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Standardization of BMI criterion for the population of Mumbai

Jahnvi Vira*, Shweta Phadke**

Abstract

Introduction: The health risks associated with increasing BMI are continuous and interpretation of BMI grading in relation to risk may differ for different ethnic groups. There is a need for developing different BMI cut-off points for different ethnic groups due to the increasing evidence that the association between BMI, percentage of body fat and body fat distribution differ across populations and therefore, the health risks increases below the cut-off point of 25 kg/m² that defines overweight in the current WHO classification. **Objective:** To standardize the BMI criterion for the population of Mumbai, BMI variation in different age groups and correlation of BMI variation & co morbidities. **Subjects:** The study included apparently healthy 1000 individuals, 500 males and 500 females in the age group of 20-70 years. Terminally ill, pregnant females, mentally and physically challenged individuals were excluded. **Procedure:** The subjects were chosen according to the inclusion and exclusion criteria. Their weight and height were measured, and BMI was calculated. Their medical condition was documented. Sex-specific receiver operating curve was used to assess the sensitivity and specificity of BMI cut off. **Results:** In the age group of 20 – 40 years, 4.3% of the individuals have increased BMI related medical problems whereas in the age group of 41 – 70 years, it is 19.6%. The incidence is significantly high in the people with age 41 and above. The BMI cut off for both the sexes in the age group of 20 – 70 years is 24 kg/m² (specificity = 81.1%, sensitivity = 72%). The BMI cut off for the females is 25kg/m² (specificity = 80%, sensitivity = 80%) and 24kg/m² for the males (specificity = 77.9%, sensitivity = 73%). The BMI cut off for both the sexes in the age group of 20 – 40 years is 25 kg/m² (specificity = 72.2%, sensitivity = 76%). The BMI cut off for the females is 25 kg/m² (specificity = 100%, sensitivity = 69.5%) and same for the males (specificity = 61.5%, sensitivity = 82.5%). The BMI cut off for both the sexes in the age group of 41- 70 years is 24 kg/m² (specificity = 82.5%, sensitivity = 76.6%), the BMI cut off for females is 24kg/m² (specificity = 82%, sensitivity = 84.9%) and same for the males (specificity = 81.3%, sensitivity = 75.3%). **Conclusion:** For the population of Mumbai, the BMI cut off for both the sexes in the age group of 20 – 70 years is 24 kg/m², 25kg/m² for females and 24kg/m² for males. The BMI cut off varies in different age groups. The BMI cut off for both the sexes in the age group of 20 – 40 years is 25 kg/m² (25 kg/m² for females and 25kg/m² for males). The BMI cut off for both the sexes in the age group of 41- 70 years is 24 kg/m² (24kg/m² for females and 24kg/m² for males). A direct correlation of BMI variation and co morbidities is found.

Keywords: Body mass index; Mumbai population, Obesity.

Introduction

According to the WHO, body mass index (BMI) is a simple index of weight-for-height.

The international classification of adult underweight according to BMI given by the WHO is as per the American and the European population.

The health risks associated with increasing BMI are continuous. Interpretation of BMI grading in relation to risk may differ for different ethnic groups. There is a need for developing different BMI cut-off points for different ethnic groups due to the increasing evidence that the association between BMI, percentage of body fat and body fat

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distribution differ across populations and therefore, the health risks increases below the cut-off point of 25 kg/m² that defines overweight in the current WHO classification.

The WHO expert consultation concludes that the proportion of Asian population with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight.

The Indian population is different from the American and European population in respect to the type of body frame, muscle mass and body fat composition and fat distribution. The lifestyle of the Indians being very different from the Americans and the Europeans and alarmed by the reports that India will become the global diabetes mellitus capital by 2050, there is a need to revise the BMI value for India. Therefore, we started with first step of miles journey, conducted this pilot study in Mumbai to derive the BMI cut off for overweight and obesity.

Aims & Objectives

Aims

To standardize the BMI criterion for the population of Mumbai.

Objectives

- To observe standard BMI value for the population of Mumbai.
- To observe BMI variation in different age groups.
- To study correlation of BMI variation and co morbidities.

Methodology

Type of study

Prospective study

Sample size

1000 individuals in the age group of 20 - 70 years

Age group	No. of males	No. of females
20 - 30	100	100
30 - 40	100	100
40 - 50	100	100
50 - 60	100	100
60 - 70	100	100
Total	500	500

Inclusion criteria

Apparently healthy individuals in the age group of 20 to 70 years.

Exclusion criteria

- ✓ Critically ill
- ✓ Physically and mentally disabled
- ✓ Pregnant females

Material used

- ✓ Calibrated bathroom weighing scale
- ✓ Non elastic measuring tape

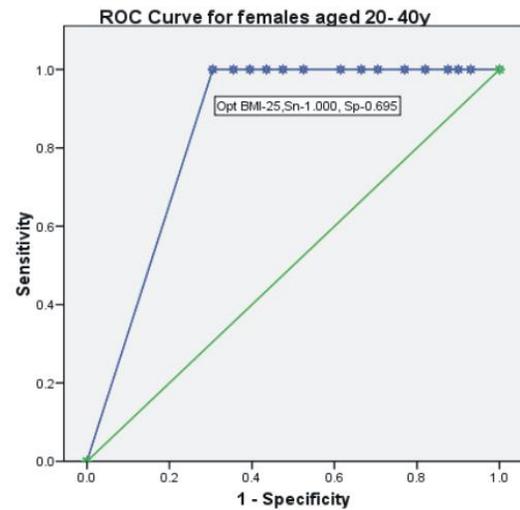
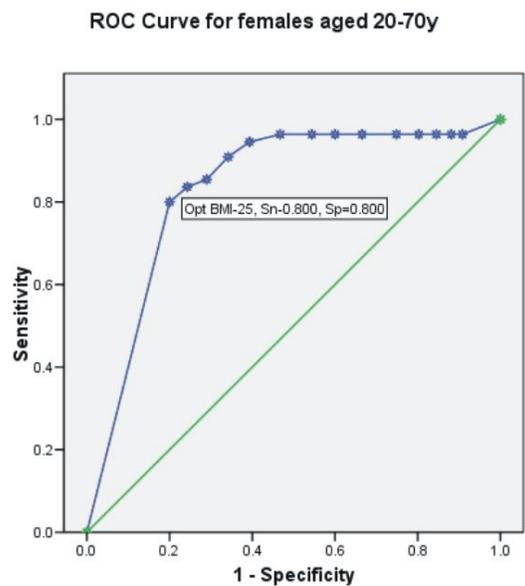
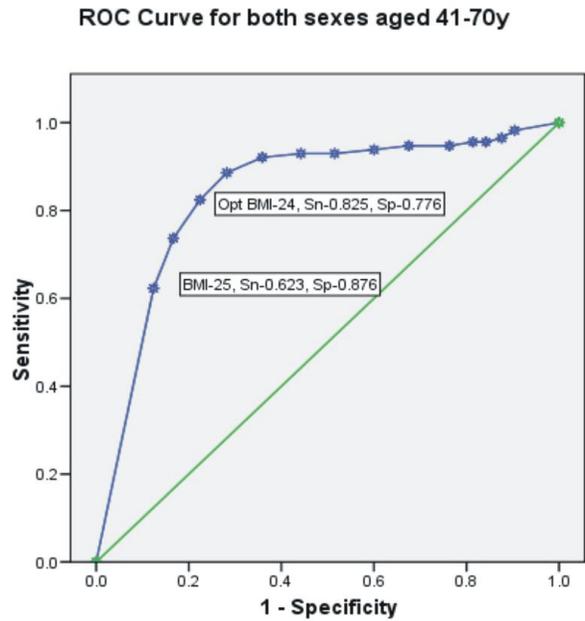
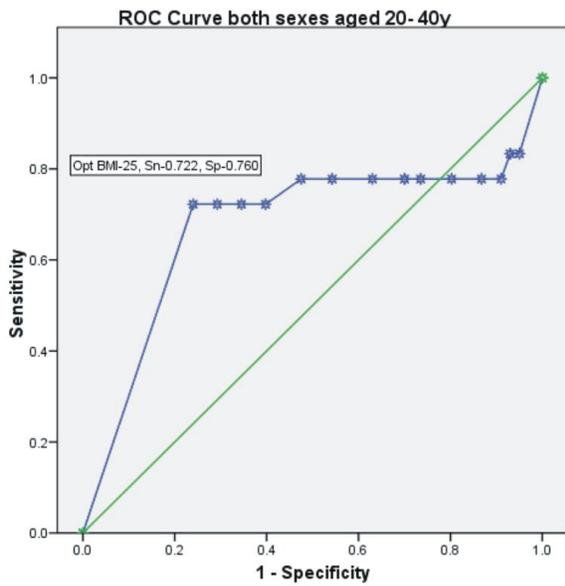
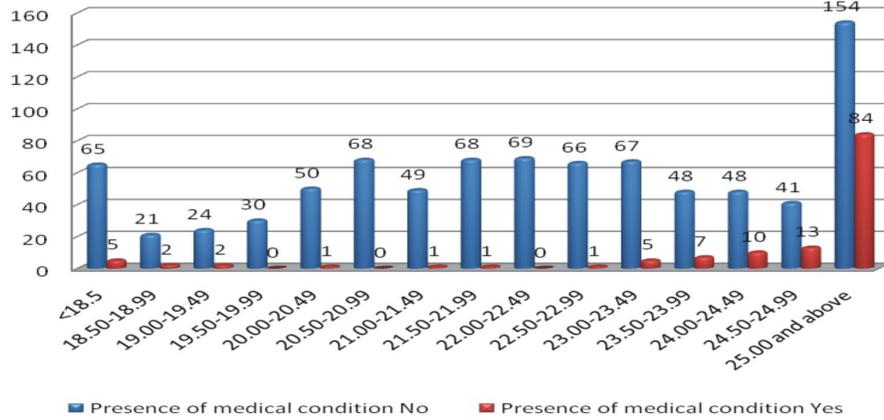
Procedure

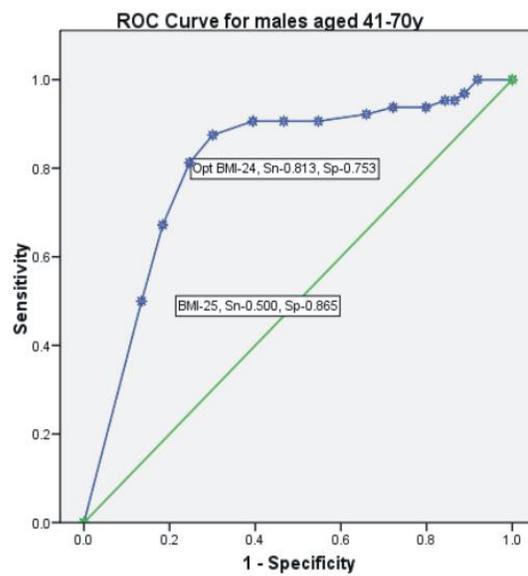
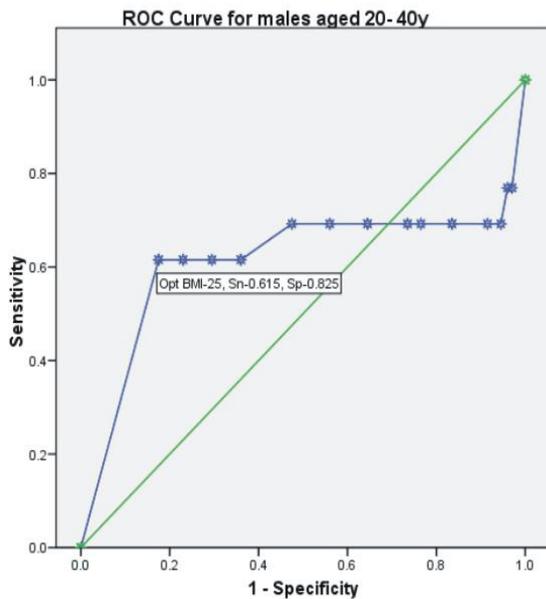
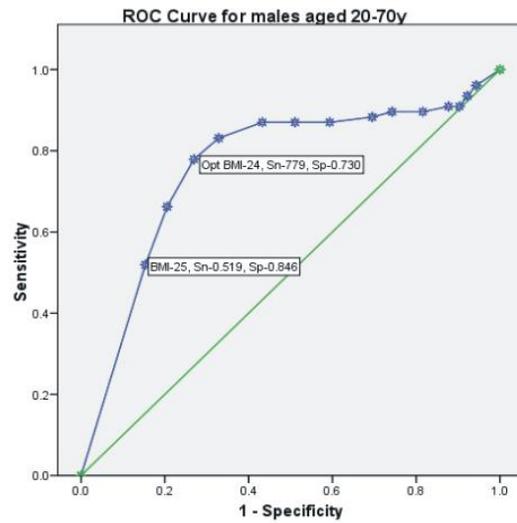
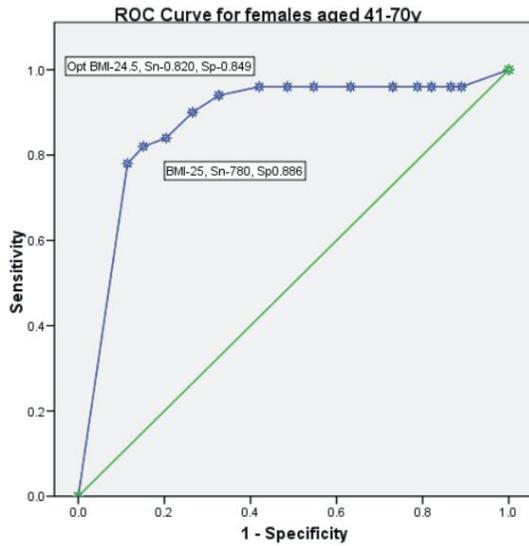
- Choosing the subjects according to the inclusion and exclusion criteria.
- Measuring their weight with the help of a bathroom weighing scale in kilograms.
- Measuring their height with the help of a non elastic measuring tape.
- The person is made to stand against the wall with feet closed. The gaze was straight and was instructed to take a deep breath. The vertex was marked. The distance was measured from the ground in meters.
- BMI calculated in kg/m²
- Medical history noted.

Data Analysis

The incidence of medical conditions increases as the BMI increases.

Chart showing the number of persons with and without medical condition in various BMI groups





Age in years	Sex	N	Total	AUC	Significance ('p' value)	Optimum BMI Cut-off		At BMI-25		
						BMI	Sensitivity	Specificity	Sensitivity	Specificity
20-70	Both	132	1000	0.791	<0.001	24	0.811	0.720	0.636	0.823
	Females	55	500	0.834	<0.001	25	0.800	0.800	0.800	0.800
	Males	77	500	0.762	0.033	24	0.779	0.730	0.519	0.846
20-40	Both	18	418	0.675	0.012	25	0.722	0.760	0.722	0.760
	Females	5	205	0.848	0.008	25	1.000	0.695	1.000	0.695
	Males	13	213	0.613	0.113*	25	0.615	0.825	0.615	0.825
41-70	Both	114	582	0.840	0.021	24	0.825	0.776	0.623	0.876
	Females	45	295	0.875	<0.001	24	0.820	0.849	0.780	0.886
	Males	64	287	0.806	<0.001	24	0.813	0.753	0.500	0.865

The optimum BMI for both the sexes in the age group of 20 - 40 years is 25 kg/m² with specificity 76% and sensitivity 72.2%.

The optimum BMI for both the sexes in the age group of 41 - 70 years is 24 kg/m² with specificity 77.6% and sensitivity 82.5%

The optimum BMI for females in the age group of 20 – 70 years is 25 kg/m² with specificity 80% and sensitivity 80%.

The optimum BMI for females in the age group of 20 – 40 years is 25 kg/m² with specificity 69.5% and sensitivity 100%

The optimum BMI for females in the age group of 41 – 70 years is 24.5 kg/m² with specificity 84.9% and sensitivity 82%

The optimum BMI for males in the age group of 20 – 70 years is 24 kg/m² with specificity 73% and sensitivity 77.9%

The optimum BMI for males in the age group of 20 – 40 years is 25 kg/m² with specificity 82.5% and sensitivity 61.5%

The optimum BMI for males in the age group of 41 – 70 years is 24 kg/m² with specificity 75.3% and sensitivity 81.3%

The BMI cut off for the age group of 20 – 70 years is 24 kg/m², 25kg/m² for females and 24kg/m² for males.

The BMI cut off for the age group of 20 – 40 years is 25 kg/m², same for both the sexes.

The BMI cut off for the age group of 41- 70 years is 24 kg/m², same for both the sexes.

Discussion

An important element of any measure used as a screening test is that it should be relatively cheap, easy to use in practice, noninvasive, and associated with little or no harm. It must also have good test characteristics, such as sensitivity and specificity, so it can be used with minimal false-positive and false-negative results. It seems that BMI fulfills many of these criteria.

As BMI is derived from simple measurement of height and weight, it is clearly inexpensive, noninvasive and safe.

The various uses of BMI are:

- To identify individuals at health risk due to thinness or overweight status. High BMI is a useful predictor of future adiposity as well as future morbidity and

mortality.

- To select individuals for a preventive intervention eg: food supplementation or educational action for prevention of obesity.
- To monitor progress towards normality for a patient undergoing treatment for severe thinness or obesity.
- To exclude individuals from an intervention that could be high-risk for grossly underweight or overweight subjects.
- To assess thinness or overweight status of adults in a community believed to be at risk of one or both of these.
- To monitor trends in community nutrition.
- To provide normative information. E.g.: as an anthropometric parameter, to be considered along with other biological parameters and dietary surveys in attempt to define the presence of underweight and overweight in general or local population.
- To help evaluate the impact of various types of developmental program. Eg: nutritional, health, environmental, etc

BMI and Health Risks

Diabetes mellitus

Type 2 diabetes mellitus is strongly linked to obesity. A study shows that in the Indians, a group with a high incidence of type 2 diabetes, body weight was shown to increase by 30kg from a mean of 60kg to a mean of 90kg in the years prior to the diagnosis of diabetes.[1]

Hypertension

Hypertension is strongly linked to obesity. The Swedish Obesity Study showed hypertension to be present at baseline in 44–51% of obese subjects.[2,3] It has been estimated from the Framingham Health Study that excess body weight may account for up

to 26% of cases of hypertension in men and 28% in women.[4] Not only is obesity linked with hypertension, but weight loss in obese subjects is associated with a decline in blood pressure.[5] The anti-hypertensive effect of weight loss is independent of race or gender.[8] Furthermore, chronic obesity reduces the efficacy of anti-hypertensive medication.[9]

Dyslipidaemia

Obesity is associated with an unfavorable lipid profile.[10] In a comprehensive meta-analysis, weight loss of 1kg decreased serum total cholesterol by 0.05mmol/l and LDL cholesterol by 0.02mmol/l, and increased HDL cholesterol by 0.009mmol/l.[11]

Heart disease

Obese individuals have a form of cardiomyopathy attributed to chronic volume overload, characterized by left ventricular dilatation, increased left ventricular wall stress and compensatory left ventricular hypertrophy. Most studies have reported abnormal diastolic function without abnormal systolic function.[12,13] These changes were more prominent in the patients who had a BMI >35 kg/m², compared to the less obese patients.

Coronary artery disease

The Asia-Pacific Cohort Collaboration Study, involving >300 000 adults followed up for almost 7 years, found a 9% increase in ischemic-heart disease events for each unit change in BMI. In addition, obesity was associated with both fatty streaks and raised atherosclerotic lesions in the right coronary and left anterior descending coronary arteries in young men, although not in women.[15]

Heart failure

In the Framingham Study, almost 6000 individuals without a history of heart failure (mean age 55 years) were followed for a mean of 14 years. The risk of developing heart failure

was two-fold higher in obese individuals, compared with subjects with a normal body-mass index.[16]

Atrial fibrillation

In multivariate analysis, adjusting for interim myocardial infarction or heart failure, every increase of 1 point in BMI was associated with a 4% increase in the risk of AF. In addition, there was a gradual increase in left atrial size as BMI increased.[18,19]

Cerebrovascular disease

Obesity is linked to an increased risk of stroke in both men and women. In the Physicians Health Study of 21,414 US physicians, those with a BMI 30kg/m² had a relative risk of 1.95 for an ischemic stroke and 2.25 for a hemorrhagic stroke. In these studies, the increased risk for stroke persisted, although attenuated, after adjusting for concomitant risk factors such as hypertension, diabetes and hypercholesterolemia. Recent data suggest that central fat accumulation is a stronger risk factor for stroke than overall obesity.[20,21,22]

Respiratory disease

Obstructive sleep apnoea (OSA)

Over 75% of patients with OSA are reported to be >120% of ideal body weight. Epidemiological evidence from the Wisconsin Sleep Cohort Study showed that sleep apnoea risk increased significantly with obesity.[22] A neck circumference >17 inches, which is correlated with obesity, has also been highly correlated with OSA. Obesity probably contributes to OSA via multiple mechanisms. Increased fat deposits in tissues surrounding the upper airway in obese patients may directly impinge on the airway lumen.[24,25] In addition, mild-to-moderate weight loss can substantially improve sleep apnoea.[23]

Asthma

Obese or overweight subjects account for 75% of emergency department visits for

asthma.[26,27] Longitudinal studies indicate that obesity antedates asthma, and that the relative risk of incident asthma increases with increasing obesity.[28] In addition, morbidly obese asthmatic subjects studied after weight loss demonstrates decreased severity of asthma symptoms.[29] Obesity also appears to be a risk factor for airway hyper-responsiveness.[30,31]

Gastrointestinal system

Hepatobiliary disease

Obesity is associated with cholelithiasis. In the Nurses' Health Study, women with BMI >45 kg/m² had a seven-fold increase in risk for gallstones compared to women with BMI <24 kg/m². Women with BMI >30 kg/m² had a yearly gallstone incidence of >1% and those with BMI 45 kg/m² had a rate of approximately 2% per year.[32]

Non-alcoholic fatty liver disease (NAFLD)

It is strongly linked to the metabolic syndrome, of which obesity is a central component, and is in fact regarded as the hepatic manifestation of the metabolic syndrome.[32]

Osteoarthritis

There is a marked increase in osteoarthritis in the obese. It is most common in the knees, which may be a consequence of trauma related to the excess body weight. In a study of over 1000 women, the age-adjusted odds ratio of unilateral and bilateral osteoarthritis of the knee, as determined by X-ray, were 6.2 for BMI <23.4 kg/m² and 18 for BMI >26.4 kg/m²[33] A study of 800 women showed that a decrease in BMI of 2 kg/m² or more in the preceding 10 years decreased the odds for developing osteoarthritis by >50%.

Psychosocial function

In a group of 294 patients seeking consultation for bariatric surgery, half the patients had a psychiatric disorder and 29%

had co morbidity. The highest prevalence rates were 29% for somatization, 18% for social phobia, 15% for hypochondriasis and 14% for obsessive-compulsive disorder. In addition, eating disorders such as binge eating disorder and night eating syndrome have been linked with depression and obesity.[34]

Gynecological and obstetric complications

Obesity is responsible for 6% of primary infertility. Polycystic ovary syndrome (PCOS), the most common endocrine disorder in women of reproductive age, is characterized by a combination of chronic anovulation, polycystic ovary morphology and hyperandrogenism. Obesity and insulin resistance are closely related with PCOS. Women with PCOS respond favorably to weight loss, as well as to pharmacological treatment of insulin resistance, with decrease in androgen levels and ovulation.

In our study, apparently healthy individuals were randomly selected from Mumbai. Terminally ill, pregnant females, mentally and physically challenged individuals were excluded from the study.

Mean BMI of the study population is 23.25kg/m², for the male it is 23.09kg/m² and that for the females is 23.39kg/m².

Out of the 1000 individuals, 132 had medical problems. 77 out of 500 males and 55 out of 500 females. Incidence of increased BMI related medical problems are higher in males compared to the females.

In the age group of 20 - 40 years, 4.3% of the individuals have increased BMI related medical problems whereas in the age group of 41 - 70 years, it is 19.6%. The incidence is significantly high in the people with age 41 and above.

According to the present WHO classification, BMI greater than 25 kg/m² defines overweight. There was an increasing evidence of the emerging high prevalence of type 2 diabetes and increased cardiovascular risk factors in parts of Asia where the average BMI is below the cut-off point of 25 kg/m². [1,2]

Reference on the basis of the available data in Asia, the WHO expert consultation concluded that Asians generally have a higher percentage of body fat than white people of the same age, sex, and BMI. Thus, current WHO cut-off points do not provide an adequate basis for taking action on risks related to overweight and obesity in many populations in Asia.[36] However, the available data do not necessarily indicate one clear BMI cut-off point for all Asians for overweight or obesity. The BMI cut-off point for observed risk in different Asian populations varies from 22 kg/m² to 25 kg/m²; for high risk it varies from 26 kg/m² to 31 kg/m².

In our study we found the BMI cut off for both the sexes in the age group of 20 – 70 years is 24 kg/m² (specificity = 81.1%, sensitivity = 72%). The BMI cut off for the females is 25kg/m² (specificity = 80%, sensitivity = 80%) and 24kg/m² for the males (specificity = 77.9%, sensitivity = 73%).

The BMI cut off for both the sexes in the age group of 20 – 40 years is 25 kg/m²(specificity = 72.2%, sensitivity = 76%). The BMI cut off for the females is 25 kg/m² (specificity = 100%, sensitivity = 69.5%) and same for the males (specificity = 61.5%, sensitivity = 82.5%).

The BMI cut off for both the sexes in the age group of 41- 70 years is 24 kg/m² (specificity = 82.5%, sensitivity = 76.6%), the BMI cut off for females is 24kg/m²(specificity = 82%, sensitivity = 84.9%) and same for the males (specificity = 81.3%, sensitivity = 75.3%).

Sex-specific receiver operating characteristic curves were used to assess the sensitivity and specificity of BMI cut off.[37]

The purpose of a BMI cut-off point is to identify, the proportion of people with a high risk of an undesirable health state that warrants a public health or clinical intervention within the population of Mumbai. When applied to a population, the purpose of anthropometric cut-off points is to identify independent and interactive risks of adverse health outcomes associated with different body compositions, so as to inform policy, trigger action, facilitate prevention

programs, and assess the effect of interventions. Reducing BMI cut-off values for action on overweight and obesity would increase their prevalence rates overnight and, therefore, increase governmental and public awareness.[36]

Conclusion

- The BMI cut off for both the sexes in the age group of 20 – 70 years is 24 kg/m². The BMI cut off is 25kg/m² for the females and 24kg/m² for the males.
- The BMI cut off for both the sexes in the age group of 20 – 40 years is 25 kg/m². The BMI cut off for the females and males is 25 kg/m².
- The BMI cut off for both the sexes in the age group of 41- 70 years is 24 kg/m², the BMI cut off for females and males is 24kg/m².
- In the age group of 20 – 40 years, 4.3% of the individuals have increased BMI related medical problems whereas in the age group of 41 – 70 years, it is 19.6%. The incidence is significantly high in the people with age 41 and above.

Scope for further research

- The role of abdominal obesity in Asians (as identified by waist circumference, waist to hip or waist to height ratio), in predicting the metabolic syndrome needs further investigation.
- The impact of fetal nutrition on adult diseases needs further research, especially in Asian societies, who have many children born with low birth weights. Indian and some other data presented showed the association between early nutritional disadvantage and later weight gain and how this is a particularly strong indicator of enhanced morbidity.
- Studies to investigate the attitudes to obesity in different cultural groups

(including attitudes about fatter children).

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Phonophoresis with Aceclofenac has Significant Effect in the Relieving Pain in Upper Trapezius Tender Point

Sumit Kalra*, Nidhi Kalra*

Abstract

Purpose: The aim of this study was to find the immediate effect **aceclofenac** gel on pain threshold and range of motion which follows a single treatment of tender points in the upper trapezius muscle. **Methods:** 30 subjects presenting with upper trapezius muscles spasm, aged 20-30 years old, participated in this study. Subjects underwent a screening process to establish the presence of tender points in upper trapezius muscle. Subjects were divided randomly into 2 groups.

Group A = Aceclofenac gel and ultrasonic gel as coupling medium

Group B = ultrasonic gel as coupling medium

Visual Analogue Scale and Range of Motion is assessed pre treatment and immediately post treatment.

Result: The p value of VAS (post treatment) and ROM (post treatment) in Group A 0.000. **Conclusion:** ultrasound with aceclofenac gel was better for immediate pain relieve as compared to aqua sonic gel only

Keywords: Tender point; Phonophoresis; Ultrasound; Aceclofenac gel.

Introduction

Neck pain/back pain is common and can limit individual's ability to participate in normal daily activities. Neck/back pain frequently becomes chronic.[1] Leading to difficulty in performing adls else can lead to repeated stress injuries Topical NSAIDs can provide good levels of pain relief; topical Aceclofenac solution is equivalent to that of oral NSAIDs.[1]

Topical NSAIDs can provide good levels of pain relief, without the systemic adverse events associated with oral NSAIDs, when used to treat acute musculoskeletal conditions.[2]

Study done by Pattanittum P *et al* in 2013 reveals that there remains limited evidence

from which to draw firm conclusions about the benefits or harms of topical or oral NSAIDs in treating lateral elbow pain. Although data from five placebo-controlled trials suggest that topical NSAIDs may be beneficial in improving pain (for up to 4 weeks), non-normal distribution of data and other methodological issues precluded firm conclusions. Some people may expect a mild transient skin rash. Evidence about the benefits of oral NSAIDs has been conflicting, although oral NSAID use may result in gastrointestinal adverse effects in some people. No direct comparisons between oral and topical NSAIDs were available. Some trials demonstrated greater benefit from glucocorticoid injection than from NSAIDs in the short term, but this was not apparent in all studies and was not apparent by 6 months in the only study that included longer-term outcomes.[2,3]

Topical gel preparation has remains one of the most popular and important pharmaceutical dosage forms. As a result, the therapeutics effects of the drugs are achieved effectively whereas the systemic side effects can be avoided or minimized. The Non-

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Steroidal Anti-Inflammatory Drugs (NSAIDs) have been widely used in the treatment of rheumatoid arthritis and other related condition Aceclofenac, a non-steroidal anti-inflammatory drug, has been used in the treatment of rheumatoid arthritis and osteoarthritis. In order to decrease the gastric ulcerogenic effects, aceclofenac gels have been developed. This study was conducted to develop a gel formulation of aceclofenac using four types of gelling agents: carbopol,

hydroxypropylmethylcellulose (HPMC), carboxymethylcellulose sodium (Na CMC) and sodium alginate. Effect of penetration enhancer (propylene glycol) on the release has been studied. The gels were evaluated for physical appearance, rheological behavior, drug release and stability. The drug release from all gelling agents through a standard cellophane membrane was evaluated using Keshary-Chien diffusion cell. All gels showed acceptable physical properties concerning color, homogeneity, consistency, spreadability and pH value. Among all the gel formulations, carbopol showed superior drug release than followed by Na CMC, HPMC and sodium alginate. Drug release decreased with increase in polymer concentration. Drug release was not linearly proportional with the concentration of penetration enhancer or co-solvents.

Stability studies showed that the physical appearance, rheological properties, and drug release remained unchanged upon storage for two months at ambient conditions. Aceclofenac, a non-steroidal anti-inflammatory drug, has been used in the treatment of rheumatoid arthritis and osteoarthritis. In order to decrease the gastric ulcerogenic effects, aceclofenac gels have been developed. This study was conducted to develop a gel formulation of aceclofenac using four types of gelling agents: carbopol, hydroxypropylmethylcellulose (HPMC), carboxymethylcellulose sodium (Na CMC) and sodium alginate. Effect of penetration enhancer (propylene glycol) on the release has been studied. The gels were evaluated for physical appearance, rheological behavior,

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Non-steroidal anti-inflammatory drugs (NSAIDs) are the most commonly prescribed drugs for the treatment of OA. NSAIDs are definitely better than placebo and are enjoying the status of popular “over the counter” medicines amongst the health professionals and the patients.[5] Aceclofenac, a US-FDA approved drug in 1988, is the most commonly prescribed NSAID for the treatment of OA-related pain. The efficacy of Aceclofenac is still believed to be unmatched as it is as effective as the newer approved pain relief medications for OA and continues to be a benchmark pharmacological treatment option for OA to the physician. Despite several advantages, Aceclofenac is also associated with the NSAID-category side effects like gastrointestinal (GI) adverse effects including bleeding, ulceration, and perforation of the stomach, small intestine, or large intestine, which can be fatal too. These drawbacks of a timely tested drug always motivated the medicinal chemists to develop a new/modified NSAID with enhanced safety and comparable efficacy. This driving force resulted in the development of ACE, that is, a derivatized Aceclofenac developed by Grau *et al* in 1991 to improve its gastrointestinal tolerability ACE offered a relatively better gastric tolerance vis-à-vis the other NSAIDs including Aceclofenac. The incidence of gastric ulcerogenicity of ACE

has been reported to be significantly lower than that of the other frequently prescribed NSAIDs, for instance, 2-folds lesser than naproxen, 4-folds lesser than Aceclofenac, and 7-folds lesser than indomethacin. ACE is also expected to provide economic benefits owing to its better tolerability and marked efficacy. On pharmacokinetic fronts, ACE is well absorbed from gastrointestinal tract and circulates mainly as unchanged drug, while the food presence rarely alters its pharmacokinetic properties. Model independent pharmacokinetic parameters like, and half-life as well as the absorption of ACE are not affected by escalating age and, therefore, dose manipulations are not generally advocated in the elderly patients. Though reported to be well-tolerated, a few incidences of rare hypersensitivity reactions after oral intake of ACE are reported including hypersensitivity vasculitis photoallergic contact dermatitis, exudative erythema multiforme anaphylactic reaction and acute tubulointerstitial nephritis. Also, two NSAIDs with similar chemical structure with ACE, namely, alclofenac and fenclofenac, have been associated with higher incidences of rashes and, subsequently, withdrawn in late 1970s and 1980s, respectively.[7]

Mechanism of Action of Aceclofenac

The mode of action of ACE is mainly based on the inhibition of synthesis of prostaglandins (PG). ACE inhibits the cyclooxygenase (Cox) enzyme, which is involved in the synthesis of PG. *In vitro* data in unstimulated bovine aortic coronary endothelial cells indicated the selectivity for Cox-2 by ACE more than Cox-1. ACE also inhibits the synthesis of the inflammatory cytokines, interleukins, and tumor necrosis factors. Also, effect of ACE on the cell adhesion molecules from the neutrophils has also been proposed.

Its interleukin-1 (IL-1) inhibition activity may be linked to its stimulatory effects on cartilage matrix by release of glycosaminoglycan and a chondroprotective agent, 42-hydroxyaceclofenac. The decreased production of nitrous oxide in human articular

chondrocytes is also linked to its anti-inflammatory activity. As 42-hydroxy aceclofenac participates in chondroprotection by interfering with IL-1-mediated production of promatrix metalloproteinase-1 and metalloproteinase-3 and the release of proteoglycans from chondrocytes, ACE is classified as a novel NSAID. It simultaneously down regulates the production of promatrix metalloproteinases as well as prostaglandin E2 in osteoarthritis and/or rheumatoid arthritis. Surprisingly, ACE is not involved in the tendon cell proliferation unlike indomethacin and naproxen and can be safely prescribed for the treatment of pain after tendon injury and surgery. In patients with OA of the knee, ACE decreases pain resulting in reduction of disease severity and improves the functional capacity of the knee. It reduces joint inflammation, pain intensity, and the duration of morning stiffness in patients with rheumatoid arthritis.[7]

Tender point is defined as the places on muscles that when touched with enough pressure, elicits a feeling of sensitivity in the location of point. Pain does not refer anywhere else in the body; pain is confined to tender point itself. They are usually no bigger than 1 cm.[1]

The presence of tender points in patients is closely associated with their current anxiety, and patients with a history of psychological trauma associated with anxiety (for example, childhood trauma or sexual abuse) have an increased number of tender points.[4] US is a modality which involves the generation of high frequency sound waves, and their transmission through the skin to the structures desired to be affected. US generators used clinically are limited by government regulation to approximately 1,000,000 Hertz (1 megahertz).[8]

Phonophoresis was first used to treat polyarthrits of the hand by delivery of hydrocortisone ointment into inflamed areas in 1954. Since then it has been reported to be used in the treatment of various dermatological and musculoskeletal disorders.[9]

The mechanism by which ultrasound

enhances the transdermal penetration of substances is not entirely clear. One could think of the vasodilation observed on macroscopic examination, but this would certainly not be enough on its own, since it does not imply any change of the waterproof keratin layer of the skin, which should necessarily be altered.[8]

The purpose of this study is to study the effectiveness of aceclofenac gel as the coupling medium in the immediate pain relief of tender point.

Methodology

Number and Source

30 subjects were taken from young population.

Inclusion Criteria

1. Male or Female with age of 20-30 years.
2. Subjects with upper trapezius muscle spasm.

Exclusion Criteria

1. Subjects with trigger point of trapezius muscle.
2. Subjects with musculoskeletal disorder that would limit performance in these subjects.
3. Skin disorders which would irritate by either increase in warmth of the part or by the lubricants which might be used, e.g. eczema.
4. In presence of malignant tumours.
5. In case of any previous fracture or surgery at neck.
6. All contraindications of ultrasonic therapy.

Method of selecting & assigning subjects to groups

40 subjects having an upper trapezius

muscle spasm were considered for this study. They were then screened to remove the subjects who did not fulfil the criteria for the study. After screening, the subjects they were randomly divided into two groups.

Instruments and Tool used

1. Ultrasound machine Meditek Ultrasonic digital, Meditek cooperation
2. Tropical ointment consisting of Aceclofenac 10gm Chlorzoxazone 500 mg Paracetamol 500 mg Aceclofenac 10 gm Chlorzoxazone 500 mg Paracetamol 500mg.
3. Ultrasound gel.

Research Design

Experimental design.

Variables

Independent variables - Ultrasonic Therapy

Dependent variables - Visual Analogue Scale, ROM

Procedure

Subjects fulfilling the inclusion criteria were taken into consideration. The procedure was explained to the subjects and a written consent was taken after explaining the benefits and clearing the doubts of the subject regarding study. After pain level assessment by help of visual analogue scale (VAS) and Range of Motion using the universal goniometer they were randomly divided into two groups namely, A and B.

Group A were given phonophoresis ultrasound with Aceclofenac along with aquasonic gel as coupling medium and Group B were given ultrasound with aquasonic gel as coupling medium. The ultrasound was given for 5 minutes at 0.8 w/cm² 16. After the treatment pain level and Range of Motion is taken again.

Result

A paired sample t test reveal a statistically reliable difference between the mean number of VAS pre and post in Aceclofenac /Group A (M= 6.6, s =1.03280) and (M= 3.8, s =1.48645) that the $t(14)=12.582$, $P(\hat{\alpha})= .000$ at two tail test A paired sample t test reveal a statistically reliable difference between the mean number of ROM pre and ROM post in Aceclofenac/Group A (M=27.0000, s= 5.29150) and (M= 36.07, s = 4.20) that the $t(14) = -11.093$, $P(\hat{\alpha})= .000$ at two tail test.

A paired samples t test reveal a statistically reliable difference between the mean number of VAS pre and VAS post in Group B (M=-6.8000, s = 1.22017) and (M 4.5, s=1.50238) that the, $t(14) =8.9$, $P(\hat{\alpha}) = .000$ at two tail test.

A paired samples t test reveal a statistically reliable difference between the mean number of ROM pre and ROM post in Group B (M=-24.01, s=10.73357) and (M=34.111, s=9.51290) that the, $t(14) = -10.569$, $P(\hat{\alpha}) = .000$ at two tail test.

An independent-samples t-test was conducted to compare VAS post treatment in Group B and Group A. There was a significant difference in the scores for pulsed (M=4.5, SD=1.5) and Group A (M=3.96, SD=1.48) conditions; $t(28)=0.855$, $p = 0.400$. the result suggest that VAS decreases more in Group A mode than in Group B. An independent-samples t-test was conducted to compare ROM post treatment in Group B and Group A. There was a significant difference in the scores for Group B (M=33.73, SD=9.51) and Group A (M=37.06, SD=4.19) conditions; $t(28)=-1.24$, $p=0.225$. The result suggest that ROM increases more in Group A.

Discussion

According to the unpaired t test done between post values of VAS in case of pulsed mode and continous mode the p value is <0.005. The post value of ROM in Group A

and Group B the p value is <0.005.

From the experimental work finding it can be concluded that Aceclofenac is a non-steroidal anti-inflammatory drug (NSAID) that exhibits anti-inflammatory, analgesic activities and used for the treatment of rheumatoid arthritis. Aceclofenac by oral administration can produces stomach indigestion, so it is not suitable for the treatment of rheumatoid arthritis patient with gastric ulcer, so, to avoid gastric irritation to G.I.T, minimizing systemic toxicity. To overcome the side effects associated with oral aceclofenac therapy and to have the benefits associated with topical therapy; Aceclofenac topical gels are prepared in this study. Studies showed that drug release was decrease with increase in gelling agent concentration because polymer concentration increases; viscosity increases. From the experimental work finding it can be concluded that Aceclofenac is a non-steroidal anti-inflammatory drug (NSAID) that exhibits anti-inflammatory, analgesic activities and used for the treatment of rheumatoid arthritis. Aceclofenac by oral administration can produces stomach indigestion, so it is not suitable for the treatment of rheumatoid arthritis patient with gastric ulcer, so, to avoid gastric irritation to G.I.T, minimizing systemic toxicity. To overcome the side effects associated with oral aceclofenac therapy and to have the benefits associated with topical therapy; Aceclofenac topical gels are prepared in this study. Studies showed that drug release was decrease with increase in gelling agent concentration because polymer concentration increases; viscosity increases[5] gel formulations provide a suitable delivery system for drugs because they are less greasy and can be easily removed from the skin. Percutaneous absorption of drugs from topical formulations involves the release of the drug from the formulation and permeation through skin to reach the target tissue. The release of the drug from topical preparations depends on the physicochemical properties of the vehicle and the drug employed. In order to enhance drug release and skin permeation, methods such as the selection of a suitable

vehicle[5], co-administration of a chemical enhancer[3] have been studied. Gel base formulation makes the drug molecules more easily removable from the system than cream and ointment.[4,5]. Gels for dermatological use have several favorable properties such as being thixotropic, greaseless, easily spreadable, easily removable, emollient, nonstaining, compatible with several excipients and water-soluble or miscible.[10]

Aceclofenac is chemically [[[(2,6-Dichlorophenyl) amino] phenyl] acetyl] oxy] acetic acid[7], is a new orally effective NSAID of the phenyl acetic acid group. It possesses a remarkable anti-inflammatory, analgesic and antipyretic properties. The continued use of aceclofenac through oral route causes ulcerogenic effect, flatulence, indigestion (dyspepsia), vertigo, dizziness, dyspnoea, stomatitis, itching (pruritis).[8,9] When a drug system is applied topically, drug diffuses passively out of its carrier or vehicle. A unique feature of aceclofenac's pharmacology is that it stimulates glycosaminoglycans (GAG) synthesis, which in turn enhances skin permeation of NSAIDs. [4,5,10]

Aceclofenac when presented in the form of topical gel can reduce local inflammations. Hence for local inflammation or pain in the body, the topical application of aceclofenac may be useful which also avoids the side effects associated with the oral therapy. Hence, a topical ointment containing aceclofenac was prepared. It is established that gel formulations are superior to other topical formulations, because these systems have better application properties in comparison to creams and ointments.[12] The objective of the present study was conducted to develop a gel formulation of aceclofenac using four types of gelling agents: carbopol, hydroxypropylmethylcellulose (HPMC), carboxymethylcellulose sodium (Na CMC) and sodium alginate. The effect of penetration enhancer (propylene glycol) on the release has been studied.

The gels were evaluated for physical appearance, rheological behavior, drug release

and stability. The drug release from all gelling agents through a standard cellophane membrane was evaluated using Keshary-Chien diffusion cell.[6] The mechanism by which ultrasound enhances the transdermal penetration of substances is not entirely clear. One could think of the vasodilation observed on macroscopic examination, but this would certainly not be enough on its own, since it does not imply any change of the waterproof keratin layer of the skin, which should necessarily be altered. No volunteers presented any complication of any kind nor did they report any discomfort with the treatment at any time, all of them resuming normal life immediately after the end of treatment. Apart from slight redness and a temperature increase on touch, no sign of local irritation was detected by macroscopic inspection of the irradiated areas.[4,10]

Conclusion

The study concludes that ultrasound with aceclofenac gel is better for immediate pain relief as compared to ultrasound with aquasonic gel only for immediate pain relief in tender points in muscles all over the body.

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This century will be the century of the brain. Intelligence will define success of individuals; it remains the main ingredient of success. Developed and used properly, intelligence of an individual takes him to greater heights. Ask yourself, is your child intelligent! If yes, is he or she utilizing the capacity as well as he can? I believe majority of people, up to 80% may not be using their brain to best potential. Once a substantial part of life has passed, effective use of this human faculty cannot take one very far. So, parents need to know how does their child grow and how he becomes intelligent in due course of time. As the pressure for intelligence increases, the child is asked to perform in different aspects of life equally well. At times, it may be counter-productive. Facts about various facets of intelligence are given here. Other topics like emotional intelligence, delayed development, retardation, vaccines, advice to parents and attitude have also been discussed in a nutshell. The aim of this book is to help the child reach the best intellectual capacity. I think if the book turns even one individual into a user of his best intelligence potential, it is a success.

PEDIATRICS COMPANION

By **Dr. Rajesh Shukla**

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This book has been addressed to young doctors who take care of children, such as postgraduate students, junior doctors working in various capacities in Pediatrics and private practitioners. Standard Pediatric practices as well as diseases have been described in a nutshell. List of causes, differential diagnosis and tips for examination have been given to help examination-going students revise it quickly. Parent guidance techniques, vaccination and food have been included for private practitioners and family physicians that see a large child population in our country. Parents can have some understanding of how the doctors will try to manage a particular condition in a child systematically. A list of commonly used pediatric drugs and dosage is also given. Some views on controversies in Pediatrics have also been included. Few important techniques have been described which include procedures like endotracheal intubations, collecting blood samples and ventilation. I hope this book helps young doctors serve children better.

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Activity of Core Musculature during Bridging Variations - An Overview

Saurabh Sharma

Abstract

Neutral zone in spinal stability plays a vital role in core stability .it has been proven that before initiation of any limb activity first transverses abdominis is electrically active and then peripheral concerned musculature acts. Difference in activation and cross-sectional area of trunk muscles have been demonstrated between LBP patients and healthy controls. As part of stabilization exercises bridging is a common exercises. Bridging has many variations and it becomes imperative that exercise which elicits maximum electrical activity may be therapeutically more suitable. . The supine posture with knees and hips bent used during bridging exercise is to most LBP patients a comfortable, pain-free posture. From this position more graded activities can be performed such as lifting the pelvis. In order to create more functional tasks, limb movements can be added. An unstable support surface cause body perturbation, leading to an increase in activity by the trunk muscles in an effort to maintain postural stability. An unstable surface is used during the bridging exercise; the co activation of trunk muscles may be enhanced to reduce body perturbation. **Conclusion:** Along with limited literature there is conflicting evidence as to the activation of core musculature with different bridging stabilization exercises.

Keywords: EMG; Core muscles; Bridging; Transversus abdominis; Multifidus; Unstable surface.

Concept of core

The core could be understood as a muscular cylinder with the abdominals anteriorly, gluteals posteriorly, the diaphragm as roof , and the pelvic floor as the floor.[1] The core musculature generally support the lumbo-pelvic-hip complex eventually stabilizing the pelvic and spinal region, and kinetic chain during functional movement.[2] Tse *et al* define the core musculature includes muscles of the trunk and pelvis that are responsible for maintaining the stability of the spine and pelvis and are critical for the transfer of energy from larger torso to smaller extremities during many sports activities.[3]

Anders Bergmark classified the musculature of core into local muscle system and global muscle system.[4] Local muscle system consists of slow twitch fibers which are shorter in length and are controlling inter segmental motion in responding to the changes in posture and extrinsic loads. These muscles are primary stabilizers because they do not generate enough force to create movements in the joints through which they pass.[5] Local muscles include transverse abdominis, multifidi, internal oblique, deep transversospinalis and pelvic floor muscle. On the other hand global muscle system comprise of fast twitch fibers which are longer in length and possess large lever arms, allowing to produce large amounts of torque and gross multiplanar movements while countering external loads for transfer to the local musculature.[2] Global muscles include erector spinae, external oblique, rectus abdominis and quadrates lumborum.[6]

The musculatures of the abdominals are the very vital component considering core. The transverse abdominis received more attention

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in spinal stabilization. The transverse abdominis originates from multitude of structures and finally inserts into the diaphragm, inguinal ligament and iliac crest.[7] The fibers of TrA runs horizontally (except for the most inferior fibers, which run parallel to the internal oblique muscle) creating a belt around the abdomen found the fascicles of transverse abdominis varied in their orientation between regions, in upper regions the fascicles are horizontal and increasingly inferomedial in the middle and lower regions.[8] The internal oblique and the transverse abdominis work together to increase the intra-abdominal pressure from the hoop created via the thoracolumbar fascia. Increased intra-abdominal pressure has been shown to impart stiffness to the spine.[9]

The unisegmental lumbar multifidus are the most medial of the lumbar spine muscles ascending from the spinous processes caudally two to five levels, functioning primarily as an extensor of the spine¹⁰. Being twice as large in number as any other muscle in the lumbar region and unique in its fiber arrangement indicates it's architecturally designed to produce very large forces over a narrow range of length.[11] Additionally, research has reported a smaller cross sectional area of the lumbar multifidus has been associated with increased hip, groin, and thigh muscle injuries in athletes.[12] The transverses abdominis and multifidi fire prior to any movement.[13,14] However, patients with LBP have delayed contraction of the transversus abdominis and multifidi prior to limb movement.[13] This Evidence suggests its preparatory stabilizing effect to the trunk will allow force production at the extremities.

Core stability

Core stability or core strengthening is a well known term in the sports medicine and rehabilitation. The terms "core stability" and "core strength" are commonly interchanged throughout literature.[15,16,17] The focus of the rehabilitation research is on improving the quality of life of non-athletic people who are suffering from low back pain, leaving them

unable to perform simple everyday tasks.[14] According to Hibbs *et al*, general everyday tasks, such as walking, require much less core strength and stability as compared to dynamic athletic movements, due to their low load nature. It is quite reverse in the athletic setting, which is focused on enhancing performance through training that involves heavily loaded and dynamic movements (i.e., athletic movements).[14] Leetun *et al* noted that athletes must have adequate strength in the lumbo-pelvic-hip complex in order to provide spinal stability throughout athletic movements.[18] Panjabi defines "clinical instability as the loss of the spine's ability to maintain its patterns of displacement under physiologic loads so there is no initial or additional neurologic deficit, no obvious deformity, and no disabling pain".[19] Punjabi defines spine stability as combination of interdependent elements: Passive subsystem (osseous, articular and ligamentous elements), Active subsystem (muscular elements) & Neural subsystem (neural elements).[20,21]

Passive subsystem only provides stability towards the end ranges of motion as the ligaments develop tension that resist spinal motion.[22] Proprioceptive capability is the paramount function of passive subsystem.[23]

Active subsystem provides substantial stability to the spine in the vicinity of the neutral zone (region of intervertebral motion around the neutral position (neither in flexion nor in extension)) with the contribution of neural elements. The ligamentous spine will fail or buckle under compression loads of as little as 2 kg or 20 N).[24,25] This inherent instability along with the tremendous demand required during different activities necessitates the role of active subsystem. Due to inherent instability the role of musculature is to stiffen the spine during the movements. [9] Therefore, the active spinal muscles of the trunk and pelvis are responsible for maintaining core stability as well as providing and transferring energy from proximal to distal body parts.[26] Activation of muscle and the stiffness is an important concept. Activation of muscle

increases stiffness, both in muscles itself as well as joints which it crosses. Activating a group of muscle synergists and antagonists in the optimal way becomes a critical issue.[27] Leetun *et al* stated that the motor control and muscular capacity create core stability.[17] It is been well established that the core muscles provide an important role in stabilizing the spine.[27,28] In the neutral zone Neural subsystem provides afferent information related to intersegmental joint position. When there is a normally functioning subsystems, the size of the neutral zone is maintained, providing mechanical stability of the spine. The size of the neutral zone has been shown to increase with ligamentous injury and intervertebral disc degeneration[29] and is thought to increase gradually due to dysfunction of any of the subsystems leading in consequences of chronic pain and disability. Finally, dynamic stability is dependent on two-way neuromuscular input to control the trunk during movements in response to forces generated from distal body segments for expected or unexpected perturbations.[30] The stability of the core is dependent on the integration of sensory, motor processing and biomechanical strategies and the ability to anticipate change.[31]

Neuromuscular control of core

The motor control model of spinal stabilization focuses on the function of deep spinal muscles because these structures are thought to have the ability to control motion between vertebral segments. The motor control approach emphasizes that subjects learn isolated volitional activation of deep trunk muscles.[32] Primarily the transverse abdominis (TrA) and lumbar multifidus (LM). It is commonly identified motor control deficits thought to be present in nearly all types of patients with LBP. A growing body of neurophysiologic and clinical evidence suggests that the deep stabilizing muscles of the spine are impaired in those with LBP.[33,34] Richardson *et al*, which has led to the development of the motor control intervention approach for LBP.[7,35]

Success in a majority of sports is dependent upon producing external forces while maintaining dynamic stability. Balance is maintained by keeping the body's centre of gravity over its base of support. External forces have the potential to disrupt balance by altering the centre of gravity. [36] While external loads are acting on the body, internal forces particularly in the lumbo-pelvic-hip complex are utilized to maintain equilibrium of the body.[37] Communication between the musculature of the core and neuromuscular system is what enables the body to regain this new equilibrium state and allow for core stability to occur.[38]

Once above mentioned mechanism of core stability fails instability results. Instability is the failure of the core musculature to apply enough force to maintain correct vertebral alignment. [39] In this context loss of core stability would lead to a suboptimal production of external forces. When stability is present, there is a failure to maintain correct vertebral alignment, Cowley *et al* argue that core instability could be caused by deficiencies in muscular strength, muscular capacity and coordination of limb movement or a combination of any of these.[40]

Anticipatory postural adjustments

When a simultaneous task to perform a fast, focal voluntary movement coexists with a task to maintain equilibrium, feed forward adjustments in the activity of the postural muscle are used to counteract the perturbing forces. These reactions are generated by the CNS in anticipation of a perturbation, and therefore they have been termed "anticipatory postural adjustments".[41] There is a pre programming of the postural musculature, demonstrated this concept in showing that other muscles contract before the limb agonist when stability is challenged due to limb movement.[26] This postural adjustment allows the body to increase proximal stability and allow distal mobility.

EMG

Prescribing exercise based on these traditional methods may elicit an insufficient training approach. Alternatively, knowledge of neuromuscular activity through various physical fitness exercises can contribute to an improved understanding of function and informed prescription. EMG has been the one of the most researched technique in measuring the electrical activity of the muscle.[42] Recently, other modalities of estimating muscle activation have been implemented including muscle functional magnetic resonance imaging and ultrasound imaging.[43,44] Difference in activation, and cross sectional area of trunk muscles have been demonstrated between LBP patients and healthy controls.[45,46,47] In order to understand the reason for changes in muscle activation related to LBP, understanding about the muscle characteristics in healthy individuals is needed.

Rehabilitative ultrasound imaging (RUSI) permits visualization of the musculature and has been used to examine the function of the TrA.[48] RUSI is a valid tool at measuring muscle activation compared to MRI during an abdominal hollowing task with a correlation of .87.[49]

It also had been found that the multifidi and abdominal muscles require only 5% of a MVC for activities of daily living and 10% of a MVC for rigorous activities to stiffen the spinal segments.[50] Therefore a forced maximal contraction is not needed in order to increase core stability. Work done by researchers found that the amount of stability provided during a given task is dependent upon the load and direction of the load placed on the core.[27,51] Stability is greatest during the most difficult tasks and decreases during periods of low muscular activity.[27]

Bridging exercise as a stabilization exercise

Bridging exercises are a commonly used form of stabilization exercise for the trunk muscles and they can also be applied to a large spectrum of patients with LBP.[52] The supine posture with knees and hips bent used during

bridging exercise is to most LBP patients a comfortable, pain-free posture. From this position more graded activities can be performed such as lifting the pelvis. In order to create more functional tasks, limb movements can be added. The movement can strengthen global musculature through weight bearing. It can also facilitate pelvic motion in a standing posture and in preparation for the stance phase of gait.[53]

Unstable surface

An unstable support surface cause body perturbation, leading to an increase in activity by the trunk muscles in an effort to maintain postural stability.[54] Therefore, if an unstable surface is used during the bridging exercise, the co activation of trunk muscles be enhanced to reduce body perturbation. When a back bridging exercise was performed on a unstable supporting surface using a balance pad or an air cushion, the trunk muscle activity increased.[52] The transverse abdominis activity ratio increased during a sling based back bridging exercise when the exercise were performed with abduction of the hip. Although, Imai *et al* used various stabilization exercises and unstable support surfaces.[54] The changes of muscle activities in the back bridging exercise could not be isolated in their study, and there are conflicting opinion on whether using unstable surfaces such as a Swiss ball is effective at increasing the level of difficulty.[55,56]

In a separate study, performing a bench press on an unstable surface was shown to have no effect on electromyographic (EMG) recordings, al-though, force output was decreased.[57,58] In contrast, trunk muscle activity increased when performing a squat on an unstable surface . The patients with LBP demonstrated a tendency to activate their trunk (global mobilizer and local stabilizer) muscles to higher % MVIC levels during the unstable surface, in the supine and prone positions.[59] Concerning the abdominal muscle activity, several studies investigated only the activity of the rectus abdominis (RA)

and external oblique (EO).[60,61,62, 63,64, 65,66] Both classified as so-called global muscles. Concerning the back muscle activity, the erector spinae muscles were often considered as one muscle group.[67,52,68]

Conclusion

Consequently, there is a dearth of complete overview of relative abdominal and back muscle activity. As interplay between local and global muscle systems is considered important, analysis is needed to detect the relative contribution of the local to global muscle activity. Hence, further research should emphasize on establishing the differences in electrical activity of various bridging variants.

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Effect of Complex Training on Salivary Cortisol Level, BOMB Test and Balance Performance in Shot-put Throwers: A Review

Mallika Nazish*, Saurabh Sharma**

Abstract

Performance in track and field throwing events depends to a large extent, on muscle power production. Combination of plyometric training and weight training are thought to be useful for developing athletic power. Training is an important component for achieving the goal. Both novice and elite throwers spend a large part of time preparing for conventional strength or various forms of power training in order to increase their power and strength, and ultimately aim to improve their throwing performance. However, there is a dearth of evidence of such training programs on shot put throwing performance. Steroid hormones play a key role in modulating the training response of the neuromuscular system. **Conclusion:** Literature on shot put players is very limited. BOMB may be a useful performance testing tool for throwers in the sports of athletics this review highlights the acute effect of complex training on salivary cortisol level, throwing performance and dynamic balance by measuring on SEBT in shot put elite athlete.

Keywords: Complex training; BOMB; Cortisol level; SEBT.

Concept of complex training

Ebben *et al*[21] reviewed that the combining plyometric training and weight training may be helpful in developing athletic power. Importantly, complex training alternates similar high load weight training exercises with plyometric exercises, set for set, in the same workout Performance in track and field throwing events depends to a large extent, on muscle power production.[75] Training is an important component for achieving the goal. Zara *et al*[74] stated that both novice and elite throwers spend a large fraction of their preparation using either conventional strength training or various forms of power training in order to increase their power and strength, and ultimately aim to improve their throwing performance. However, there is a dearth of evidence of such training programs

on shot put throwing performance. As salivary cortisol act as a biomarker for the resistance training. Nunes *et al*[50] stated that Steroid hormones play a key role in modulating the training response of the neuromuscular system. For example, the anabolic effects of testosterone (T) and the catabolic effects of cortisol (C) help to control muscle growth and performance.[17] However, little is known about the T and C responses of elite female athletes and the influence of different workouts.[40,44] Nunes *et al*[50] said that such an analysis is important because resistance training is now widely employed by female athletes to improve neuromuscular performance. Ekstrand[22] suggested that BOMB may be a useful performance testing tool for throwers in the sports of athletics. Salehzadeh *et al*[56] reported that Balance is inseparable part of the daily activities and it is an important index in the evaluation of athletes' performances and in this research he reported that combination of strength(resistance training) and plyometric training had a positive result in increasing the balance although they worked on handball players. Although there is lack of knowledge in literature on these

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important variables in shot putting athlete. This review examines the literature evidence of acute effect of complex training on salivary cortisol level, throwing performance and dynamic balance by measuring on SEBT in shot put elite athlete.

Shot putting is one of the most ancient forms of athletic competition. Considerable research has been performed on the event. But there is no research on the training aspect in the shot put athlete especially female athlete. Shot put is a game of immense power required for a short period of time. The goal of shot putting is throwing a heavy ball as far as possible. The researches done in the field of techniques, analysis etc. G terzis[66] states that neuromuscular training is the most important for the shot put athlete. Mont Hubbard[37] describes the importance of release variables in shotput. Gerasimos terzis[67] said that muscle strength correlates better than LBM with rotational shotput performance in elite shot putters. From a practical standpoint, there is a question arise, the question of whether training should be more focused towards the development of maximal strength or maximal power output. Schmidtbleicher[59] suggested that maximum strength is the primary influencing factor on power output. Results from a study by Stone and colleagues[62] confirmed the relationship between maximum strength and power and also provided insight to their effect on shot put performance. This study examined the relationship between strength and power indicators for 11 well-trained collegiate shot putters and found that maximum strength was strongly associated with peak power output, even with lighter loads such as the shot. Another study by Reis and Ferreira[55] evaluated the validity of several strength and power tests to predict performance in the shot put. The research gave equivocal results as some tests of power (such as a variety of jumping tests) did not correlate with performance while throwing tests (power) and weight lifting tests (strength) showed a significant association with performance As might be surmised, it is difficult to precisely determine the extent to which a thrower's anthropometry (especially

body mass) and muscle physiology characteristics are due to genetics and which are due to training. Ultimately it may be safe to say that the physical characteristics of elite level shot putters are likely affected by both training and genetics. In 2012, Gerasimos terzis[67] stated that 3 maximal bouts of shot put followed by 3 consecutive counter movement jumps or a bout of 20 m sprinting induce an acute increase in shot put performance in experienced shot putters. But there is no literature regarding any training based study along with the salivary cortisol level.

Plyometric training

The combination of weight training and plyometric training has also been investigated.[1,9, 12,26] Complex training combine biomechanically comparable high-load resistance training followed by Plyometric exercises on a set-for-set basis and has been proposed as a way to improve the quality of the plyometric training stimulus.[20] Ebben and Watts[20] upon literature study have come forward with recommendations for program design. Due to limited data, affirmative guidelines regarding the optimal amount of rest between sets of resistance training and subsequent plyometrics in the complex cannot be given. Evans *et al*[23] examined a complex of bench press and medicine ball put and found increase in medicine ball put when performed after the 5 repetitions maximum (5RM) bench press. This study suggests that efficacy of upper-body complex training and 4 minutes of intra complex rest may give better result.

Previous research has indicated that the overwhelming majority of shot put research that has been conducted largely on male athletes may not be applicable to female athletes.[2,3]

More specifically, the flight phase of the glide or spin may serve as a means of plyometrically loading the rear leg at touch-down. This would be expected to create greater force output owing to the stretch reflex effect

on the knee extensors. Likewise, it might be beneficial to perform plyometric exercises with loads similar to those of experienced in shot putting to mimic the load placed on the rear leg at rear foot touch-down, so that athletes can learn how to use the strengthened muscles.[73]

Biomarkers

Salivary biomarkers are used in stress research as it has proven superior to testing biomarkers in blood. It is well known that acute and chronic exercise elicits changes in levels of hormones and immunological compound.[8,10,28] With recent advances in the field of immune logical and molecular biology, scientists have found more promising ways of analyzing salivary biomarkers and apply them to stress research.[46] More recently, several studies have utilized saliva measures as to assess the levels of these compounds in response to exercise and training.[15,16,49,24, 34,19] Saliva offers a non-invasive and stress-free alternative to serum. In the last few years, saliva analysis has been a useful method of choice for hormone analyses.[27] Saliva collection and analysis is rapidly developing as a tool for the assessment of physiological bio- markers of sports training and Saliva can provide a useful, non-invasive alternative to the collection of serum and plasma, because it can be collected rapidly, frequently and without stress.[10] Papacosta & Nassis *et al*[52] stated that the use of saliva for monitoring steroid, peptide, and immune markers in sport and exercise has made saliva sampling and analysis very attractive to several researchers and clinicians. Cortisol the core glucocorticoid in humans, is known for its important role in metabolism and immune function.[53,31]. Increased cortisol levels are associated with anxiety[41], depression states[29] and intensive physical exercise.[51,63] It is considered catabolic in nature because of its effect on protein and carbohydrate metabolism.[69,72] Stimulation of gluconeogenesis by cortisol spares blood glucose and reduces protein stores. Such diminution of stored protein

may lead to a wasting of skeletal muscle.[69]

Salivary cortisol is a well known biomarker used for assessing resistance training. Salivary hormonal responses to resistance exercise between long-term strength-training and untrained middle-aged men have been investigated.[45] Training that combines both power and strength stimulus has been reported to be superior to more conventional weight training bouts in actualizing strength and power gains.[1,6,13,24] In 2007 article, Cormie *et al*[13] concluded that combining strength and power produced greater improvements in jump height or related power output compared with a power workout that was matched for work performed. Indeed, the use of a combination of high force and high power seems to be superior to classical exercise prescriptions in terms of functional benefits.[30,33,54] Crewther *et al*[14] examined the salivary free cortisol response to resistance exercise with respect to the different training variables, equated by the workout duration and load volume. Hormones with anabolic or catabolic properties, such as testosterone and cortisol, respectively, show quantitative changes, signaling a catabolic state, in relation to the intensity and duration of a preceding physical load.[27] Psychological stressors of competition may be the prime regulator of C and performance.[18] The non-invasive nature of saliva collection also eliminates stress responses associated with blood collection techniques (e.g. Venipuncture).[14] Chronically elevated cortisol levels have been linked to various stressors (eg. Depression, trauma, over training); hence this glucocorticoid is also considered to be one of the primary stress hormones.[17]

A rise in C levels has been observed in many sporting competitions, and these hormonal changes often enhanced the performance and behavioral outcomes. For example, judoists displaying higher Sal-C levels also had higher motivation to perform and obtained the better outcome[57] and higher C levels were found in judo winners when compared with losers.[64] These data confirm suggestions

that C may be essential for working capacity and performance.[70] Thus, acute elevations in C may actually benefit athlete performance during competition.[18] Resting circulating cortisol and testosterone concentrations have been examined in athletes as possible biological markers of overreaching and the overtraining syndrome.[69] Training strain is recognized as a potent stimulator for stress hormone (e.g., glucocorticoids and catecholamines) secretion.[35,43] Nunes *et al* [50] reported that that high volume resistance exercise schemes can stimulate greater C secretion because of higher metabolic demand in elite female athletes. Crewther *et al*[18] stated on effect of training volumes on salivary cortisol level with higher in values when relate to the 1 RM lift during stimulated competition in weightlifters. Complex training and salivary cortisol level is not addressed simultaneously together but in a recent research by Beaven *et al*[7] showed a trivial increase in the cortisol level and this study was mostly focused on salivary testosterone level rather than cortisol level.

Star Excursion Balance Test (SEBT)

The Star Excursion Balance Test (SEBT) is a dynamic test that has prerequisites for strength, flexibility, and proprioception. The goal of the SEBT is to maintain single leg stance on one leg while reaching as far as possible with the contra lateral leg.[39] The SEBT is used to assess physical performance, balance ability among different sports. Researchers have suggested using the SEBT as a screening tool for sport participation and as a post-rehabilitation test to ensure dynamic functional symmetry.[42] Further, researchers have shown that SEBT performance improves after training.[32,36,42] Dynamic balance is defined and measure as the ability of a person to keep balance from dynamic condition to static condition.[71]. Some training that athletes use to improve different performances is strength and plyometric training. In most of the researches, it is reported that a combination of plyometric trainings and strength trainings in comparisons with using

these trainings alone and separately, cause to achieve the highest performances.[1,60] Asadi *et al*[5] reported increased score in dynamic balance by using SEBT test in basket players after in season plyometric training. although there is a little research on dynamic balance when both strength and plyometric training combined as complex training. In a research by Salehzadeh, Karim, *et al*[56] reported an increase in SEBT score in teenage handball players during 8 week of complex training.

Backward overhead medicine ball throw test is a reliable test used to assess the strength in upper body. Medicine ball throws integrate, multidimensional training in that they permit multiplanar movement, greater ranges of motion, and amalgamate a variety of muscle contraction sequences and velocities.[11] The dynamic nature of standing medicine ball throws is increasingly being used as a training tool because they integrate the whole body into each movement task. In pursuit to develop training programs that are more sport specific, coaches are trying to find new methods of using medicine ball throws to train the specific performance characteristics. Physically it requires proprioception and coordination, with multi planar movement.[11] To assess athletic ability during this type of activity, testing may also need to involve integrated, multidimensional movement that simulates as closely as possible the activities required for success in a particular sport.[11]

There is short of study in this area of salivary cortisol level in track n field event especially in female shot put athlete as it is a explosive event as described above. So our purpose of study to see the acute effect of complex training on cortisol level, throwing performance, functional ability and balance in young female shot put athlete.

Current Level of Evidence

As the previous review indicates much has been written on the action of shot putting. Despite this, much still remains to be known about the movement and the training aspect. As we all know the training is an important

component for any sport performance. Now a day's an emerging focus of research is on salivary cortisol which is an important biomarker for any resistance and plyometric training together defined as the complex training. There is a lack of knowledge on to the measurement of power and balance performance together in shotput female athlete after and complex training. Special circumstances unique to the event and the advancement of research methodology make the training ideal for further research.

Research on Current Elite Athletes is Limited

In addition to the effect of doping, the techniques used, the skill level of Participants, and athlete genders are all issues that leave room for further study. The large majority of current research on the shot put has examined sub-elite athletes ranging from the novice to collegiate level throwers.[37] Only a small number of studies have quantitatively examined elite athletes.[4,48,73]. Previous research on shot putting[47,65] and other activities[68] has indicated that the movement kinematics for performers of different skill levels is significantly different even in relatively homogenous subject pools. This may indicate that research findings from one skill level are not applicable to others, especially when the objective is performance enhancement.

Conclusion

By reviewing the literature, there seems to be dearth of evidence on the research on salivary cortisol efficacy on complex training. The research is needed so as to understand the effect of complex training as this training is done by female shot put thrower. This research could give us a light on the consideration of salivary cortisol as a biomarker in the field of sports training.

The gender variability of salivary cortisol, SEBT is also poorly understood. Hence, it would be highly important parameter to analyze the by means of research.

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[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. *J Oral Pathol Med* 2006;35:540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. *Acta Odontol*

Scand 2003;61:347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antiseptics. State of the art. *Dermatology* 1997;195 Suppl 2:3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. *J Periodontol* 2000;71:1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. *Dent Mater* 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovou J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM, editors. *Dental caries: The disease and its clinical management*. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

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[8] World Health Organization. *Oral health surveys - basic methods*, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online – Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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