授課講師學經歷

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課程名稱（主題）	全世界肥胖症的發生率與盛行率 肥胖症與代謝症候群 肥胖定義與體位評估
服務單位(包含職稱)	臺北醫學大學保健營養學系
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授課內容摘要

肥胖人口在全世界各個國家都有日益增加的趨勢，包括美國、紐西蘭、歐洲等國，甚至亞洲各國。有些國家肥胖人數占全人口之三分之一以上，隨著西風東漸，國人飲食習慣日益西化，體重過重或肥胖的比率也日益增多。雖然在過去幾十年來，學者對肥胖成因的認識有更進一步的了解，而國人肥胖發生率仍日益增加。體重過重或肥胖對健康的影響是眾所皆知，在衛生署公布的國人十大死亡原因中，超過一半以上的疾病與過重或肥胖有關，體重控制對於很多疾病的預防或治療都有相當大的幫助，因此，要找出有效的體重控制方法是非常重要的。由於體重過重或肥胖與許多疾病有密切關係，例如：心血管疾病、糖尿病、中風、癌症等，因此，維持理想體重有助於預防許多疾病。美國國家公共衛生促進會宣布，他們在 2000 年的疾病防治目標便是，降低體重過重或肥胖的人數，但顯然此目標並沒有達到，2010 年仍以體重控制為其目標。體重過重或肥胖的產生主要是長期的熱量堆積，熱量攝取多於熱量消耗，而熱量攝取是來自於飲食，因此，飲食設計是最常用來控制體重的方法。本課程簡介肥胖的定義、在全球各國的發生率與盛行率、肥胖症與代謝症候群及體位評估的方法。

肥胖的盛行率、定義與評估方法、代謝症候群

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1

Epidemiology

發生率Incidence rate~

盛行率Prevalence rate~

Obesity

2

Obesity as a [1] _____ Problem

"Globesity"~ The Crisis of Growing Proportions

Ref~ Bjorntorp: International Textbook of Obesity

www.who.org

3

A global race

- The spread of the obesity epidemic to a growing number of countries and the rapid rates of increase in recent years are what have public health advocates worried. Last year the Washington-based World-Watch Institute reported that, for the first time in history, estimates of the number of overweight people in the world rival estimates of those who are malnourished. In its 2002 World Health Report, the World Health Organization (WHO) ranked obesity among the top 10 risks to human health worldwide.

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- The epidemic has been well documented and extensively studied in the United States, where as early as the 1960s nearly half of Americans were overweight and more than 13 percent were obese. Today some 64 percent of U.S. adults are overweight and 30.5 percent are obese. That is double the obesity rate of two decades earlier and one-third higher than just 10 years ago.

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- But the United States is not even the leader in the global race to national corpulence. That distinction is held by Samoa, where two-thirds of all women and half of men are obese. In the Americas, Canada trails somewhat behind the United States, with 50 percent of adults overweight and 13.4 percent obese. But data from Argentina, Colombia, Mexico, Paraguay, Peru and Uruguay show more than half of these countries?populations are overweight, and more than 15 percent are obese.

6

- "Obesity and overweight are increasing much faster in Latin America than in North America or Europe," he says. "They are fast replacing hunger and malnutrition as contributors to mortality."

7

WHO

- Obesity is a complex condition, one with serious social and psychological dimensions, that affects virtually all age and socioeconomic groups and threatens to overwhelm both developed and developing countries.
-
- In 1995, there were an estimated 200 million obese adults worldwide and another 18 million under-five children classified as overweight.

8

WHO

- As of 2000, the number of obese adults has increased to over 300 million. Contrary to conventional wisdom, the obesity epidemic is not restricted to industrialized societies; in developing countries, it is estimated that over 115 million people suffer from obesity-related problems.

9

- **Obesity is a major [2] _____ and economic problem of global significance.**
- **Prevalence rates are increasing in all parts of the world, both in affluent Western countries and in poorer nations.**
- **In 1995, the excess adult mortality attributable to [3] _____ was estimated to be about 1 million deaths, double the 0.5 million attributable to [4] undernutrition .**

10

Overview of the Health Costs

- US figures suggest that about 4_____ of non-insulin-dependent diabetes mellitus (NIDDM) and[5] of both coronary heart disease (CHD) and hypertension can be attributed to obesity.

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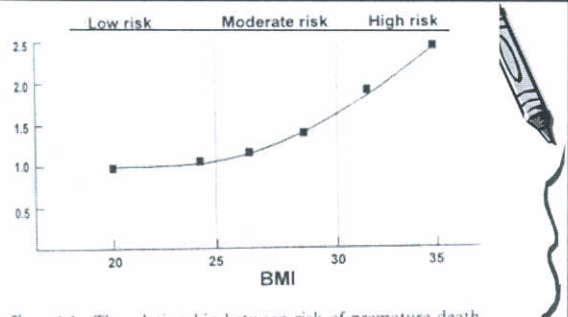

Figure 1.1 The relationship between risk of premature death and BMI. The figure is based on data from professional, white US women who have never smoked and illustrates the graded increase in relative risk of premature death as BMI increases. Adapted from WHO (1)

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Table 1.3 Relative risk of health problems associated with obesity

Greatly increased (relative risk much greater than 3)	Moderately increased (relative risk 2–3)	Slightly increased (relative risk 1–2)
NIDDM Gallbladder disease Dyslipidaemia Insulin resistance Breathlessness Sleep apnoea	CDH Hypertension Osteoarthritis (knees) Hyperuricaemia and gout	Certain cancers Reproductive hormone abnormalities Polycystic ovary syndrome Impaired fertility Low back pain due to obesity Increased anaesthetic risk Fetal defects arising from maternal obesity

Source: WHO (1)

***Psychosocial problems**

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- **Conservative estimates clearly indicate that obesity represents one of the largest costs in national health care budgets, accounting for up to [6]___ of total expenditure in several developed countries.**

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Table 1.4 Conservative estimates of the direct economic costs of obesity

Country	Year	Obesity definition	Estimated direct costs	% National health care costs
USA	1995	BMI ≥ 30	US$52 billion	5*
Australia	1989/90	BMI > 30	AUD$464 million	> 2
Netherlands	1981–89	BMI > 25	Guilders 1 billion	4
France	1992	BMI ≥ 27	FF 12 billion	2

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- **In the USA in 1995, for example, the overall *direct costs attributed to obesity* (through hospitalizations, outpatients, medications and allied health professionals' costs) were approximately the same as those of diabetes, [7]_____ greater than those of coronary heart disease, and [8]_____ greater than those of hypertension.**

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- **It is also important to consider the cost to the individual in terms of ill health and reduced quality of life (intangible costs), and the cost to the rest of society in terms of lost [9]_____ due to sick leave and premature disability pensions (indirect cost).**

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The Global Obesity Problem

- The number of people worldwide with a BMI of 30 or above is currently thought to exceed 250 million, i.e. [10]_____ of the world's adult population.

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Table 1.5 Estimated world prevalence of obesity

	Population aged ≥15 years (millions)	Prevalence of obesity (%)	Approximate estimate (mid-point) of number of obese individuals (millions)	
Established market economies	640	15–20	96–128	(112)
Former socialist economies	330	20–25	66–83	(75)
India	535	0.5–1.0	3–7	(5)
China	825	0.5–1.0	4–8	(6)
Other Asian countries and Islands	430	1–3	4–12	(8)
Sub-Saharan Africa	276	0.5–1.0	1–3	(2)
Latin America and Caribbean	280	5–10	14–28	(21)
Middle East	300	5–10	15–30	(22)
World	3616			(251)

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Important Issues Associated with Data Collection

- **The first of these relates to the limited availability of suitable data for an accurate assessment of obesity prevalence and trends in different countries.**

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- **The second issue relates to the need for caution when making comparisons of obesity rates between studies and countries.**
  - **Classification systems**
  - **Mismatched age groups**
  - **Inconsistent age-standardization of study populations**
  - **Discordant time periods**
  - **Dates of data collection**
  - **Use unreliable self-reported weight and height measurements for calculation of BMI**

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- **In the US, obesity has until very recently been routinely classified as a BMI at or above 27.8 kg/m² in men and 27.3 kg/m² in women.**
- **With these cut-off points, 31.7% of men and 34.9% of women were deemed obese in the period 1988-1994.**
- **These estimates fall to 19.9% of men and 24.9% of women when a BMI of 30 kg/m² is applied.**

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- **A third issue is the need to be aware that many countries such as Brazil and Mexico show great variation in wealth by region.**

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Table 1.6 Prevalence of obesity (BMI ≥ 30 kg m⁻²) in a selection of countries

	Country	Year	Age	Prevalence of obesity (%)[a] Men	Women
Europe	Finland	1991-93	20-75	14	11
	Netherlands	1995	20-59	8.4	8.3
	UK England	1997	16-64	17	20
	Scotland	1995	16-64	16	17
	Italy	1994	15+	6.5	6.3
	France	1997[b]	15+	8.6	8.4
	Czech Republic	1995	20-65	22.6	25.6
	former East Germany	1992	25-69	21	27
	former West Germany	1990	25-69	17	19
	Russia	1996	Adults	10.8	27.9

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North America	Canada	1991	18–74	15	15
	USA	1988–94	20–74	19.9	24.9
Central and South America	Mexico (urban)	1995	Adults	11	23
	Brazil	1989	25–64	5.9	13.3
	Curaçao	1993–94	18+	19	36
Middle East	Iran, Islamic Republic of (south)	1993–94	20–74	2.5	7.7
	Cyprus	1989–90	35–64	19	24
	Kuwait	1994	18+	25	44
	Jordan (urban)	1994–96	25+	35.7	59.8
	Bahrain (urban)	1991–92	20–65	9.5	30.3
	Saudi Arabia	1990–93	15+	16	24

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Australasia and Oceania	Australia (urban)	1995	25–64	18.0	18.0
	New Zealand	1989	18–64	10	13
	Samoa (urban)	1991	25–69	58.4	76.8
	Papua New Guinea (urban)	1991	25–69	36.6	54.3
South and East Asia	Japan	1993	20+	1.7	2.7
	India (urban Delhi middle class)	1997	40–60	3.19	14.28
	China	1992	20–45	1.2	1.6
	Malaysia		18–60	4.7	7.9
	Singapore[5]	1992	Adults	4	6
	Kyrgyzstan	1993	18–59	4.2	10.7
Africa	Mauritius	1992	25–74	5.3	15.2
	Tanzania	1986–89	35–64	0.6	3.6
	Rodrigues (Creoles)	1992	25–69	10	31
	Cape Peninsula (Coloured)	1990	15–64	7.9	44.4

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- **In [11] _____, obesity prevalence now ranges from about 6 to 20% in men and from 6 to 30% in women.**
- **Rates are highest in the East and lowest in some of the Central European and Mediterranean countries.**
- **USA: 20% in men and 25% in women.**
- **Canada: 15%**

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BMI>30

- Australia and New Zealand: 15-18%
- Japan: [12]_____.
- Middle East: women->25%
- The highest obesity rate in the world are found in the Pacific Island populations of Melanesia, Polynesia and Micronesia.

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Recent Trends

- The countries of North America and Europe have seen startling increases in obesity rate over the last 10-20 years.
- England:from 6% to 17% in men and from 8% to 20% in women after 1980.

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- USA: from 10.4% to 19.9% in men and from 15.1% to 24.9% in women over the period 1960-1962 until 1988-1994.

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USA

	Overweight	Obesity
• 1960	43%	12.8%
• 1994	54.9%	22.3%

- HANES II (1976-1980)
- HANES III (1988-1994)
  - overweight ↑8.9%
  - obesity↑ 5.9%
  - BMI ↑0.9

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Nutrition Surveys in Taiwan

- **1980-1981: The first dietary household survey**
- **1986-1988: The second dietary household survey**
- **1993-1996: Nutrition and Health Survey in Taiwan ([13]_____)**
- **1999-2000: The Elderly Nutrition and Health Survey in Taiwan**
- **2001-2002: Elementary School Children's Nutrition and Health Survey in Taiwan**
- **2005-2008: Nutrition and Health Survey**

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Table 4
Prevalence of overweight/obesity in Asia

Country	Age group (years)	N	Overweight (BMI 25-30) (%)		Obesity (BMI > 30) (%)		Reference
			Male	Female	Male	Female	
Taiwan	20-64 (Overall)	M 1112 F 1298	22.3	18.3	2.3	5.0	Current study
	20-64 (Metro cities)	M 167 F 180	22.3	17.4	2.2	1.2	Current study
	(Mountainous area)	M 171 F 193	44.6	34.8	11.7	25.7	
China	20-45		Metro 12.3 Rural 5.3	Metro 14.4 Rural 9.8	Metro 1.0 Rural 0.5	Metro 1.7 Rural 0.7	5
Japan	35-64	12926	24.3	20.2	1.9	2.9	9
Malaysia	18-60		Metro 23.9 Rural 12.9	Metro 17.5 Rural 19.6	Metro 5.6 Rural 1.8	Metro 8.8 Rural 2.6	8
	≥18	31097	16.6		4.4		17
Philippine	≥20	M 4588 F 4997	12.7	15.2	1.7	3.4	18
Thailand	≥20	13380	12.9	19.5	1.7	5.6	7
Hong Kong (Chinese)	18-65	1531	10.0 (BMI ≥ 27)	27.9	2.2	4.8	6

Preventive Medicine 37 (2003) 233–241

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Table 2. Prevalence and Trend of Overweight and Obesity among Adults with Gender Specification in Taiwan

	Taiwan's criteria [#]				WHO-Asian's criteria [†]			
	Overweight		Obese		Overweight		Obese	
	1993-96	2000-01	1993-96	2000-01	1993-96	2000-01	1993-96	2000-01
Males								
20-44	20.7	25.5	8.3	16.3	23.3	21.1	20.4	32.1
45-64	31.3	36.2	15.2	17.8	22.3	29.9	36.6	38.1
≥65	17.6	29.1	13.7	9.4	18.9	25.8	24.7	25.8
Overall [§]	22.9	28.9	10.5	15.9	22.5	24.1	24.7	33.1
Females								
20-44	16.2	12.9	6.9	7.4	16.5	13.4	15.2	14.3
45-64	28.3	28.6	24.4	16.2	21.6	24.2	44.7	33.0
≥65	26.4	30.0	24.8	17.0	21.5	22.1	43.3	35.3
Overall	20.3	18.7	13.7	10.7	18.3	17.2	25.5	21.4

[#] Taiwan's criteria is defined as overweight BMI >= 24 and obese BMI >=27.
[†] WHO-Asian's criteria is defined as overweight BMI >= 23 and obese BMI >=25.
[§] Age-adjusted prevalence.
Data for 1993-96 is based on reference 8, and 2000-01 is based on NHRI survey.

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Future Projections

- Worldwide growth in the number of severely overweight adults is expected to be [14] _____ that of underweight adults between 1995 and 2025.

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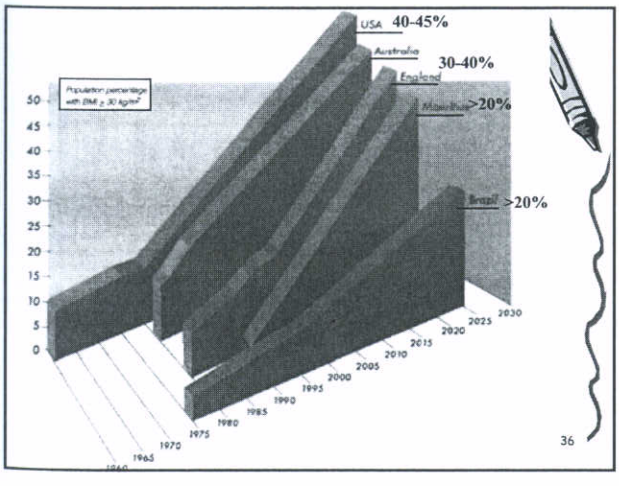

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- If current trends persist, the entire US population could be overweight within a few generations.

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Key Features and Patterns of the Global Obesity Epidemic

- **Socioeconomic Status**
- **Modern Societies**
- **Developing and Transition Societies**
- **Urban Residence**
- **Age**
- **Gender Differences**

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Table 1.7 Prevalence of overweight (BMI > 25) in urban adults by socioeconomic status in Delhi, India

	% Overweight	
Socioeconomic status	Males	Females
Middle class		
1. High	32	50
2. Middle	16	30
3. Low	7	28
Slum (poor)	1	4

Source: Gopalan (14).

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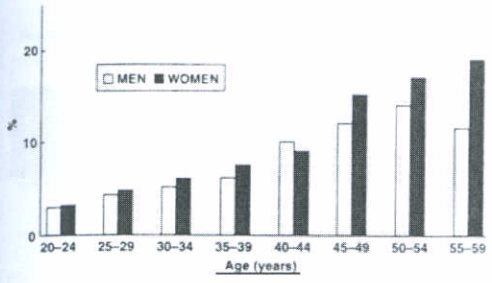

Figure 1.3 Obesity prevalence across the lifespan in the Netherlands. There is a consistent rise in the prevalence of obesity throughout all age groups in the Dutch population, reaching a peak in the seventh decade. Source: Seidell (15)

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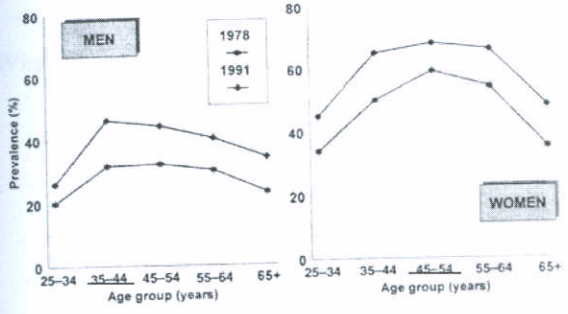

Obesity prevalence across the lifespan in Western Samoa.

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High-risk Groups for Weight Gain

- Minority Populations in Industrialized Countries
- Vulnerable Periods of Life
- Other Factors Promoting Weight Gain
  - Genetic
  - Biological
  - Lifestyle
  - Smoking cessation
  - Drug treatment

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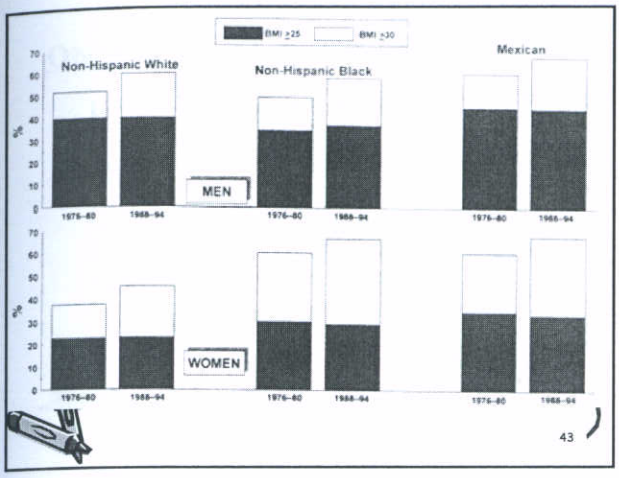

What is Driving the Global Obesity Epidemic?

1. **The Changing Environment**
2. **Economic Growth and Modernization**
3. **Other Possible explanations**
   1. **Changing demographic structure of populations**
   2. **Cultural body shape ideals**

   -Diet component: Mg deficiency
   -In-utero nutrition

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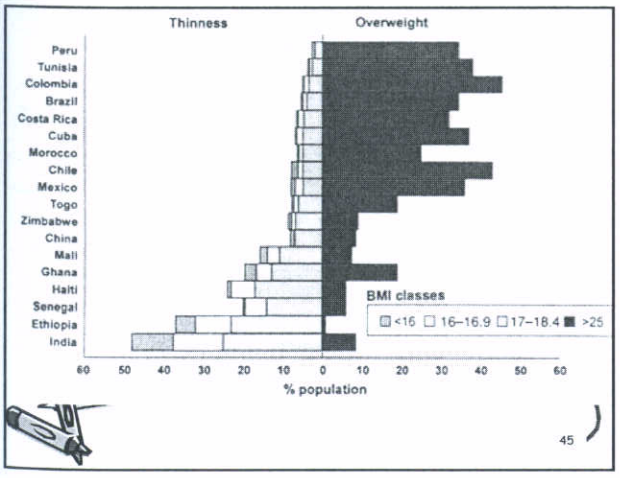

Obesity in Children and Adolescents

1. **Defining Obesity in children and adolescents**
2. **The Scale of the Childhood Obesity Problem**
3. **Health Impact of Obesity in Childhood**
4. **Stunting and Obesity**
5. **Key factors Underlying the Increase in Childhood Obesity Rates**

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Table 1.9 Prevalence of overweight[a] in 6- to 8-year-old children

	USA (1988–1991)	China (1993)	Russia (1994–1995)	South Africa (1994)	Brazil (1989)
Girls	24.2	12.2	17.8	20.3	10.5
Boys	21.3	14.1	25.6	25.0	12.8

[a]Defined as BMI higher than the US reference NHES 85th percentile
Source: Popkin *et al.* (35)

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Table 4 Prevalence and secular trends of overweight and obesity among 12 to 15-y-old school children in Taiwan with gender specification

	1980–1982			1986–1988			1994–1996		
Age (y)	n	Overweight[a]	Obese[a]	n	Overweight	Obese	n	Overweight	Obese
Boys									
12	541	9.8	15.7	609	10.2	16.4	131	12.2	21.4
13	172	15.1	15.1	591	10.3	17.4	248	10.1	16.5
14	1057	13.9	11.1	617	11.5	13.9	238	12.6	14.7
15	536	13.6	10.6	439	11.9	10.5	64	12.5	12.5
Total[b]	2306	13.0	12.4	2256	10.9	14.8	681	11.6	16.4
Girls									
12	531	9.8	15.4	556	12.4	14.8	151	14.6	8.8
13	143	12.6	9.1	538	14.2	10.2	226	9.3	11.9
14	971	10.6	9.0	537	14.3	9.3	237	8.9	11.0
15	542	13.8	7.2	430	10.9	9.8	71	8.5	16.9
Total[b]	2187	11.3	10.1	2061	13.1	11.1	685	10.2	11.1

[a]Overweight is defined as body weight at 110–120% of mean body weight and obese is defined as >120% of mean body weight at same age and gender stratum.
[b]Age-adjusted prevalence.

International Journal of Obesity (2001) 25, 170–176

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The Epidemiology of Obesity

1. Classification of Obesity and Fat Distribution
2. Global Prevalence of Obesity and Time Trends
3. Prevalence of a Large Waist Circumference

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Anthropometric Indices of Obesity and Regional Distribution of Fat Depots

A. Methods Commonly used to measure body fatness
B. Measuring Body composition in Special groups
C. Anthropometric assessment of Obesity

50

What is Obesity and How is it measured?

Definition

- A condition of abnormal or excessive [15] accumulation in adipose tissue to the extent that health may be impaired.

BMI (body mass index)
Central fat distribution

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Measuring General Obesity

- The [16] _____ provides the most useful and practical population-level indicator of overweight and obesity in adults.

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Table 1.1 Classification of overweight and obesity in adults according to BMI

Classification	BMI ($kg \cdot m^2$)
Underweight	< 18.5
Normal range	18.5–24.9
Overweight	≥ 25
Pre-obese	25.0–29.9
Obese class I	30.0–34.9
Obese class II	35–39.9
Obese class III	≥ 40

Source: WHO (1).

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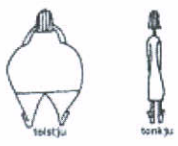
- BMI may not correspond to the same degree of fatness across all population.
- This suggests that population-specific BMI cut-off points for obesity need to be developed.



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台灣成人肥胖定義

	身體質量指數(BMI) (kg/m²)	腰圍 (cm)
體重過輕	BMI ＜ 18.5	
正常範圍	18.5≦BMI＜24	
異常範圍	過重：24≦BMI＜27 輕度肥胖：27≦BMI＜30 中度肥胖：30≦BMI＜35 重度肥胖：BMI≧35	男性：≧90公分 女性：≧80公分

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Measuring Central Obesity

- For a comprehensive estimate of weight-related health risk it is also desirable to assess the extent of intra-abdominal or "[17] _____" fat accumulation.
  - Waist circumference
  - Waist-to-hip ratio

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Table 1.2 Sex-specific waist circumference measurements for identification of individuals at increased health risk due to intra-abdominal fat accumulation

	Risk of metabolic complications	Waist circumference (cm)	
		Men	Women
Alerting zone	Increased	94	80
Action zone	Substantially increased	102	88

Adapted from WHO (1)

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Do centrally obese Chinese with normal BMI have increased risk of metabolic disorders?

W-T Yeh, H-Y Chang, C-J Yeh1,, K-S Tsai, H-J Chen1 and W-H Pan1,

CONCLUSIONS: In order to screen out high-risk obese individuals, isolated centrally obese subjects should not be overlooked.

Therefore, we recommend to assess waist circumference in parallel to, not just sequential to the measurement of BMI in Chinese.

International Journal of Obesity (2005) 29, 818–825.

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We found that the prevalence of obesity in the elderly was 16.9% in Taiwan according to the criterion of BMI 27 kg/m2 and 33.2% by WHO criteria for Asians (BMI 25 kg/m2). It was higher in women than in men. With the high prevalence of CVD risk factors and their positive relationship with BMI, WC, and WHR, the problem of obesity among the elderly should not be overlooked.

OBESITY RESEARCH Vol. 13 No. 1 January 2005

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測量身體組成

在研究室內，

有許多的技術可作爲身體組的測定方法：

- 18 _____.
- 多項同位素稀釋法
- 體內鉀離子總量

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水中稱重法

- 又稱密度測量法
- 應用阿基米德原理設計而成
- 測得出一[19]____，換算成體脂肪的百分比
- 例如：比重爲1.048相當於體脂肪25%
- 體密度愈大者，體脂肪愈少

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多項同位素稀釋法

- 專測體內水的總重與細胞外的重量
- 根據物質在特定液體間會自行均勻分佈的原理而設計
- 重氫等放射性元素可以用來測量體內總水份量。
- [20]_____只分佈於細胞外液之間室，故可以用來區別細胞內外間室。

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體內鉀離子總量

- 鉀在體內的濃度一定，其值高或低可代表[21]_____的指標

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Table 4.1 Methods of measuring body fat and fat distribution

Methods	Accuracy	Practicality	Sensitivity to change	Cheapness	Fat distribution detection
Laboratory/ standard methods					
Underwater weighing	++++	++	+++	+++	–
Potassium-40 counting	+++	+++	+	+++	–
Dual-energy X-ray absorptiometry	+++	++	++	++	++
Computerized tomography	+++++	+++	+++	+	+++++
Magnetic resonance imaging	+++++	++++	+++	+	+++++
Multi-compartment models	+++	+	+	+	–
Air displacement (BOD POD)	?	++++	?	++	–
Field/ anthropometric methods					
Skinfold thickness	+++	++++	+++	+++++	–
Circumference	+++	++++	+++	+++++	+++++
Body mass index	+++	++++	+++++	+++++	–

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身高

- 身高的值不但可提供標準身高下理想體重的比值，且可以提供標準
22 _____ 排泄量的比較指數

65

身高的重要性

- 定期測身高爲營養評估步驟的一部份
- 以身高比較體重，是最常使用的一種營養狀況指標
- 肌酸酐對身高的指數比，提供骨骼肌肉重量值。
- 標準身高定義爲後腳跟至頭頂的距離

膝高

- 膝高與身高有很高的相關性，可用於測量不能站立者、脊椎彎曲者之身長

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體重

- 指身體的水分、脂肪組織、與瘦肌肉群的總重量
- 提供營養狀況與液體平衡的指標
- 顯示營養治療與改變營養維護計畫的有效性

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體重測量

- 在一天之中變化不同，每天需在同一時間測量
- 以[23]_____測量
- 若24小時內，體重超過[24]_____以上，注意是否有過多的液體滯留、呼吸短促或腳踝水腫
- 磅秤每[25]_____校正一次

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皮層厚度測量

- 身體的脂肪約有50%儲存在皮下組織層，故測量皮層厚度可以確定體內脂肪儲存的數量，是評估體脂肪與體蛋白儲存量的一種間接方式。
- 測量時使用的彎腳規可以測出二層皮膚及其間的脂肪

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測量皮層厚度的部位

- 測量三頭肌及肩胛骨位置，是能量儲存評估的最佳指標
- 另外，可以[26]_____來估算體脂肪含量，體脂肪愈高，生物電阻愈大

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三頭肌皮層厚度測量步驟

- 上臂的後[27]_____定位
- 受測者的手臂輕輕垂下，測量者以大拇指和食指沿著鷹嘴圖現抓起皮膚及皮下組織，其抓取點應高於中點標誌記處約1公分左右，將皮下脂肪拉離其下的肌肉組織
- 測者拿起彎腳規，鉗住中點位置的脂肪厚度。讀出數值，重複兩次，平均其值並記錄

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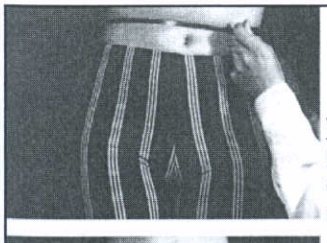
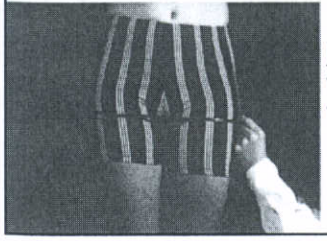
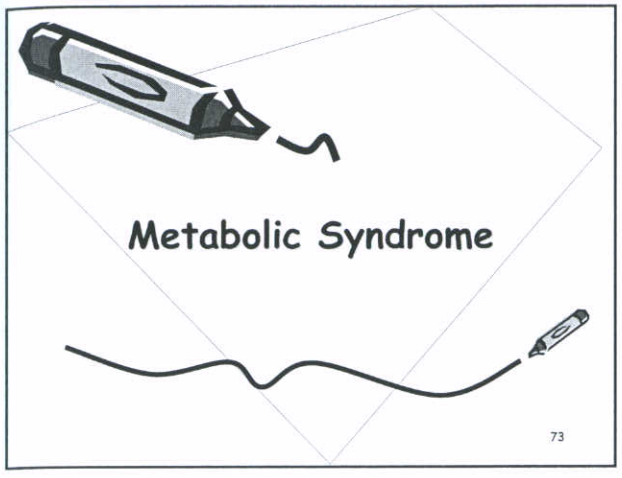


Waist circumference: midway between iliac crest and lowest rib margin



Hip circumference: at the level of the greater trochanters

72



Definition

- 1988: insulin resistance syndrome or syndrome X
- WHO: include a measure of central obesity
- EGIR: European Group for the Study of Insulin Resistance
- NCEP: National Cholesterol Education Program
  - ATPIII: Adult Treatment Panel
- IDF: The International Diabetes Federation, 2005

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Table 1.1 Features of the World Health Organization (WHO), European Group for the Study of Insulin Resistance (EGIR) and National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP-III) definitions of the metabolic syndrome

	WHO (WHO Consultation, 1999) Impaired glucose tolerance or diabetes and/or insulin resistance and two of the other factors	EGIR (Balkau and Charles, 1999) Presence of fasting hyperinsulinaemia (the highest 25%) and two of the other factors	ATP-III (NCEP Expert Panel on Detection, 2001) Three or more of the following factors (triglycerides and HDL counted separately)
Central obesity	WHR: >0.9 (men), >0.85 (women) and/or BMI > 30 kg m^{-2}	Waist: ≥ 94 cm (men), ≥80 cm (women)	Waist: ≥ 102 cm (men), > 88 cm (women)
Blood pressure (mmHg)	≥ 140/90	≥ 140/90 or treated for hypertension	> 130/85 or treated for hypertension
Dyslipidaemia (mmol l^{-1})	Triglycerides ≥ 1.7 HDL < 0.9 (men), <1.0 (women)	Triglycerides > 2.0 or HDL-cholesterol <1.0 or treated for dyslipidaemia	Triglycerides ≥ 1.7 HDL-cholesterol: <1.0 (men), < 1.3 (women)
Dysglycaemia (mmol l^{-1})	Fasting glucose ≥ 6.1 and/or 2 h post-challenge glucose ≥7.8 on diabetes	Fasting plasma glucose > 6.1, but non-diabetic	Fasting plasma glucose ≥ 6.1
Insulin resistance	Glucose uptake during hyperinsulinaemic euglycaemic clamp in lowest quartile for population	Presence of fasting hyperinsulinaemia (i.e. among the highest 25% of the non-diabetic population)	Not applicable
Other factors	Microalbuminuria (urinary albumin excretion rate > 20 μg min^{-1} or albumin:creatinine ratio > 30 mg g^{-1}	None	Not applicable

Abbreviations: BMI, body mass index; HDL, high-density lipoprotein; WHR, waist:hip ratio.

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Table 1: IDF metabolic syndrome worldwide definition

Central obesity Waist circumference* – ethnicity specific	
Plus any two of the following	
Raised triglycerides	≥1.7 mmol/L (150 mg/dL) or specific treatment for this lipid abnormality
Reduced HDL-cholesterol	<1.03 mmol/L (40 mg/dL) in males <1.29 mmol/L (50 mg/dL) in females or specific treatment for this lipid abnormality
Raised blood pressure	Systolic: ≥130 mmHg or diastolic: ≥85 mmHg or treatment of previously diagnosed hypertension
Raised plasma glucose**	Fasting plasma glucose ≥5.6 mmol/L (100 mg/dL) or previously diagnosed type 2 diabetes If above 5.6 mmol/L or 100 mg/dL, an oral glucose tolerance test is strongly recommended but is not necessary to define the presence of the syndrome.

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Table 2: Country-/ethnicity-specific values for waist circumference

Country/ethnic group		Waist circumference (cm) (as measure of central obesity)	
Europids	Male	≥ 94	
	Female	≥ 80	
South Asians	Male	≥ 90	Taiwan
	Female	≥ 80	
Chinese	Male	≥ 90	
	Female	≥ 80	
Japanese	Male	≥ 85	
	Female	≥ 90	

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Factors that influence prevalence of the metabolic syndrome and variation between populations

- Age
- Gender
- Ethnicity
- Obesity and fat distribution
- Diet and physical activity
- Birthweight
- Genetic factors
- Endocrine factors
- Menopause/hormone replacement therapy
- Inflammation
- Alcohol
- Co-morbidity

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Table 2.1 Metabolic and anthropometric features in South Asians, Europeans and African-Caribbeans in the Southall Study

Feature	Men			Women	
	European ($n=1515$)	South Asian ($n=1420$)	African-Caribbean ($n=209$)	European ($n=246$)	South Asian ($n=291$)
Diabetes prevalence (%)	5	20	15	2	16
Fasting insulin ($mU\,l^{-1}$)	7.2	9.8	7.1	4.8	7.5
2-h Insulin ($mU\,l^{-1}$)	19	41	22	21	44
Median systolic BP (mmHg)	121	126	128	120	126
Median diastolic BP (mmHg)	78	82	82	76	77
BMI ($kg\,m^{-2}$)	25.9	25.7	26.3	25.2	27.0
Waist:hip ratio	0.94	0.98	0.94	0.76	0.85
Plasma lipids ($mmol\,l^{-1}$)					
Total cholesterol	6.11	5.98	5.87	6.3	6.0
HDL-cholesterol	1.25	1.16	1.37	1.58	1.38
Triglyceride (fasting)	1.48	1.73	1.09	1.21	1.38
Triglyceride (2-h)	1.39	1.72	0.99	1.01	1.27

Adapted from McKeigue, Shah and Marmot (1991).
Abbreviations: BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein.

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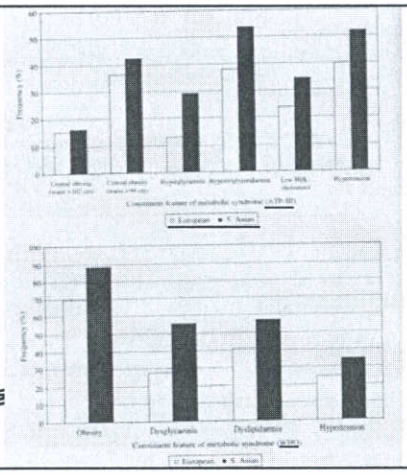
Metabolic Syndrome



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Metabolic Syndrome/anthropometric disturbance

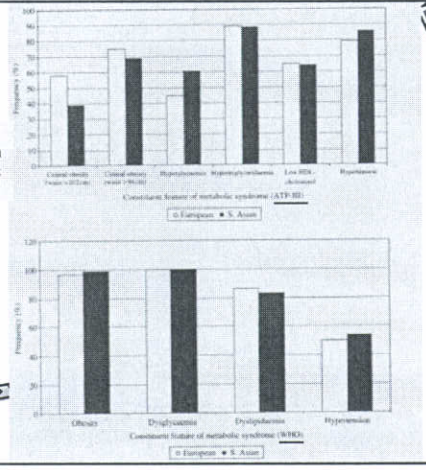

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Table 2.3 Prevalence of the metabolic syndrome by weight category, diabetes status and ethnicity[a] among Southall men (unpublished observations)

	ATP-III definition of the metabolic syndrome		WHO definition of the metabolic syndrome	
	European	S. Asian	European	S. Asian
Whole group	17.4%	29.2%	17.6%	42.8%
BMI < 25 kg m^{-2}	4.9%	14.8%	5.8%	24.7%
BMI < 30 kg m^{-2}	11.6%	25.2%	13.8%	40.2%
Non-diabetic[b]	15.2%	22.1%	15.0%	34.5%
Non-diabetic[b] and BMI < 25 kg m^{-2}	3.7%	10.1%	4.5%	17.4%
Non-diabetic[b] and BMI < 30 kg m^{-2}	9.9%	18.6%	11.6%	31.7%

[a] All reported ethnic differences are highly statistically significant ($P < 0.0001$).
[b] Known or newly diagnosed diabetes.

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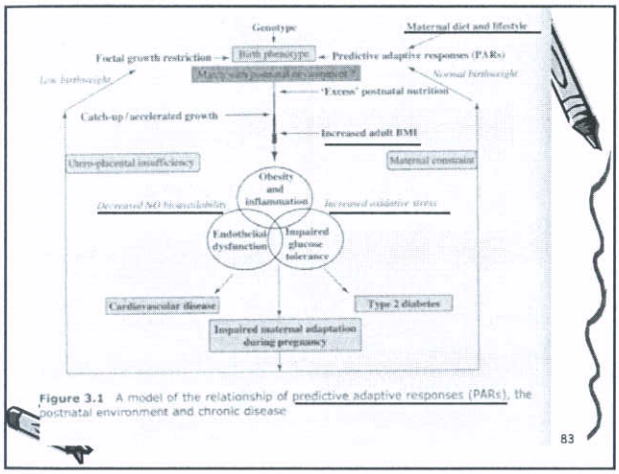

Figure 3.1 A model of the relationship of predictive adaptive responses (PARs), the postnatal environment and chronic disease

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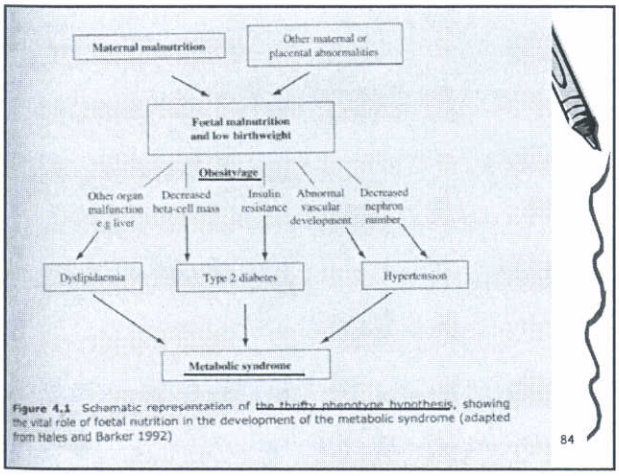

Figure 4.1 Schematic representation of the thrifty phenotype hypothesis, showing the vital role of foetal nutrition in the development of the metabolic syndrome (adapted from Hales and Barker 1992)

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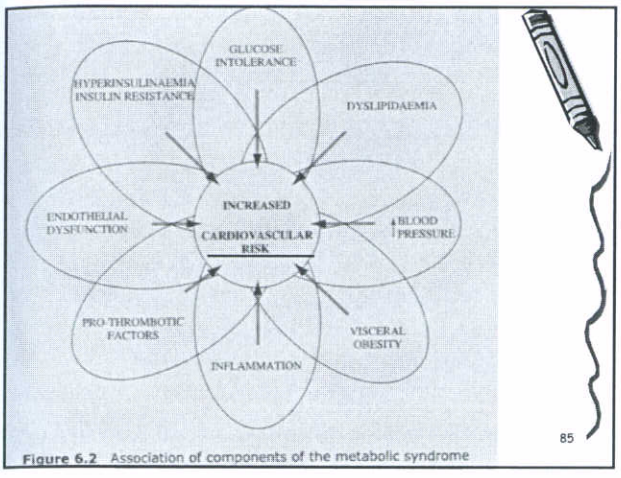


Figure 6.2 Association of components of the metabolic syndrome

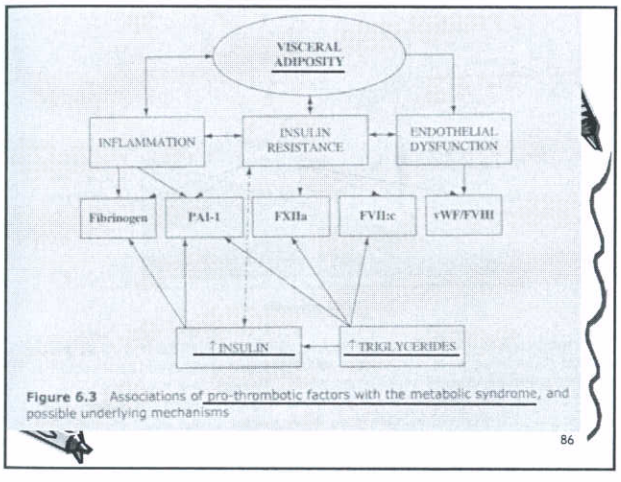


Figure 6.3 Associations of pro-thrombotic factors with the metabolic syndrome, and possible underlying mechanisms

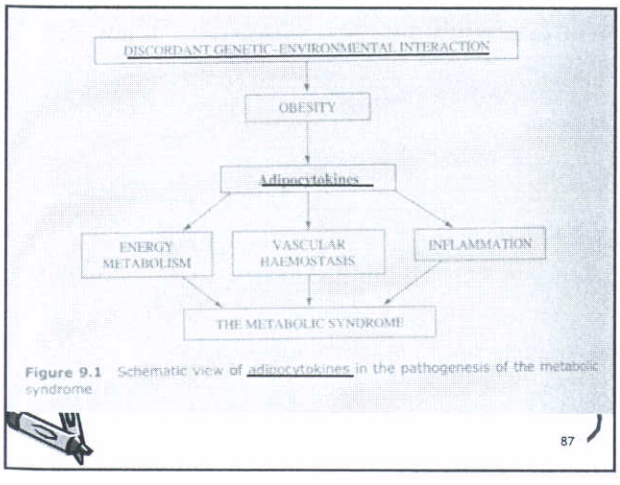


Figure 9.1 Schematic view of adipocytokines in the pathogenesis of the metabolic syndrome

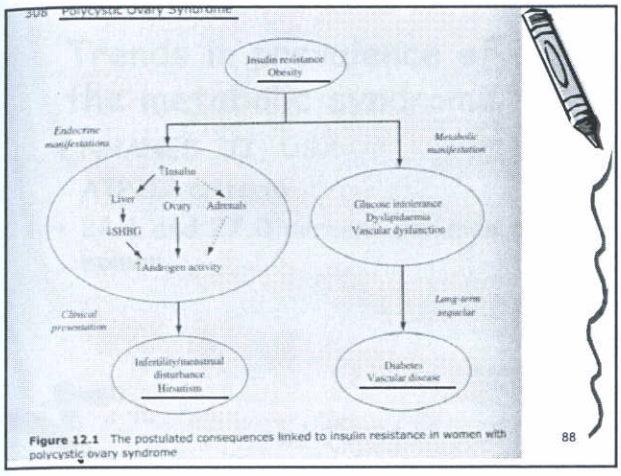
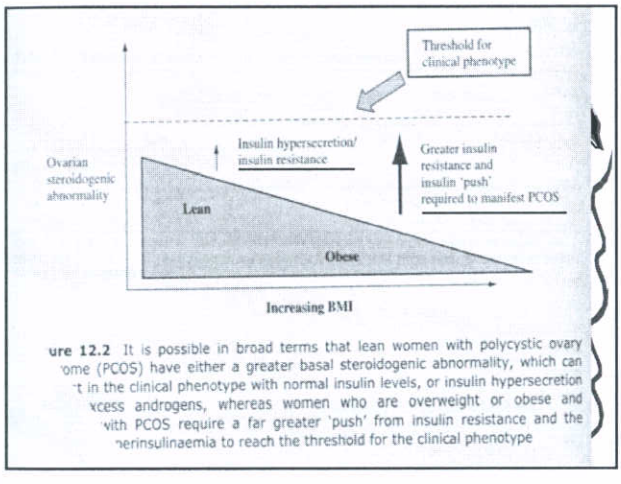
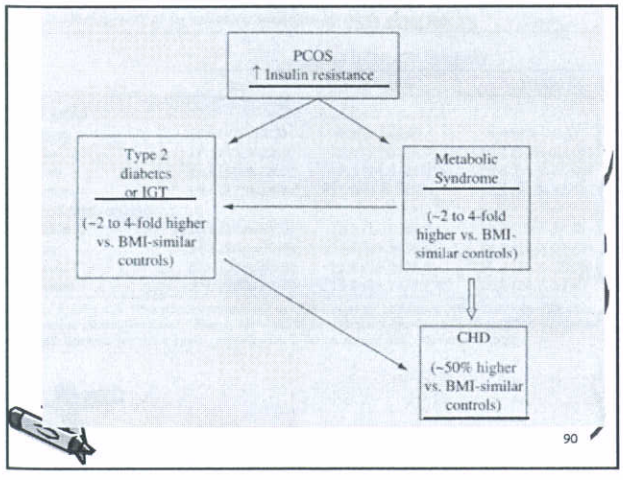


Figure 12.1 The postulated consequences linked to insulin resistance in women with polycystic ovary syndrome



ure 12.2 It is possible in broad terms that lean women with polycystic ovary ome (PCOS) have either a greater basal steroidogenic abnormality, which can t in the clinical phenotype with normal insulin levels, or insulin hypersecretion xcess androgens, whereas women who are overweight or obese and vith PCOS require a far greater 'push' from insulin resistance and the perinsulinaemia to reach the threshold for the clinical phenotype



Trends in prevalence of the metabolic syndrome

- NHANES III, USA
- ATPIII criteria
- 24.1 and 27.0 percent for men and women

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Table 1—*Prevalence* of central obesity by ethnic group and sex*

	NCEP ATP III waist circumference†		Asian waist circumference‡	
	Men	Women	Men	Women
Ethnic group				
Chinese	3.7 (3.0–4.7)	6.9 (5.9–8.2)	26.2 (24.2–18.2)	21.0 (19.3–23.0)
Malay	4.8 (2.9–7.8)	22.0 (17.6–27.0)	29.8 (24.9–35.2)	43.2 (37.7–48.9)
Indian	8.6 (5.3–13.6)	25.5 (19.5–32.6)	41.4 (34.5–48.7)	53.8 (46.2–61.2)

Data are % (95% CI). *Prevalence standardized to 1998 Singapore population, weighted for age, sex, and ethnic distribution; †NCEP ATP III waist circumference cutoffs: >102 cm in men, >88 cm in women; ‡Asian waist circumference cutoffs: >90 cm in men, >80 cm in women.

Tan CE Diab Care 2004(27):1182-88.

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Table 2—*Prevalence* of the metabolic syndrome by ethnic group and sex*

	Original NCEP ATP III criteria		
	Men	Women	Total
Ethnic group			
Chinese	10.8 (9.5–12.3)	8.3 (7.2–9.6)	9.4 (8.5–10.4)
Malay	17.3 (13.5–22.0)	20.0 (15.8–24.9)	18.7 (15.8–22.0)†
Indian	21.7 (16.4–28.3)	19.3 (14.0–26.0)	20.4 (16.5–25.0)†
All races	13.1 (11.8–14.6)	11.0 (9.7–12.3)‡	12.1 (10.8–13.5)
Modified Asian criteria‖			
Chinese	18.1 (16.4–19.9)	12.5 (11.1–14.0)	14.8 (13.7–16.0)
Malay	24.7 (20.2–29.9)	23.8 (19.3–28.9)	24.2 (21.0–27.8)†
Indian	32.4 (26.0–39.5)	25.8 (19.7–33.0)	28.8 (24.3–33.9)†
All races	20.9 (19.3–22.7)	15.5 (14.1–17.1)§	18.2 (16.7–19.9)

Data are % (95% CI). *Prevalence standardized to 1998 Singapore population; †$P < 0.001$ for difference between one ethnic group and Chinese; ‡$P = 0.046$ for difference between two sexes; §$P < 0.001$ for difference between two sexes; ‖waist circumference >90 cm in men and >80 cm in women.

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Table 3—*Prevalence* with 95% CI of metabolic syndrome according to modified Asian criteria by ethnic group and age-group*

	18–29 years	30–39 years	40–49 years	50–59 years	60–69 years
Ethnic group					
Chinese	2.1 (1.4–3.2)	4.5 (3.4–6.0)	10.7 (8.9–12.8)	22.1 (18.8–25.9)	25.0 (20.5–30.2)
Malay	8.6 (5.2–14.0)	13.3 (9.2–18.8)	24.5 (18.0–32.5)	35.1 (24.3–47.7)	38.0 (25.2–52.8)
Indian	4.3 (1.6–10.9)	14.6 (9.1–22.6)	26.5 (17.9–37.2)	38.2 (24.9–53.6)	50.8 (33.6–67.7)
All races	2.9 (2.1–4.1)	6.3 (5.1–7.9)	14.9 (12.8–17.3)	26.7 (23.1–30.7)	31.0 (26.2–36.2)

Data are % (95% CI). *Prevalence standardized to 1998 Singapore population.

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Table 15.1 Targets for treatment of the metabolic syndrome

	High risk	Very high risk[a]
Blood pressure (mmHg)	<135/85	<120/80
Fasting glucose (mmol l^{-1})	<6.1	<5.6
2-h Post-challenge plasma glucose	<10	<8
Triglycerides (mmol l^{-1})	<1.7	<1.5
High-density lipoprotein-cholesterol (mmol l^{-1}) M/F	>0.9 / >1.0	>1.0 / >1.1

[a] Confirmed atherosclerotic vascular disease.

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Treatment by lifestyle modification

- Lifestyle intervention in
  - Obesity
  - pre-diabetes and type 2 diabetes
  - Dyslipidaemia
  - Hypertension
  - Hypercoagulability and low-grade inflammation

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