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ASSOCIATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) AND BODY MASS INDEX AMONG ASIAN POPULATIONS: A REVIEW

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ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is emerging as a major health related burden. The nutrition depletion and an increased metabolic demand lead to weight loss, therefore, malnutrition serves as a diagnostic feature of COPD. The data available from Asian countries regarding the nutritional status and COPD are very less and population or hospital based cross-sectional and longitudinal studies with standard nutritional assessment criteria are urgently required to know about this disease increasing at an alarming rate. In present review article, we scrutinized the available literature to find out the COPD association with body mass index (BMI) in the Asian population.

Keywords: COPD, BMI, underweight, normal weight, overweight/obese.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterized by persistent airflow obstruction, which is progressive and not fully reversible in nature (Pauwels and Rabe, 2004). The chronic airflow obstruction in COPD is caused by the combination of parenchymal destruction (emphysema) and airways disease (obstructive bronchiolitis) (Vestbo *et al*., 2013). It has a huge epidemiological burden in low, middle as well as high income countries, and considered as a fourth leading cause of death (Murray & Lopez, 2013). Globally, the prevalence of COPD is estimated to be approximately 9% to 10% in adults aged 40 years and above (Halbert *et al*., 2006; Mannino and Buist, 2007). According to World Health Organization, it has been estimated that about 3 million deaths were caused by the disease in 2015. Of these, more than 90% of COPD deaths occurred in low- and middle--income countries (WHO factsheet, updated 2017). The projection for 2030 implies that COPD will be the third leading cause of death worldwide (World Health Statistics 2008).

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The rising prevalence of COPD is associated with various comorbidities such as respiratory failure (Sin *et al*., 2006; Fabbri *et al*., 2008), coronary artery diseases, heart failure (Barnes & Celli, 2009), pulmonary vascular hypertension (Mal, 2007), and lung cancer (López-Encuentra, 2002). The causes of COPD have distinct patterns according to different geographical locations. Tobacco smoking is the biggest risk factor in high and middle income countries while in low income countries exposure to indoor air pollution such as the use of biomass fuels for cooking and heating, causes the COPD burden (Liu *et al*., 2007; Kurmi *et al*., 2010). Besides these, several other risk factors have been studied during past decades such as outdoor air pollution, long-standing asthma, and occupational exposure to dust/chemical fumes, lower respiratory tract infection during childhood (Mahmood *et al*., 2017) and genetic factors (Sandford *et al*., 1997). COPD is also prevalent in non-smokers (Hagstad *et al*., 2014; Pelicaric *et al*., 2012; Walia *et al*., 2016).

Malnutrition is also a potential risk factor associated with COPD (Ezzell & Jensen, 2000; Cao *et al*., 2006; Gologanu *et al*., 2014). Body Mass Index (BMI) categories have been studied in association with COPD by Lee *et al* (2013). Few studies have traced weight loss and nutrition depletion as a diagnostic feature of COPD (Benton *et al*., 2010; Dhakal *et al*., 2015; Hoong *et al*., 2016; Ingadottir *et al*., 2017). The undernourished COPD patients have greater mortality than the normally or well-nourished patients (Engelman *et al*., 1999).

A perusal of literature reveals that, a number of studies have been reported from different part of the world, examining the association with COPD with BMI, however, a limited numbers of such studies have been conducted in Asian countries. Of these, some studies have considered BMI as a prime contributor in development of the disease (Chan *et al*., 2017; Hogan *et al*., 2017), while others have studied BMI as an additional risk factor (Lee *et al*., 2016; Nakao *et al*., 2017). In the present review, an attempt has been made to compile the available literature to explore the differences in the prevalence rate of COPD in relation to BMI categories among Asian populations.

BMI and COPD

The World Health Organization (2000) has given Asian classification for BMI as: underweight (<18.5 kg/m^2), normal weight (18.5 to 22.9 kg/m^2), overweight (23 to 27.5 kg/m^2), and obese >27.5 kg/m^2). The prevalence of COPD according to BMI among Asian populations for combined sexes is presented in Table 1. The samples given in majorities of the studies consider both sexes together for COPD patients as well as controls. There are only a few studies that analysed their data separately for men and women.

UNDERWEIGHT AND COPD

Studies on Japanese COPD patients documented and proved that the weight reduction is a prime factorial indicator among COPD subjects. The underweight

prevalence was higher among hospitalized COPD patients (31%) than COPD subjects (14%) in general population (Oh *et al*., 2013; Yamauchi *et al*., 2014; Konishi *et al*., 2016). Population based studies conducted on Chinese also concluded that there is a correlation of low body weight and COPD. The percentage of underweight COPD subjects among Chinese ranged from 10.1% to 21.0% (Oh *et al*., 2013 and Zhong *et al*., 2007). In a study conducted in Regional Institute of Medical Sciences, Imphal, Manipur, India, Shimray *et al* (2014) found that among hospitalized COPD patients 46% were underweight. In north India Gupta *et al*. (2014) reported 57.8% underweight hospitalized COPD patients. This high proportion may be because the authors considered underweight patients below BMI value of 18.0 instead of 18.5 as proposed by WHO. Studies conducted on COPD patients in India showed a higher proportion of underweight COPD subjects as compared to Japan and China. A study conducted on 93 COPD patients in Motahari and Faghihi therapeutic Centre of Shiraz, Pakistan, weight loss was observed in 64 patients, which is significantly higher as compared to 108 controls of similar domain as the cases (Ahmadi *et al.*, 2012). South Asian countries have the highest number of underweight COPD patients as compared to rest of Asian countries. Oh *et al*.,(2013) conducted a study on seven cities belongs to different countries of Asia and documented the highest underweight COPD patients in Sri Lanka 47.3% followed by 32.1% Philippines, 25.0% in Malaysia, 9.8% in Korea and 8% Taiwan. But in seven Latin American cites studies, 6.7% were underweight (de Oca *et al*., 2008) which is very low as compared to the Asian countries. Ageing also enhance the body mass degradation among the COPD affected individuals. The underweight COPD subjects increases with age 28.2% (65-74 years) to 47.5% (75-84 years) and decreases with further advancing of age to 24.3% (>85 years) (Yamauchi *et al*., 2014). The decline in number of COPD patients with advancing age may be due to higher mortality rate in old age (above 85 years) as compared to lower age group (de Oca *et al*., 2008). The identical relation of BMI with COPD severity has also been mentioned in Asian populations (Agarwal *et al*., 2013; Yamauchi *et al*., 2014). The proportion of underweight COPD patients increased with advancing of COPD severity i.e. from I, II, III and IV it was 18.1%, 21.4%, 37.4% and 56.6% respectively (De, 2012). This shows the positive correlation with COPD severity and low BMI.

OVERWEIGHT AND OBESE AND COPD

The prevalence of COPD was found to be lower in well-nourished individuals than the undernourished individuals. The existence of COPD among obese and overweight is poorly understood (Naik *et al.*, 2014). The proportion of over weighted and obese COPD patients was found 4 % among individuals aged more than 65 years in Japan (Yamauchi *et al*., 2014). Oh *et al*., (2013) also reported the lower percentage of obese COPD patients in Malaysia (14%), Philippines (11%), Sri Lanka (9%) and the higher percentage Chinese (42.9%), Japanese (18.3%), Koreans (24.3%) and Taiwanese (32%). In Indian studies, COPD among overweight and obese individuals ranged from 6.8% to 20% (Gupta *et al*., 2014; Agarwal *et al*., 2013). In a cross-sectional study on Chinese population, Zhong *et al*., (2007) documented that

the 6.0% COPD subjects in his study were overweight (24.0 to 27.9 kg/m^2) and 5.4% were obese (≥28 kg/m^2). Later in 2016, Zhang *et al*., published a much higher estimated prevalence (i.e. 27.5% COPD patients) of overweight/obese (>25.4 kg/m^2) among Chinese. The findings from studies conducted on non-Asian populations, such as Madrid on 198,670 patients (aged >40 years), where about 3.2% of the subjects were detected to have COPD among which 25% were obese (García-Olmos *et al*., 2013). In a prospective cohort study conducted at the Copenhagen City Heart Study (Denmark) on 1,218 men and 914 women aged 21–89 years with airway obstruction (FEV1: FVC ratio <0.70), mortality due to COPD decreases as BMI increases (Landbo *et al*., 1999). Further, it has been supported by Cao *et al* (2012) in a meta-analysis based on 22 studies concluding that overweight and obesity had the protective effect against COPD mortality rates. In another prospective cohort study conducted on 1,213,829 Koreans aged 30–95 years, the risk of mortality was found drop off progressively with increasing BMI (Jee *et al*., 2006). Among Asian populations association of COPD and overweight/obesity does not give a clear picture.

NORMAL WEIGHT AND COPD

By studying the COPD patients having normal weight, Yamauchi *et al*., (2014) documented that 7% Japanese patients had low normal weight (18.5 to 22.9 kg/m^2), 5 % high normal weight (23.0 to 24.9 kg/m^2). 9.5% Chinese were between 8.5 - 23.9 kg/m^2, which is less as compared to the underweighted COPD subjects discussed earlier (Zhong *et al*., 2007). De Oca *et al*., (2008) found 30.3% COPD subjects in normal weight category from PLANTINO study, which is found to be low as compared to studies from Asian countries, such as 47% in China, 67.9% in Japan, 65.9% in Korea, 60.9% in Malaysia, 56.9% in Philippines, 43.6% in Sri Lanka, 60% in Taiwan (Oh *et al*., 2013), 35.4 to 60% (Gupta *et al*., 2014; Agarwal *et al*., 2013) from north India.

CONCLUSIONS

The association of COPD and BMI has been observed in all categories of BMI. The studies conducted in the Asian continental supported the relation of underweight and COPD. The reduction of body weight was observed among COPD affected individuals in Asian population. The risk of developing COPD in underweight BMI group was three times higher than that in the normal BMI group (Ding *et al*., 2015). Some studies on Asian continental also showed a positive association of COPD and obesity, while others do not support this view. The difference is also because of study sample, e.g. in population specific studies the prevalence of overweighed/obese COPD patients were found to be less as compared to hospitalized COPD patients who perhaps belong to mixed population (Zhong *et al*., 2007; Agarwal *et al*., 2013; Gupta *et al*., 2014). Since, the data available on Asian countries regarding relationship of COPD and BMI is less, it is suggested that more studies across Asian populations need to be conducted to arrive at substantive conclusion.

Table 1: Prevalence of COPD patients by categories of BMI in Asian Population

Reference	*Country*	*Study population*	*Subjects**	*Mean age*	*Mean BMI*	*Under weight^*	*Normal weight#*	*Over Weight!*	*Obese$*
Katsura *et al*., (2005)	Japan	Tokyo Metropolitan Geriatric Medical Centre	83	74.6	20.8	41%	NA	59%	NA
Chaicharn Pothirat *et al*., (2007)	Thailand	Northern Thailand COPD Patients	195	67.7	NA	41.8%	50.0%	8.2%	0.0%
Sajal De (2012)	India	Tertiary Care Hospital From Central India	1269	62.1	20.2	37.9%	48.9%	11.0%	2.2%
Joo *et al*., (2012)	Korea	KOREANS	354	64.6	NA	5.7%	70.8%	23.5%	0.0%
Oh *et al*., (2013)	Korea	Seven Asian Cities	922	68.2	22.1	19.4%	NA	20.5%	NA
		China	70	68.9	24.0	10.1%		42.9%	
		Japan	268	69.4	22.3	13.8%		18.3%	
		Korea	173	69	23.0	9.8%		24.3%	
		Malaysia	92	68.3	21.1	25.0%		14.1%	
		Philippines	109	64.1	20.8	32.1%		11%	
		Sri Lanka	110	63.8	20.0	47.3%		9.1%	
		Taiwan	100	72.3	23.8	8.0%		32.0%	
Gupta *et al*., (2014)	India	COPD Patients Northern India	147	55.6	18.23	57.8%	35.4%	4.1%	2.7%
Ding *et al*., (2015)	China	Li Ethnic Group In Hainan	277	69.9	20.2	32.5	57.1	10.5	NA
Hogan *et al*., (2017)	Vietnam	COPD outpatients	29	69.7	21.1	27.6%	62.1%	6.9%	0.0%

* subjects are COPD patients both males and females combined.
^ Under weight is defined according to WHO Guidelines of BMI (< 18.5kg/m^2)
# Normal weight 18.5 kg/m^2 –24.9 kg/m^2;
! 25.0 kg/m2 –29.9 kg/m^2 overweight &$ obese (>30.0kg/m^2)
NA-not available

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