWEEN BMI AND LUMBAR MOBILITY

BMI	LUMBAR MOBILITY		
	NORMAL	REDUCE	INCREASE
UNDERWEIGHT	53%	33%	13%
NORMAL	68%	14%	18%
OVERWEIGHT	53%	12%	33%
TYPE 1 OBESE	50%	50%	0%
TYPE 2 OBESE	25%	0%	75%

CORRELATION BETWEEN BMI AND SPINAL STRENGTH

BMI	SPINAL STRENGTH GRADING				
	1	2	3	4	5
UNDERWEIGHT	0	0	67%	33%	0
NORMAL	0	0	50%	32%	18%
OVERWEIGHT	0	17%	60%	27%	7%
TYPE 1 OBESE	0	13%	75%	13%	0
TYPE 2 OBESE	0	0	75%	25%	0

INTERPRITATION



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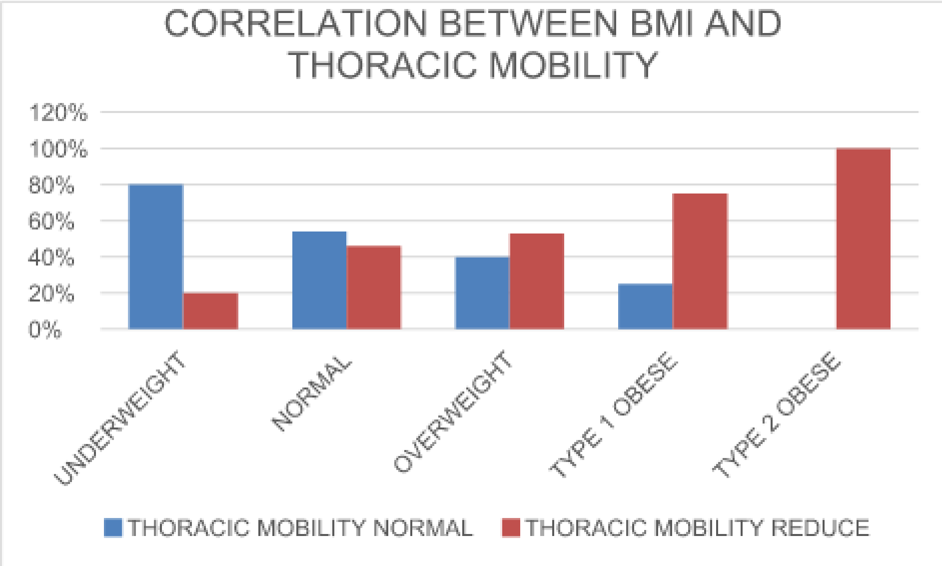
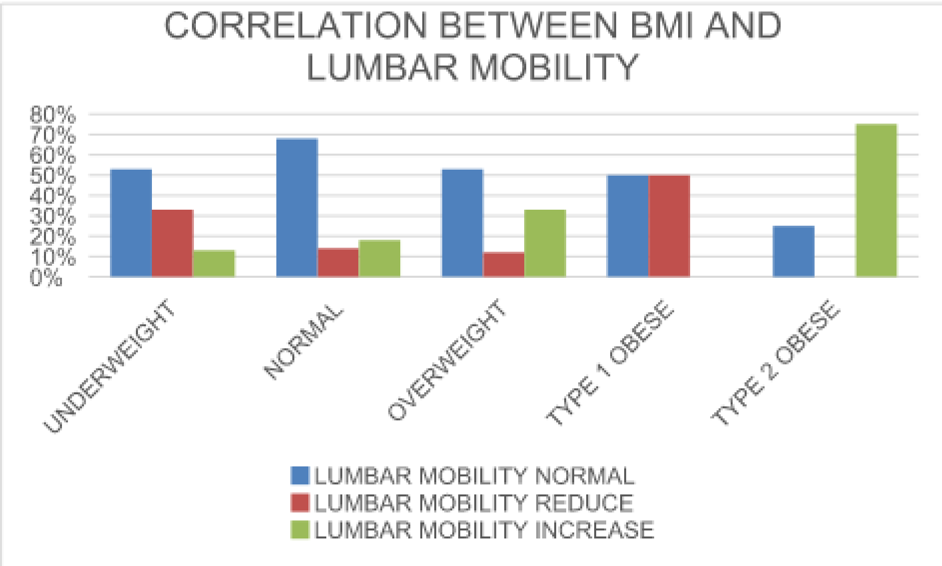
In 53% underweight subjects cervical ROM is normal and 47% subject it is reduce. In normal bmi category 61% subjects cervical range is normal and 39% it is reduce. In 60% overweight subjects cervical range is normal and 88% subjects range is reduce. cervical range is 13% normal in type 1 obese subjects and 88% subjects range is reduce. In type 2 obese category cervical range is normal in 50% subjects and in 50% subjects it is reduce.



In underweight category 53% subjects having normal thoracic mobility and 33%subjects it is reduce and in 13% subjects the mobility is increased. In overweight category 53% subjects having normal thoracic mobility and 12% subjects the mobility is reduce and in 33% subjects thoracic mobility is increase. In normal BMI category 68% subjects having normal thoracic range ,14% subjects range is reduce, in 18% subjects thoracic mobility is increase. In type 1 obese category 25% having normal thoracic range and 75% subjects having reduce range. In type 2 obese category 100% subjects having reduce thoracic mobility.



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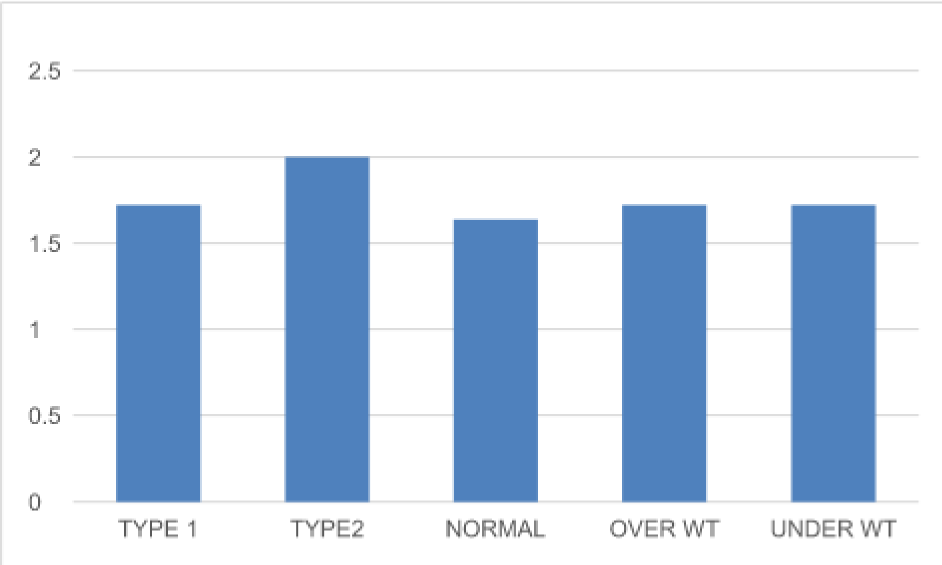
For lumbar mobility , in underweight category 53% subjects having normal range, in 33% subjects lumbar range is reduced and in 13% subjects range is increased. In normal bmi category 68% subjects lumbar range is normal, in 14% subjects lumbar rage is reduce and 18 % subjects range is increased. In overweight category 53% subjects having normal lumbar mobility , the lumbar range is reduce 13% subjects and 33% subjects the lumbar range is increased. In type 1 obese category in 50% subjects lumbar range is normal and 50% subjects range is reduce. In type 2 obese category lumbar range is normal in 25% subjects and in 75% subjects the range is increased.



The core muscle strength is fair in 67% subjects and 33 % subjects strength is good. In normal bmi category, 50% subjects the strength fair and 32% subjects the strength is good and 18% subjects the strength is normal. In overweight category 17% subjects the strength is poor, 60% subjects the strength is fair and 27% subjects strength is good and 7% subjects the core strength is normal. In type 1 obese subjects 13% subjects the strength is poor, 75% subjects the strength is fair and in 13% subjects the strength is good. In type 2 obese category 75% subjects the strength is fair and 25% subjects the strength is good.

PROCEDURE

The data for this study were derived from a medical database containing random younger adults (18yr-25yr) old male and female Logistic regression models were to assess the association between the BMI and body height to various degrees of spinal deformities by severity.

Subjects read the subject information sheet and after consenting to participate their weight and height were evaluated, find out the body mass index of each participants with respect to who classification as mention earlier. Examining the red and yellow flags, assessment of past medical history ,history of present condition & social history done. Then participate were attired so that their back was visible for landmark identification.

Starting with cervical mobility participant ask to sit and erect their spine with eyes on straight line then all measurements were taken by the goniometer with respect to all landmarks and referring a book name Measurement of joint motion by Cynthia c. norkin with 3 yrs. of knowledge and practice.

Moving forward to thoracic spine mobility, special questions are used to identify precautions or absolute contraindications to examination. Then examination of thoracic spine was done as showed in bellow pictures with the help of Orthopedic physical assessment book by David j. Magee. With repetitive practice .

Lumbar assessment starts with triage. Assessing the posture , movement patterns & other

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observations movement testing were done. Palpation skills were learn from the therapeutic exercise book by Carolyn kisner, with practice and 3 years of knowledge.

Total 6 dynamic endurance test were taken on yoga mat ,with the safety measure of subject , each test were guide, if necessary assess the subjects & avoiding the compensatory movements and breath holds while tests.

After completing the demographic data , study were done on each subjects. And discussion were done. And asking to change their activity of daily living and suggesting some modification and medical help as per their end result. And giving them a radar chart to help them to spot their health of spine and to avoid progressive deformity. Providing a biofeedback with help of radar chart which will be one of the tool to assess patients physical function, by physiotherapist.

With respect to covid 19 pandemic, focusing on the health and safety of respected subjects. Based on regional regulations and maintain a 2-meter distance, if necessary .Performing the above test as per all the measures of covid 19

III. STATISTIC ANALYSIS

Arithmetic mean and standard deviation was calculated for each outcome measures.
Arithmetic mean was derived from adding all the values together and dividing the total number of values.

IV. RESULTS

The prevalence of spinal deformities was significantly greater among the underweight male and female patients ($p<.001$). Increased BMI had a protective effect for developing spinal deformities. The odds ratios for severe spinal deformities were greater compared with mild spinal deformities in the underweight groups. The risk for developing spinal deformities increased significantly with height for both genders ($p<.001$).

CONCLUSION

An association between height and the risk for spinal deformities by severity was found for all height groups. Below normal BMI is associated with severity of spinal deformities, whereas above-normal BMI apparently has a protective effect. Body height is also positively associated with the severity of spinal deformities.

V. LIMITATIONS

Subjects were not homogenous.
Inadequate time for study.
There was a small group so there is poor distribution of gender.
Poor geographical area.

VI. SUGGESTIONS AND RECOMMENDATIONS

This study can be further taken up for studies, so that we can properly assess the subjects and find out the correlation between bmi and spinal mobility for further study.
This study can be done on larger population. .
This study can be done on other population than other geographical area.
Adequate time should be given to actually screen the target population.

VII. DISCUSSION

The purpose of the study is to search out correlation between BMI and Spinal mobility and its strength. The total 70 subjects were taken in study between the 18-25 yr age groups. By fulfilling all the inclusion criteria. The range of spinal mobility was measured with the tape method and goniometer, Body mass index classification by who (world health organization) Spinal mobility measures by measurement of joint motion (a guide to goniometry 3rd edition) – cynthia c. Norkin and d. Joyce white,Magee , carolyn kisner . Classification of core strength by orthopedic physical assessment 6th edition – david j. Magee carolyn kisner Result were as follows, there was a correlation between BMI and Spinal mobility. The increase the bmi variable may affect the range of the cervical, thoracic, and lumbar region. The range of flexions , extension, side flexion, rotation ($p<0.073$) Bmi has significant correlation with spinal rang of motion., there results suggest that the rang of BMI are often used as an objective measure for the evaluation of spinal strength. The bmi may vary spinal strength too. To understand the correlation between BMI and spinal mobility is very important because it gives an accurate baseline for understanding predisposing factors for development of postural disorder. With likely achieve structural dysfunction.

VIII. CONCLUSION

The cervical mobility is normal in normal bmi category and reduce in type 1 obese subjects.
The thoracic mobility is normal in underweight subjects and reduce in type 2 obese subjects.

The lumbar mobility is normal in normal bmi category subjects and reduce in underweight subjects and increased in type 2 obese subjects.
In type 1 obese and type 2 obese category the core strength is fair and in underweight subjects core strength is good and in normal bmi category the strength is normal.

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