

ORIGINAL ARTICLE

**ANOREXIA NERVOSA AND EATING DISORDER NOT OTHERWISE SPECIFIED (NOS) IN SINGAPORE: A SEVEN-YEAR RETROSPECTIVE STUDY**

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**Abstract**

**Objective:** Anorexia nervosa and eating disorder not otherwise specified (NOS), an eating disorder not fulfilling anorexia nervosa DSM-IV criteria are on a rising trend in Singapore. The aims of this paper were to study the clinical characteristics and features of patients with anorexia and eating disorder NOS in Singapore. **Methods:** A retrospective cohort analysis of 373 patients between 2003 and 2010 at a tertiary hospital was done. Inclusion criteria included inpatients and outpatients with the age range of 12 years old to 40 years old fulfilling the Diagnostic and Statistical Manual (DSM)-IV criteria for anorexia nervosa and patients with the diagnosis of eating disorder NOS. The subjects are analyzed based on the severity of the eating disorder and the presentation subtypes. **Results:** An analysis of the overall demographic data revealed the female to the male ratio to be 22.4:1. The Chinese formed the largest ethnic group in the study population with 242 (86.1%) patients, and the bulk of the patients (75.8%) patients were between 12 to 20 years old. Anorexia nervosa-restricting subtype was the most common eating disorder (55.2%) and the most common body mass Index (BMI) was between BMI 14.6 – 16.5 (35.2%). Restriction technique ( $p = 0.01$ ), binge/purge ( $p = 0.03$ ) and exercise ( $p < 0.001$ ) are statistically significant to cause transaminitis in patients. **Conclusion:** There were significant changes in the demographics compared to the study reviewing patients from 1994 and 2002. There was a significant increase in the Caucasian population with changes in the Singapore immigration policy. A detail history taken during first visit can reduce the morbidity and mortality of these patients. *ASEAN Journal of Psychiatry, Vol. 17 (1): January – June 2016: XX XX.*

**Keywords:** Anorexia Nervosa, Eating Disorder, Restriction, Binge/Purge, Transaminitis

**Introduction**

Anorexia nervosa is on the rise globally. The last demographic analysis of anorexic patients in Singapore was done in 2005. A total of 126 patients were included in the eight-year retrospective study [1]. It is timely for a more recent review to ascertain the current demographic picture in this group of patients.

Anorexia nervosa frequently appears during the teen years or young adulthood but may also develop during childhood or later in life [2, 3]. They usually affect both women and men in a ratio of around 10:1.

The Diagnostic and Statistical Manual of Mental Disorders (DSM IV) criteria for anorexia nervosa [4] are defined as: A. Refusal to maintain body weight at or above a

minimally normal weight for age and height (e.g. weight loss leading to maintenance of body weight less than 85% of that expected; or failure to make an expected weight gains during the period of growth, leading to body weight less than 85% of that expected); B. Intense fear of gaining weight or becoming fat, even though underweight; C. Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial about the seriousness of the current low body weight; E. In post-menarche females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles (A woman is considered to have amenorrhea if her periods occur only following hormone, e.g., estrogen, administration.); E. They are divided into either the restrictive type or the binge-eating/purging type, (a) Restrictive Type: during the current episode of Anorexia Nervosa, the person has not regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics or enemas), and (b) Binge-Eating/Purging Type: during the current episode of Anorexia Nervosa, the person has regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas).

Eating disorder not otherwise specified (NOS) is generic group encompassing patients who eating disorders not fulfilling anorexia or bulimia categories. This study will look at the group which does not fulfill DSM-IV criteria for anorexia nervosa, e.g. lack of menstruation. This group will be re-classified as anorexia nervosa patients under the new DSM-V criteria.

During times of starvation, the hepatocytes may first undergo reduction in size and gradual cessation of metabolic activities. During extreme starvation, the complete cessation of core metabolic activities may bring about cell death or apoptosis. The breakdown of the cellular membranes will lead to leakage of the liver enzymes and present with the phenomenon of transaminitis i.e. abnormalities in liver function tests.

This study presents the current demographic picture of patients suffering from anorexic and

eating disorder NOS and also attempts to identify whether the means of weight loss is associated with medical complications, specifically liver function abnormalities.

## **Methods**

The study design was a retrospective cohort study of patients with eating disorders under the care of Department of Psychiatry, Singapore General Hospital from 01 January 2003 to 31 December 2010. Inclusion criteria included inpatients and outpatients with the age range of 12 years old to 40 years old fulfilling the DSM-IV criteria for anorexia nervosa and patients with the diagnosis of eating disorder not otherwise specified (without fulfilling the criteria of amenorrhea, i.e. absence of at least 3 menstrual cycles) [5][6] with liver function tests done. The age limit was set from 12 years old to 40 years old because patients less than 12 years old would be treated in a hospital specializing in pediatric care and would not be transferred to Singapore General Hospital. The upper limit of 40 years old was set because the epidemiology of first onset eating disorders usually occurred in the younger age group and the catchment for eating disorder patients above 40 years old was small. The period of study was limited from Jan 2003 to Dec 2010 because Singapore General Hospital Eating Disorder service was only set up in 2003. The cut-off of Dec 2010 was an arbitrary cut off to facilitate completion of the thesis.

Data mining was done by 2 independent doctors from Apr 2012 to Mar 2013. Both doctors were trained together to ensure consistency in the data collection. Patients with existing liver diseases, drug overdoses (intentional and accidental) during the first consultation or had history of substance abuses, e.g. alcohol, opiates were excluded from the study as they might cause liver function abnormalities with their pre-existing medical conditions.

The study was cleared by the Singhealth Centralised Institutional Review Board (CIRB) which operated in accordance with the International Conference on Harmonisation (ICH) / Singapore Guideline for Good Clinical Practices (SGGCP). The statistical power of

the study was calculated by the help from a statistician. A total of 373 patients were identified in the study of which 281 were included. Ninety-two patients were excluded as 89 of them had either bulimia nervosa or eating disorder NOS with body mass index more than 18.5. Three were excluded as they exceeded the age limit of 40 years old. The case notes of eligible patients were reviewed and information about the demographics, body mass index, presence and absence of liver function abnormalities. Methods uses for weight loss and treatment regime were collected.

The liver function abnormalities were determined by looking at elevations of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and also alkaline phosphatase (ALP) in the liver panel during the initial consult. Any results which were above the stipulated range for the respective liver enzymes would be considered as having liver function abnormalities or transaminitis.

The various methods which were used for weight loss for all included patients were correlated with the presence of abnormal liver function tests. The main methods included restriction of diet, binge-purging, exercising and usage of drugs such as laxatives, diuretics and slimming pills. It was easy to elicit history of restriction of diet, binge-purging or long term usage of drugs such as laxatives, diuretics and slimming pills from the history. However, the definition of “adequate” exercise to amount to weight loss was subjective. According to the Health Promotion Board guidelines to healthy weight loss, an individual needed to do at least 150 minutes to 300 minutes of moderate-intensive aerobic activity per week for optimum weight loss. Each

session of aerobic activity should last at least 10 minutes. [7] The above guide was set as the criteria for investigating exercise as a risk factor for weight loss in patients with eating disorders.

More often than not, more than one method was used in their attempts to lose weight. Data analysis was done comparing one method against the rest, eg. restrictive (in the absence or presence of other weight loss methods) compared with all other weight loss methods without using restriction of diet.

Statistical analysis was done using the Statistical Package for Social Sciences Version 21.0 (SPSS v21.0 for Windows XP). Parametric variables would be analyzed using T-test and Chi-square test while nonparametric variables would be analyzed using Kruskal-Wallis and Man-Whitney U tests for continuous and categorical variables respectively. Statistical significance was set at 0.05. The data analyst was blinded to the data collection.

## **Results**

### ***Demographics Analysis***

A total of 281 patients with eating disorders were included in the study. The demographic details are appended in Table 1. An analysis of the overall demographic data revealed the female to a male ratio to be 22.4:1. The Chinese formed the largest ethnic group in the study population with 242 (86.1%) patients. The second largest ethnic group belonged to Caucasian with 20 (7.47%) patients. The third and last ethnic groups belonged to the Indian and Malay with 11 (3.91%) patients and 7 (2.49%) patients respectively.

**Table 1. Demographic and clinical characteristics of the sample**

Variable	All (%) (n = 281)	BMI Group 1 (%) (n = 5)	BMI Group 2 (%) (n = 30)	BMI Group 3 (%) (n = 87)	BMI Group 4 (%) (n = 96)	BMI Group 5 (%) (n = 63)
Gender						
Female	95.7 (269)	100 (5)	100 (30)	95.83 (84)	96.43 (93)	92.16 (57)
Male	4.27 (12)	0.0	0.0	4.17 (3)	3.57 (3)	7.84 (6)
Age (years)	18.3 ± 4.9 <sup>a</sup>	22.0 ± 6.0 <sup>a</sup>	19.0 ± 5.6 <sup>a</sup>	17.8 ± 4.7 <sup>a</sup>	18.5 ± 5.3 <sup>a</sup>	18.2 ± 4.0 <sup>a</sup>
12 – 16	44.48 (125)	20.0 (1)	37.4 (12)	50.0 (45)	42.9 (42)	38.0 (25)
17 – 20	31.31 (88)	20.0 (1)	33.3 (10)	31.9 (26)	31.0 (29)	36.0 (23)
21 – 30	21.35 (60)	60.0 (3)	24.1 (7)	15.3 (14)	21.4 (21)	26.0 (15)
31 – 40	2.84 (8)	0.0	3.45 (1)	2.78 (2)	4.76 (4)	0.0
Race						
Chinese	86.12 (242)	100 (5)	90.0 (27)	93.1 (81)	84.38 (81)	77.78 (49)
Malay	2.49 (7)	0.0	0.0	0.0	3.13 (3)	6.35 (4)
Indian	3.91 (11)	0.0	3.45 (1)	3.45 (3)	3.13 (3)	6.35 (4)
Caucasian	7.47 (21)	0.0	6.9 (2)	3.45 (3)	10.71 (9)	9.52 (6)
Eating Disorder diagnosis						
AN-R	55.15 (155)	60.0 (3)	80.0 (24)	77.0 (67)	49.0 (47)	22.2 (14)
AN-B/P	24.91 (70)	40.0 (2)	16.7 (5)	18.39 (16)	35.4 (34)	20.6 (13)
EDNOS	19.93 (56)	0.0	3.3 (1)	4.5 (4)	15.6 (15)	57.2 (36)
Means of weight loss <sup>b</sup>	n=344	n=9	n=38	n=112	n=124	n=61
Restriction	56.20 (186)	44.4 (4)	63.2 (24)	63.4 (71)	47.6 (59)	45.9 (28)
B/P	24.14 (89)	33.3 (3)	18.4 (7)	16.1 (18)	29.0 (36)	36.2 (25)
Exercise	15.86 (55)	11.1 (1)	15.8 (6)	18.8 (21)	19.4 (24)	4.9 (3)
Drugs	3.79 (14)	11.1 (1)	2.6 (1)	1.79 (2)	4.0 (5)	8.2 (5)

AN-R = Anorexia nervosa–restrictive subtype; AN-B/P= Anorexia nervosa-binge-purge subtype; EDNOS = Eating Disorder Not Otherwise Specified; <sup>a</sup> Mean ± standard deviation are reported for age; <sup>b</sup>Numbers may add up exceeding initial population of 281 as the patients may use one or more methods of weight loss.

Two hundred and thirteen (75.8%) patients were between 12 to 20 years old. Significantly, patients between 12 to 16 years old who would be in secondary school education formed 44.5% of the study population. Sixty (21.4%) patients were aged between 21 to 30 years old, and the smallest proportion belonged to 31 to 40 years-old group with 8 (2.9%) patients. Correlation coefficients were computed between BMI and age, and it was not significant,  $r = .028$ ,  $p > 0.05$ .

Anorexia nervosa- restricting subtype was the most common eating disorder, accounting for 155 patients and constituted 55.2% of the total population. Anorexia nervosa- binge-purging subtype formed the second most common eating disorder in the study, accounting for 24.9% (70 patients) of the total population. Eating disorders not otherwise specified\* accounted for 19.9% (56 patients) of the total population.

### **Demographics analysis with severity of body mass index**

We divided the body mass index into 5 groups for more detailed analysis in order to elucidate the body mass index ranges which were at the highest risk of developing transaminitis and of having a comorbid psychiatric condition. As our study population consisted of patients with anorexia sub-types, we set the upper limit of the body mass index to be 18.5 while having no restrictions on the lower limit. Group 1 consisted of patients with body mass index less than or equal to 10.5, Group 2 consisted of body mass index from 10.6 to 12.5, Group 3 consisted of body mass index from 12.6 to 14.5, Group 4 consisted of body mass index from 14.6 to 16.5 and lastly Group 5 consisted of body mass index from 16.6 to 18.5. The bulk of the study population was in Group 4 (BMI 14.6 – 16.5) with 96 (35.2%) patients followed by Group 3 (BMI 12.6 – 14.5) with 87 (30.1%) patients. Group 5 (BMI 16.6 – 18.5) was the next group with 63 (20.9%) patients followed by Group 2 (BMI 10.6 – 12.5) with 30 (10.7%) patients. Group 1 (BMI < 10.5) formed the smallest group with only 5 (1.8%) patients.

Group 1 constituted eating disorder patients with the most severe and lowest body mass index, i.e. less than or equal to 10.5. There were only 5 females in this very severe category and there were no males. Only Chinese was found in this category of eating disorder. Of the 5 patients, 2 were between 12 to 20 years old and three were between 21 to 30 years old. There was no patient in the 31 to 40 years-old group.

Group 2 constituted the second most severe range of body mass index with the range from 10.6 to 12.5. There were again no males with 30 female patients representing the category. Chinese was the predominant race in this category of BMI with 27 (90.0%) patients, followed by Caucasian with two (6.7%) patients and Indian with one (3.3%) patient. There were no Malay patients in this category. Twenty-two (72.4%) patients were below 21 years old, seven (24.1%) were 21 to 30 years old, and one (3.45%) was 31 to 40 years old. Of specific interest was the fact that teenagers

from 12 to 16 years-old form the bulk of the population with 37.9%.

Group 3 (BMI 12.6 – 14.5) had three (4.2%) males compared to 84 (95.8%) females. Chinese was the predominant race in this category of with 81 (93.1%) patients, followed by Caucasian and Indians with three (3.5%) patients each. There were no Malay patients within this group. 71 (81.9%) patients were below 21 years old, 14 (15.3%) were 21 to 30 years old, and two (2.8%) was 31 to 40 years old.

Group 4 (BMI 14.6 – 16.5) had 3 (3.6%) males compared to 93 (96.4%) females. Chinese was the predominant race in this category of BMI with 81 (84.4%) patients, followed by Caucasian with 9 (9.4%) patients, and Indians and Malays with 3 (3.1%) patients each. Seventy-four (73.8%) were below 21 years old, 21 (21.4%) were 21 to 30 years old, and 4 (4.8%) were 31 to 40 years old.

Group 5 represented the mildest category in this group and comprised of patients with body mass index between 16.6 and 18.5. Group 5 had the highest proportion of males compared to females among all the groups with males constituting 7.8% of the population in the group. Chinese was again the predominant race in this category with 49 (77.8%) patients, followed by Caucasian with 6 (9.5%) patients, Malays with 4 (6.4%) patients and Indians with 4 (6.4%) patients respectively. 48 (76.2%) were below 21 years old, 15 (23.8%) were 21 to 30 years old. There were no patients in the 31 to 40 years old group.

### **Different eating disorders subgroups**

An analysis of the 5 BMI groups was done with anorexia nervosa (restrictive subtype), anorexia nervosa (binge-purge subtype) and eating disorder not otherwise specified\*. A one-way analysis of variance was conducted to evaluate the relationship between Eating Disorder (ED) diagnoses and BMI. The three ED diagnoses are Anorexia nervosa–restrictive subtype (AN-R ); Anorexia nervosa-binge-purge subtype (AN-B/P ); and Eating Disorder Not Otherwise Specified (ED NOS

The result was significant,  $F(2,227) = 51.44$ ,  $p = 0.01$ . The effect size (eta square) at 27%, was strong.

Tukey post-hoc comparisons of the three groups indicated that all three groups were significantly different from the other two groups, with AN-R with the lowest mean BMI ( $M = 14.15$ ,  $SD = 1.75$ ),  $p = .01$ , followed by AN-BP (Mean,  $N = 15.21$ , Standard deviation,  $SD = 1.66$ ),  $p = 0.01$ , and lastly Eating Disorder NOS ( $M = 16.78$ ,  $SD = 1.66$ ),  $p = .001$ .

There were a total of 155 patients with anorexia nervosa (restrictive subtype). There were 3 (1.5%) patients with very severely low BMI in Group 1 ( $BMI < 10.5$ ) and 24 (16.8%) patients in Group 2 with BMI 10.6 to 12.5. The largest proportion fell in Group 3 (BMI 12.6 – 14.5) with 67 (42.3%) patients. 47 (30.7%) patients were in Group 4 and 14 (8.8%) patients were in Group 5 respectively.

There were 70 patients in the anorexia (binge-purge subtype) group. Two (3.6%) patients were in the severely low BMI group (Group 1), five (8.9%) patients were in Group 2 (BMI 10.6 -12.5), 16 (17.9%) patients were in Group 3 (BMI 12.6 – 14.5), 34 (53.6%) patients were in Group 4 (BMI 14.6 – 16.5) and lastly 13 (16.1%) patients were in Group 5. Group 4 (BMI 14.6 – 16.5) formed the bulk of the patients in this group. In the Eating Disorder NOS group, there were 56 patients. There were no patients in the severely low BMI range (i.e.  $BMI < 10.5$ ). One (2.8%) patient was in Group 2 (BMI 10.6 – 12.5), four (8.7%) patients were in Group 3 (BMI 12.6 – 14.5), 15 (26.1%) patients were in Group 4 (BMI 14.6 – 16.5) and the bulk of the population fell in Group 5 (BMI 16.6 – 18.5) with 36 (63.0%) patients.

### ***Different weight loss methods***

The means to losing weight could be divided into 4 broad categories, restrictive, binge-purge, exercise and lastly drugs, which included slimming pills, laxatives and diuretics. More often than not, more than one weight loss methods were used as the patients' means to losing weight.

Restriction was the most common method for weight loss with 186 (56.2%) patients adopting the method. Binge-purging was the second most common with 89 (24.1%) patients and exercise were the third most common with 55 (15.9%) patients. The number of people who used drugs such as slimming pills, laxatives and diuretics were grouped collectively. Together, they came up to 14 (3.8%) patients and formed the smallest group.

### ***BMI and Restrictive type***

An independent-samples t-test was conducted to evaluate the difference in BMI between patients who used restrictive mean to control weight versus those who did not use this mean. The result was significant,  $t(277) = 5.37$ ,  $p = .001$ . Patients who used restrictive means to control weight have lower BMI ( $M = 14.51$ ,  $SD = 1.89$ ) than patients who did not ( $M = 15.79$ ,  $SD = 1.87$ ). The effect size, Cohen  $d$ , at  $-0.68$ , is moderate.

### ***BMI and Binge-Purge Type***

An independent-samples t-test was conducted to evaluate the difference in BMI between patients who used binge-purge means to control weight versus those who did not use this mean. The result was significant,  $t(277) = -2.50$ ,  $p = 0.05$ . Patients who used binge-purge means has higher BMI ( $M = 15.37$ ,  $SD = 1.87$ ) than patients with did not binge-purge ( $M = 14.74$ ,  $SD = 1.99$ ). The effect size, Cohen  $d$ , at  $0.33$ , is small.

### ***BMI and Exercise Type***

An independent-samples t-test was conducted to evaluate the difference in BMI between patients who used exercise as a mean to control weight versus those who did not. The result was significant,  $t(277) = -2.48$ ,  $p = 0.05$ . Patients who used exercise as a mean to control weight had lower BMI ( $M = 14.35$ ,  $SD = 1.72$ ) than patients with did not ( $M = 15.09$ ,  $SD = 2.01$ ). The effect size, Cohen  $d$ , at  $-0.40$ , is small.

### ***BMI and Medication Type***

An independent-samples t-test was conducted to evaluate the difference in BMI between

patients who used medication as a mean to control weight and those who did not use medication. Results show no significant difference between these two groups,  $t(277) = -0.50, p > 0.05$ .

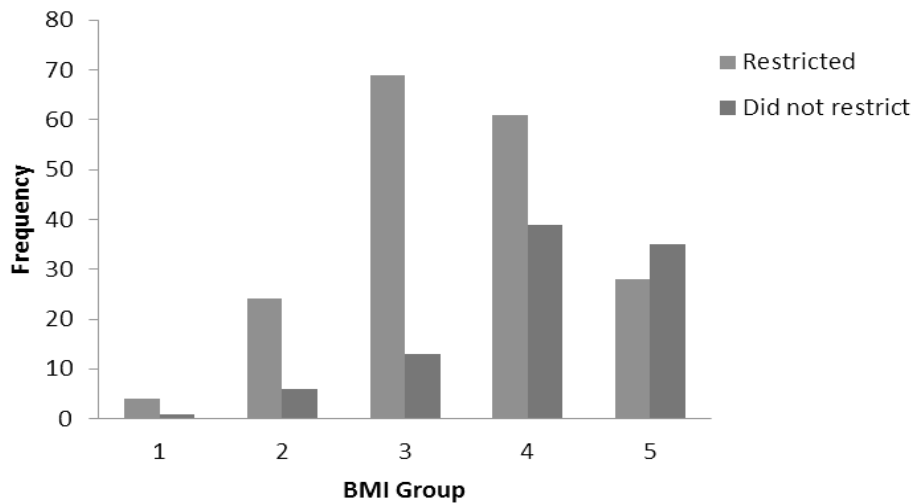
### ***Means of weight loss and presence of transaminitis***

The means to losing weight could be divided into 4 broad categories, restrictive, binge-purge, exercise and drugs, which included slimming pills, laxatives and diuretics. More often than not, a combination of methods was used. This analysis compared one weight loss methods against the other weight loss methods which could be a combination with the weight loss methods.

### ***Restrictive method***

There were 186 patients who used restriction as their method of weight loss out of 281 patients. These patients were compared to the remaining 94 patients who used other methods to lose weight. The purpose of this analysis was to ascertain if they were of increased risk to have transaminitis using the Chi-square test. Figure 1 showed the frequency of patients who employed restriction as a weight loss method compared to those who did not.

There was a significant association between using restriction as a method of weight loss and having transaminitis ( $\chi^2 = 11.42, p = .001$ ). People who use restriction as a means of weight loss were more likely to have transaminitis compared to patients who did not use restriction as a means of weight loss. (Odds ratio, OR=3.35)

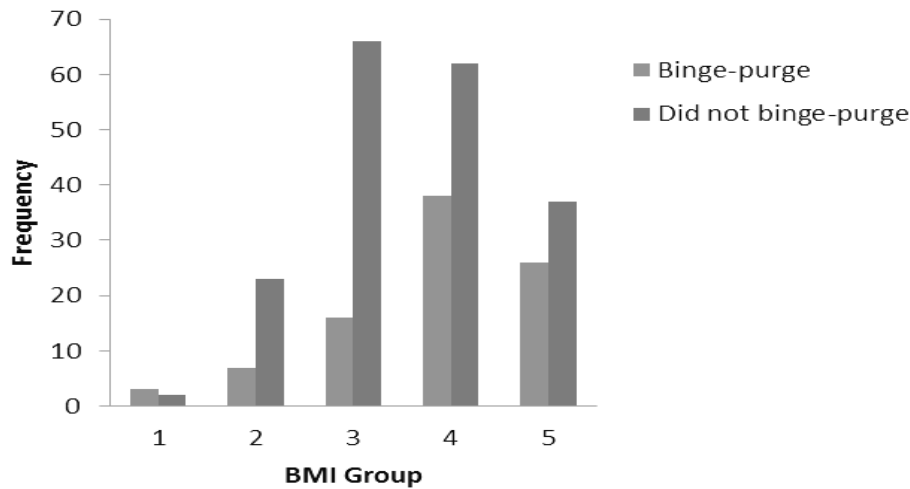


**Figure 1. Comparison of frequency of patients who used restriction as a method of weight loss and patients who did not.**

### ***Binge-purge***

Eighty-nine patients binged and/or purged to lose weight, out of the 281 patients. These patients were then compared to the remaining 192 patients who used one or more other

methods to lose weight and ascertained if they were of increased risk to have transaminitis using the Chi-square test. The frequency distribution as a function of BMI groups was shown in Figure 2.

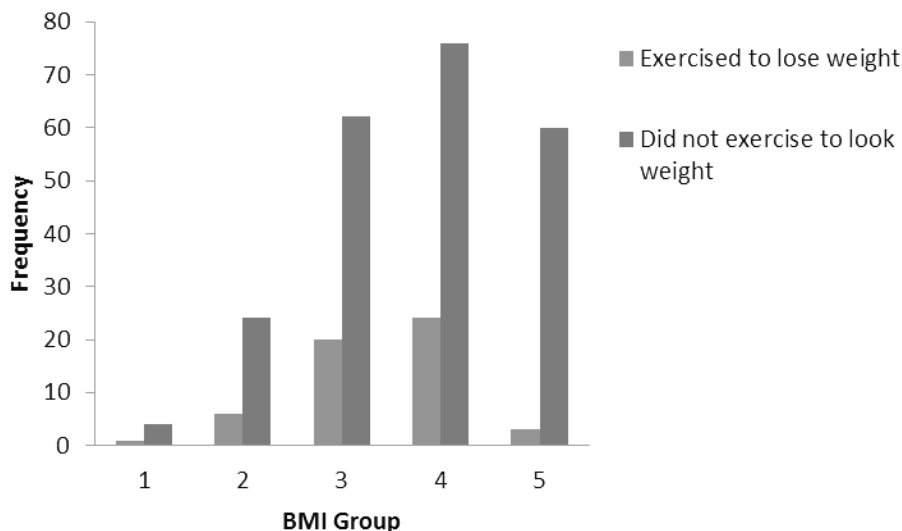


**Figure 2.** Comparison of frequency of patients who used binge-purge as a method of weight loss and patients who did not.

There was a significant association between binge-purge as a method of weight loss and having transaminitis ( $\chi^2 = 4.94, p = 0.03$ ). People who used binge-purge as a means of weight loss were less likely to have transaminitis compared to patients who did not use binge-purge as a means of weight loss (OR = 0.473).

#### *Exercise*

There were 55 patients who used exercise as their method of weight loss. These patients were compared to the remaining 226 patients who used one or more other methods to lose weight and ascertained if they were of increased risk to have transaminitis. Figure 3 showed the frequency distribution as a function of BMI groups.



**Figure 3.** Comparison of frequency of patients who used restriction as a method of weight loss and patients who did not.

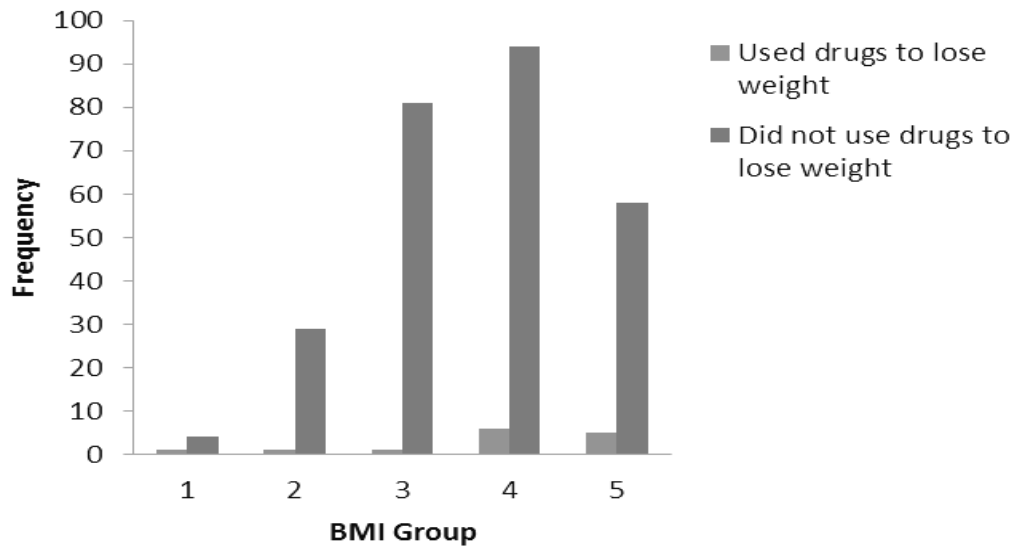


There was a significant association between using exercise as a method of weight loss and having transaminitis ( $\chi^2 = 15.49, p < .001$ ). (Figure 3) People who used exercise either on its own or together with other methods as a means of weight loss were 3.45 times more likely to have transaminitis compared to patients who did not use exercise as a means of weight loss. (OR=3.45)

### Drugs

Only a small number of patients acknowledged to using drugs such as

slimming pills, diuretics or laxatives to lose weight. This group formed the smallest group for comparison with only 14 patients using drugs either alone or in combination of other methods as their method of weight loss. These patients were compared to the remaining 267 patients who used one or more other methods to lose weight and ascertain if they were of increased risk to have transaminitis. The number of patients who used drugs and those who employed other methods are illustrated in Figure 4.



**Figure 4. Comparison of frequency of patients who used drugs as a method of weight loss and patients who did not.**

The results showed no significant association between using drugs as a method of weight loss and having transaminitis, ( $\chi^2 = 0.57, p = 0.74$ ). People who used drugs as a means of weight loss were no more likely to have transaminitis compared to patients who did not use drugs as a means of weight loss.

### Discussion

#### Demographics Analysis

The recent demographics paper on eating disorder patients in Singapore was published in 2005 by Lee H.Y. et al [1] following an

eight-year retrospective analysis from 1994 to 2002. That study focused on purely anorexia nervosa patients whereas this current thesis casted a wider net and included both anorexia nervosa patients and also patients who did not fulfill all the anorexia nervosa criteria for the eating disorder not otherwise specified group, which actually formed close to 20% of the entire study population. This thesis was a retrospective review which spanned from 2003 to 2010 and would provide an updated appraisal of the eating disorder demographics in Singapore. The advantage of having the 2005 study (which captures patients from 1994 to 2002) was that it would show the evolution

of eating disorder trends over the past ten years as the current study looked into patients from 2003 to 2010.

One notable difference between the current analysis and the 2005 analysis was the difference in the female to the male ratio. The most-recent female to a male ratio was 96:4 (269:12) which showed an increase in proportion in females compared to the 2005 ratio of female: male of 91%: 9% which approximated the well-known female: male ratio of 10: 1. This discrepancy could be due to the fact that this study now included patients from eating disorders not otherwise specified\* which might skew the data which originally only looked at anorexia nervosa groups. The other possibility could be that the study only captured the diagnosis at initial presentation. Tiffany C. Sanford-Martens et al reported difficulties in establishing male college athletes with eating disorder as their exercise regime might mask their body distortion [8,9]. Hence more clinical evaluations might be needed to establish male patients with eating disorders and only getting information on initial review might not effectively capture all the male patients with eating disorders.

Singapore is a multiracial society. The Singapore demographics profile 2012 revealed that Singapore was made up of Chinese 76.8%, Malay 13.9%, Indian 7.9%, others 1.4%. [10] As we looked into the 2005 study, Chinese formed 84.1% of the anorexia patients. The Indians formed the second largest group with 7.9%, the Malays formed the third largest group with 4.8% and others (predominantly Caucasians) formed 3.2%. In the current study, the Chinese formed the largest ethnic group in the study population with 242 (86.1%) patients. The second largest ethnic group belonged to Caucasian with 21 (7.5%) patients. The third and last ethnic groups belonged to the Indian and Malay with 11 (3.9%) patients and 7 (2.5%) patients respectively.

The spread of western media is global and is easily accessible to every household in Singapore either through the Internet, television or even publications in news and magazines, i.e. its impact should be equal in

all individuals in Singapore. Hence we would expect the proportion of the patients to parallel that of the national demographics.

The proportions of Chinese's patients were comparable in the 2005 and the current study. Even though it remained at approximately 85%, it was still significantly higher compared to the National proportion. There had been an increase in the others (Caucasian) category which could be due to increase in numbers of immigrants in Singapore over the past few years, but it also did not explain the disproportionate increase compared to the National statistics. The statistics for the other races such as the Indians and Malays actually dropped over time. One postulation could be that the local Chinese and Caucasians/ other's races are more receptive to the Western media compared to the other races in Singapore. Indians and Malays might have stronger cultural beliefs, which do not pressure on the need to be thin to be considered attractive. They were brought up with diets, which were often to be considered high caloric, and they might be used to not having to lose weight to be attractive. Prof Ho T.F. and Dr Lee E.L. did a community study on eating disorders and found out that Malays are more prone to Bulimia Nervosa compared to Anorexia Nervosa, and they were also less likely to seek help.

Developmental theorist Erik Ericson had identified 11 years of age through the end of adolescence as the stage whereby the individual would undergo both identity formation and role diffusion. During this stage, the individual would struggle to develop ego identity (i.e. sense of inner sameness and continuity) and would have a preoccupation with appearance, hero worship and ideology. Group identity also developed during this stage. As discussed earlier, the western media had influenced Singapore in many ways, and it was inevitable that the Singaporean would identify more with the cultures and beliefs about the west as we were brought up embracing their shows, diet and ideals of beauty. Not surprisingly, the bulk of the patients (75.8%, n=213) patients were between 12 to 20 years old. Significantly, patients between 12 to 16 years old who would be in

secondary school education forms 44.5% of the study population.

The current shortcoming of the DSM-IV scheme for classifying eating disorders was that it could be very rigid. Patients with eating disorders who did not fit within the criteria would be immediately put down the category eating disorder not otherwise specified. Hence it was not surprising that patients with eating disorders not otherwise specified\* in the study accounted for 19.9% (56 patients) of the total study population.

The new DSM V's criteria [11] for eating disorder noted the restrictions in the current diagnostic framework. In the draft revision of DSM V framework, the amenorrhea criterion was dropped in the anorexia nervosa diagnostic criteria. This move will move patients with eating disorder not otherwise specified\* under the diagnosis of Anorexia Nervosa, which is more appropriate as the management is similar. The formal DSM V framework will be released in the middle of 2013, and we will await the effect of the new diagnostic criteria on the patients [42].

#### ***Demographics analysis with severity of body mass index***

The body mass index was divided into 5 groups for more detailed analysis so that we could target the body mass index range which constituted the most interesting results. The bulk of the study population was in Group 4 (BMI 14.6 – 16.5) with 96 (35.2%) patients followed by Group 3 (BMI 12.6 – 14.5) with 87 (30.1%) patients who were in the moderately severe group. Fortunately, Group 1 (BMI < 10.5) which constituted the most severe group also formed the smallest group with only 5 (1.8%) patients.

Based on our study findings, the largest BMI group, i.e. Group 4 (BMI 14.6-16.5) would be at a higher risk of co-morbid psychiatric disorders. And the second largest group, i.e. Group 3 (BMI 12.6-14.5) would be at increased risks of both co-morbid psychiatric disorders and transaminitis. The treating physician could make use of the BMI as an indication to explore with more details into the potential complications.

If we looked at the combined results of Group 1 and Group 2 (i.e. BMI less than 12.5), we realized that there were no males in this category. There have been studies, which showed that the clinical severities of males and females are comparable [43, 44] The difference in the presentation could be due to the small number of male patients in the study. There were also no Malays in this very severe BMI group, which could be due to the culture of the Malays being a protective factor. As the body mass index progressed higher, the ethnic proportions remained similar with Chinese forming the bulk of the population followed by Caucasians, Indians and Malays respectively. The bulk of the patients were from the 12 to 20 years old age group.

#### ***Different eating disorders subgroups***

As we looked into the analysis of the 5 BMI groups which incorporated information with anorexia nervosa (restrictive subtype), anorexia nervosa (binge-purge subtype) and eating disorder not otherwise specified\*, we had an interesting observation. The highest proportion of patients with anorexia nervosa (restrictive sub-group) fell in Group 3 (BMI 12.6-14.5), while that for anorexia nervosa (binge-purge subtype) fell in Group 4 (BMI 14.5-16.6) while that for eating disorder not otherwise specified\* fell in Group 5 (16.6-18.5) which was the mildest category.

Anorexia nervosa (restrictive subtype) had the most patients with body mass index less than 12.5 (corresponding to Group 1 and Group 2) as well. The postulation could be that anorexia nervosa (restrictive subtype) had the most severe patients out of the three groups, with eating disorder NOS having the patients with the least complications from the disease due to the higher body mass index.

#### ***Different weight loss methods***

Restricting diet appeared to be the most common method with 186 (56.2%) patients adopting the method. The image of an eating disorder patient throwing up after eating was deeply etched into the minds of those who were in touch with the media, and it was not surprising that it was the second most common method with 89 (24.1%) patients.

One of the important finding is a number of people who used drugs such as slimming pills, laxatives and diuretics to lose weight, which made up of only 14 (3.8%) patients. As the number was very small, it was difficult to compare with other international studies.

In 2002, there was nation-wide publicity documenting Singaporean artiste Andrea de Cruz's liver failure following usage of the slimming pill SLIM 10. Andrea de Cruz was engaged to be wedded to her celebrity boyfriend but the purported herbal concoction SLIM 10 caused her to have fulminant liver failure, and she required a liver transplant in order to sustain life. There was a lot of media coverage on how the slimming pills destroyed the life of the young actress [12].

If we looked at the age group of the bulk of the patients with eating disorders, they were mainly in the 12 – 20 years-old group, and they would be very familiar with the artiste and her celebrity boyfriend. The impact on the case could be a reason why drugs were less commonly used for the Singapore population to lose weight compared to the western population.

#### ***Means of weight loss and presence of transaminitis***

Patients with eating disorders have minimum body reserves. The means to losing weight can present as additional stressors to the body. Different types of weight losing measures may yield different severity of the conditions. As seen earlier in the paper, restrictive method had the most patients with lower BMI range (BMI less than 14.5) compared to the other three methods. The severity of the BMI may on its own be a critical insult to the hepatocytes causing apoptosis and transaminitis.

#### ***Restrictive method***

There were 186 patients who used restriction as their method of weight loss. Out of the 186 patients, patients with BMI less than 14.6 (reference to the earlier part to the study which pegged BMI less than 14.6 at a higher risk of transaminitis) constituted 99 (53.22%) patients. There were also more patients with

very low BMI in this group, which could account for the significant association between using restriction as a method of weight loss and having transaminitis. People who used restriction as a means of weight loss were more likely to have transaminitis compared to patients who did not use restriction as a means of weight loss.

#### ***Binge-purge***

About a third used binge-purge as their method of weight loss have BMI less than 14.6, which would put them at a higher risk of transaminitis. Theoretically, the act of binge-purging increased the risk of acid reflux into the common bile duct causing transaminitis and pancreatitis. The analysis revealed otherwise that people who used binge-purge as a means of weight loss were less likely to have transaminitis compared to patients who did not use binge-purge as a means of weight loss. As the number studied is small, further studies may be necessary to investigate this hypothesis.

#### ***Exercise***

Lee Huei Yen had highlighted a male patient with eating disorder who had a healthy BMI of 22.5 but ran 30 minutes to 1 hour daily to "keep fit". [13] His BMI plummeted to 11.9 over a few months through severe exercising and he was hospitalized with the findings of severe transaminitis. His exercise regime became more compulsive while continuing on his usual eating of healthy food consisting mainly of fruits and vegetables. He ran an hour a day and developed a highly ritualistic manner of doing static stretching exercises.

Exercise [14 - 16], especially in the eating disorder patients with low body mass index, had been purported to have a direct correlation with causing transaminitis on top of the other weight loss measures. There was a significant association between using exercise as a method of weight loss and having transaminitis. People who used exercise either on its own or together with other methods as a means of weight loss were 3.45 times more likely to have transaminitis compared to patients who did not use exercise as a means of weight loss.

### Drugs

Only a small number of patients acknowledged to using drugs such as slimming pills, diuretics or laxatives to lose weight. This group formed the smallest group for comparison with only 14 patients using drugs either alone or in combination of other methods as their method of weight loss and there was no significant association between using drugs as a method of weight loss and having transaminitis. People who used drugs as a means of weight loss were no more likely to have transaminitis compared to patients who did not use drugs as a means of weight loss. This finding could be due to the effect of the small numbers as it contradicted known studies of drugs especially slimming pills causing transaminitis.

### Conclusion

The study provided an update on the demographics of patients with anorexia and eating disorders not otherwise specified.\* The means of weight loss also help cue the treating physician on the need for further investigations and/ or referral to the Gastroenterology colleagues.

### Conflict of interest

None of the authors have any actual or potential conflict of interest related to the submitted manuscript. There was no sponsorship from pharmaceutical companies for the thesis.

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