

## Exercise Prescription and Dietary Control for Diabetes Mellitus and Obesity

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## Prevention of T2DM

☞ In people with IGT, a program of weight control is recommended, including at least 150 min/week of moderate to vigorous physical activity and a healthy diet with modest energy restriction

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### Type 2 Diabetes Mellitus (T2DM) Prevention: Outcomes of Randomized, Controlled Clinical Trials

Study	Intervention	RRR
DaQing Study <sup>1</sup>	Therapeutic lifestyle change	31–46%
Xendos <sup>2</sup>	Orlistat	37%
Finnish Diabetes Prevention Study <sup>3</sup>	Therapeutic lifestyle change	58%
Diabetes Prevention Program <sup>4</sup>	Therapeutic lifestyle change	58%
Diabetes Prevention Program <sup>4</sup>	Metformin	31%
STOP-NIDDM <sup>5</sup>	Acarbose	25%
TRIPOD <sup>6</sup>	Troglitazone	55%
DREAM <sup>7</sup>	Rosiglitazone	62%

RRR=relative risk reduction

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## 運動對糖尿病的影響 (一)

### 即時的影響

- ☞ 改善血糖濃度
  - ❖ 輕量至中等強度的運動，足以減低血糖量
  - ❖ 但對過胖患者的影響，其影響的差別則較大
- ☞ 提高細胞對胰島素的敏感度
  - ❖ 減少使用藥物治療

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## 運動對糖尿病的影響 (二)

### 長期的影響

- ☞ 減低高血壓
- ☞ 降低心臟血管疾病的機率
  - ❖ 減少血中三酸甘油酯及低密度脂蛋白膽固醇濃度
  - ❖ 增加血中高密度脂蛋白膽固醇濃度

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## 運動對糖尿病的影響 (三)

### 長期的影響

- ☞ 心理的影響
  - ❖ 減低壓力
- ☞ 肥胖的預防與矯正

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## 影響糖尿病患者對運動反應的因素

- 所使用之藥物
- 使用藥物之時間
- 運動前之血糖量
- 運動前所進食的時間,份量及種類
- 糖尿病患的嚴重情況
- 運動之強度,時間之長度及種類

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## 建議糖尿病患者的運動處方

(American College of Sports Medicine (2006). Guidelines for Exercise Testing and Prescription. Lippincott Williams & Wilkins. ADA Standards of Medical Care for DM 2006.)

### 頻次 (Frequency)

- ✘ 一般2型糖尿病患者: **at least 3 days /week with no more than 2 consecutive days without physical activity (>150 min/week of moderate-intensity or >90 min/week of vigorous aerobic exercise)**
- ✘ 如需注射胰島素之患者,可每日進行運動
- ✘ 過胖之患者,亦需每日進行運動,以增加能量的支出,達至最佳的體重控制

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## 建議糖尿病患者的運動處方

### 強度 (Intensity)

- ✘ 一般2型糖尿病患者,應選擇低至中等強度之aerobic exercise (40-60%最大攝氧量VO<sub>2</sub>max; ~50-70% of max HR)
- ✘ 部分患者可能在較高強度(>60%最大攝氧量VO<sub>2</sub>max; >70% of max HR)之運動,才見成效

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## 建議糖尿病患者的運動處方

### 時限 (Duration)

- ✘ 開始運動時,每次10-15分鐘
- ✘ 以每次最少30分鐘為佳,亦可每小節10分鐘,進行3節
- ✘ 如運動目的為體重控制,運動時間則需增至60分鐘 (>50%最大攝氧量)

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## 建議糖尿病患者的運動處方

### 型式 (Mode)

- ✘ 以個人興趣,目標為主導
- ✘ 可選擇型式包括:
  - 步行
  - 非負重之運動如游泳單車等
- ✘ 阻力訓練 (resistance exercise, RE)  
對糖尿病患者也有一定之益處

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## Resistance Exercise

- Activities that use muscular strength to move a weight or work against a resistive load. Examples include weight lifting and exercises using weight machines
- T2DM should be encouraged to perform RE 3x/week, targeting all major muscle groups, progressing to 3 sets of 8-10 repetitions at a weight that cannot be lifted more than 8-10 times
- Proven improving glycaemic control by improving insulin sensitivity to about the same extent as aerobic exercise
- Largely safe for patients with high risk for CVD

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## 建議糖尿病患者的運動處方

### 進度 (Rate of Progression)

- ✘ 影響運動進度的因素包括：
  - 年齡
  - 個人能力
  - 病情
  - 個人喜好及目標
- ✘ 一般而言，長者及過胖的糖尿病患者之進度均較慢

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## 建議糖尿病患者的運動處方

### 限制 (Limitation)

- ✘ 因2型糖尿病患者對時間的運動感到不適，所以放棄的比率較高及較難推動
- ✘ 因肌肉內組織之不同，胰島素抗拒的糖尿病患者較難適應長時間之運動
- ✘ 因此，運動應選擇在較舒適的程度，以求適應

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## 糖尿病患者運動時的注意事項

### 預防運動時出現低血糖的建議 (for those on insulin +/- insulin secretagogues)

- 在運動前、後及其間均需監測血糖
- 避免在胰島素作用的最高點時運動
- 在進行沒有預先計劃的運動，每30分鐘之運動量，需要補充額外20-30克之碳水化合物
- Added CHO should be ingested if pre-exercise glucose  $<5.6$  mmol/l +/- reduce insulin / OHA

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## 糖尿病患者運動時的注意事項

### 預防運動時出現低血糖的建議 (for those on insulin +/- insulin secretagogues)

- 運動時需容易取得碳水化合物類之食物，以作補充
- 運動後需補充碳水化合物類之小食
- 要了解低血糖時的症狀和處理原則
- 不要獨自一人進行運動

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## 糖尿病患者運動時的注意事項

### 其他注意事項

- 血糖濃度 $>16.7$  mmol/l or  $>13.3$  mmol/l及出現酮酸症則應暫緩進行運動
- 若血糖值 $<5.6$  mmol/l，在運動前要補充一些碳水化合物的小食
- 特別注意足部護理及於運動時穿著良好的鞋及綿質的襪子
- 注射胰島素者，儘量不要在黃昏或夜間做激烈運動，以免睡覺後發生低血糖

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## 糖尿病患者於運動時需要留意的情況

- 運動時應穿著舒適的衣服及運動鞋，更應避免過熱或過冷的天氣下進行
- 運動前應熱身，運動後應作靜止前運動
- 如需於運動前注射胰島素，應選擇皮脂較厚及運動量低的部位注射胰島素，如腹部
- 隨時帶備藥物

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## Evaluation of the diabetic patient before recommending an exercise program

- Not as a routine if CAD risk is low
- Usually no need if just brisk walking
- Take extra precautions if
  - Uncontrolled HT
  - Severe autonomic neuropathy
  - Severe peripheral neuropathy
  - Proliferative/proliferative retinopathy or macular oedema

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A graded exercise test with ECG monitoring should be seriously considered before undertaking aerobic physical activity with an intensity exceeding the demands of everyday living (more intense than brisk walking) in previously sedentary diabetic individuals whose 10-yr risk of a coronary event is  $\geq 10\%$

- Estimated directly using the UKPDS Risk Engine ([www.dtu.ox.ac.uk/riskengine/download.htm](http://www.dtu.ox.ac.uk/riskengine/download.htm))

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## Assessed if any of the following criteria:

- Age  $>40$  yrs, +/- CVD risk factors other than DM
- Age  $>30$  yrs and
  - T1 or T2 DM  $>10$  yrs' duration
  - HT
  - Cigarette smoking
  - Dyslipidaemia
  - Proliferative/proliferative retinopathy
  - Nephropathy, including microalbuminuria
- Any of the following, regardless of age
  - Known or suspected CAD, CVD +/- PVD
  - Autonomic neuropathy
  - Advanced nephropathy with renal failure

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## Exercise in the presence of specific long-term diabetic complication

- Advanced retinopathy
  - Vigorous aerobic or resistance exercise may be contraindicated because of the risk of triggering vitreous haemorrhage
- Severe peripheral neuropathy
  - Best to encourage non-wt bearing activities such as swimming, bicycling, or arm exercise
- Autonomic neuropathy
  - Can increase the risk of exercise-induced injury
- Microalbuminuria and nephropathy
  - No evidence that vigorous exercise increases the rate of progression of diabetic kidney disease

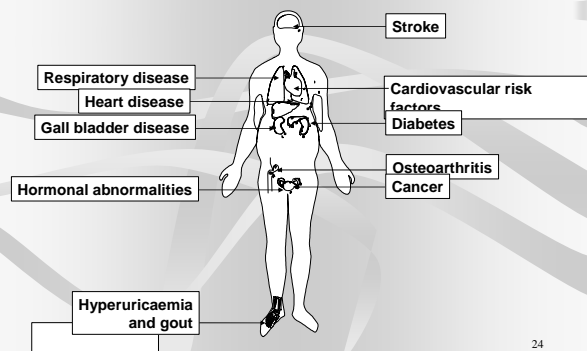
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## Obesity is a Chronic Disease

- Life-long problem, not curable in most cases
- Risk factor for many other diseases
- Manageable with lifestyle modifications, pharmacotherapy and surgery (in appropriate patients)
- Sustained moderate weight loss (5% to 10%) provides significant health benefits
- Realistic expectations must be established

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## Health Consequences of Obesity



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## Health Risks of Obesity

### Greatly increased

Type 2 diabetes

Dyslipidaemia

Metabolic Syndrome

Breathlessness  
Sleep apnoea

Gallbladder diseases

### Moderately increased

Coronary heart disease

Hypertension

Osteoarthritis

Gout

### Mildly increased

Cancer

Menstrual dysfunction

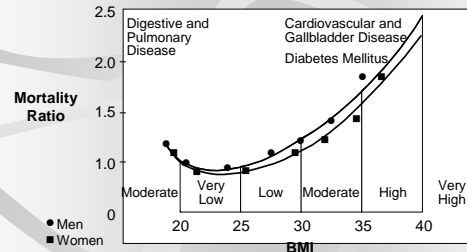
Infertility

Increased anaesthetic risk

Foetal defects (maternal obesity)

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## Obesity and Mortality Risk



Reprinted from Gray, *Med Clin North Am.* 1989;73(1):1-13, based on statistical information from Lew et al. *J Chron Dis.* 1979;32:563-576.

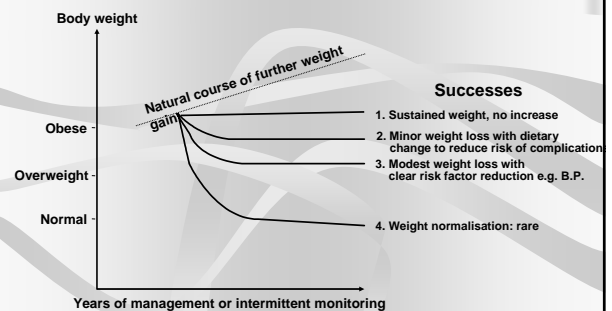
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## Keys to Success

- Disease Vs Beauty
- Prevention is the very first step
- Life-long commitment
- Realistic goals
- Multidisciplinary
- Progressive & steady weight loss
- Motivations
- Enjoyable
- Active self-participation

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## The Management of Obesity

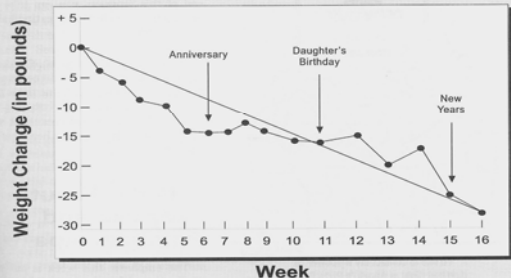


Adapted from Rössner, 1997

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## A Step-wise Weight Loss Program

### Sample Weight Change Record



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## How Do We Lose Weight?

- **Life Style Changes**
  - Dietary restriction
  - Exercise
  - Behavioural modifications
- **Pharmacological agents**
  - Lipase inhibitor : Orlistat
  - Neurotransmitter uptake inhibitor : Sibutramine
  - Others
- **Surgical procedures**

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The only magic “pill” is permanent life-style modifications – a combination of healthy diet and exercise

### The Team Approach Team Menu

Primary Care Provider	Obesity Specialist
Nurse	Registered Dietitian
Nurse Practitioner	Physician Assistant
Diabetes Educator	Fitness Counsellor
Support Groups/ Tailored Programmes	Pharmacist
	Clinical Psychologist

### The Objectives:

To lose **1-2 pound adipose tissue per week**

= promote negative energy balance

= need to cut down **3500-7000 kcal per week (500 - 1000 kcal per day)** through diet and exercise

### What is Practical?

- The best diet is the one the patient can follow in the long term
- A decrease in calorie intake is the **MOST** important component of weight loss and maintenance
- Formulas are an estimate only and are not exact science
- Research shows most overweight patients can lose weight on 1200-1500 kcal/day



### Sample Diet of City Life

- **Breakfast (Fast food restaurant) (大X樂)** 470 kcal 27 g fat  
– Set Breakfast  
(Fried egg x2, sausage x1, bread x1, milk tea + sugar 2 tsp.)
- **Lunch (Chinese restaurant) (XX茶夕廳)** 1237 kcal 101g fat  
– Stir-fried ho fan with beef 1 plate
- **Afternoon snack (Fast food restaurant)** 205 kcal 5 g fat  
– Toast with butter x1, lemon tea + sugar 2 tsp.
- **Dinner (Home)** 695 kcal 27g fat  
– Rice 1 bowl, pan-fried fish 2 tael, fried chicken wings x2,  
stir-fried vegetable 1/2 bowl, fruit x1

**Total 2607 kcal, 160g fat**

### Dietary Approach to Weight Reduction

- Promotion of healthy eating lifestyle
- Individualized meal plan
- Proper low fat cooking methods
- Sensible eating out choices
- Understanding of food labeling

**“Must be Enjoyable & Long-Lasting”**

一週飲食及運動日記				
請參考以下例子有助你填寫飲食及運動日記，每次覆診見營養師時，請帶回此日記。				
	時間	地點	食物份量及煮法	體重
早餐	8時	家	火腿三文治 1份 + 脫脂奶 1杯	65 公斤
小食	--	--	--	
午餐	1時	出外	雲吞麵 1碗 + 灼菜 (走油) 1碟	運動 急行 1小時
小食	4時	辦公室	橙 1個	
晚餐	7時	家	白飯 1碗 + 上湯芥蘭 1碟 + 蒸魚 2兩 + 切雞 1兩 (去皮) + 蘋果 1個	情緒 輕鬆
小食	10時	家	脫脂奶 1杯	

Food equivalents of different activity levels				
	Energy (kcal)	Sedentary activity (min.)	Moderate activity (min.)	Strenuous activity (min.)
Soft drink 1 pkg	127	76	24	8
Diet drink 1 can	1	<1	<1	<1
Egg tart 1 pc	209	125	40	13
Apple 1 pc	89	54	17	6

## The Facts about Exercise

- Exercise is never too late
- Exercise is essential to have a manageable diet
- Exercise is the best predictor of long-term weight loss maintenance

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## RATIONALE FOR PHYSICAL ACTIVITY IN WEIGHT MANAGEMENT

- Increases energy expenditure
- Protects/builds lean body mass
- Improves psychological factors
- Reduces risk of morbidity and mortality
- May suppress appetite

Grilo et al. In: Stunkard, Wadden. *Obesity: Theory and Therapy*; 1993:chap 15. 40

## PHYSICAL ACTIVITY: IMPACT ON COMORBIDITIES

- Enhances cardiorespiratory fitness<sup>1</sup>
- Improves lipid profile<sup>1</sup>
- Reduces blood pressure<sup>2</sup>
- Increases insulin sensitivity<sup>2</sup>
- Improves blood glucose control<sup>2</sup>

1. Grilo et al. In: Stunkard, Wadden. *Obesity, Theory and Therapy*; 1993:chap 15. 2. Pi-Sunyer. In: Frankle, Yang. *Obesity and Weight Control: The Health Professional's Guide to Understanding and Treatment*; 1988. 41

## Special Populations (Continued)

5. The Obese (Chapter 9)
  - ❖ Primary goal is likely fat reduction while trying to maintain lean body mass.
    - Obese individuals will likely lose lean body mass along with fat mass, but the goal is to minimize this.
    - Focus will be on aerobic activity.
    - Generally recommended to reduce/expend 500 –1,000 kcal/day to loose body fat. Acceptable loss is 1% of body weight/week (1.0 – 2.0 lbs/week for avg. person).
      - Exercise objective is to spend >300 kcal/day.
      - Should not reduce total kcal/day intake below 1,200 kcal.

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## ACSM Exercise Prescription

- 5 days/wk → daily
- 40 – 60 min / session or two 20-30 min sessions/day
- 40 – 70% VO<sub>2</sub>max
- 50-75% max heart rate
  - (220 - age = max heart rate)
- Aerobic exercise
- Resistance exercise

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## Physical/Medical Readiness

- Refer to physician if doing:
  - Moderate-intensity activities, and they have
    - One or more symptoms (see below),
      - Angina or other pain in arms, neck or jaw that may be due to lack of blood flow
      - Intermittent claudication
      - Shortness of breath with exertion or at rest
      - Unusual fatigue or shortness of breath with usual activities
      - Dizziness or fainting
      - Heart arrhythmias or murmurs
      - Swelling or fluid accumulation in ankles
- OR
- Known cardiovascular, pulmonary, or metabolic disease

Adapted from: American College of Sports Medicine, *ACSM's Guidelines for Exercise Testing and Prescription*, sixth edition, Media, PA: Williams and Wilkins, 2000

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## Physical/Medical Readiness

- Refer to physician if doing:
  - Vigorous-intensity activities, and they are/have
    - One or more symptoms (see previous slide), or
    - Known cardiovascular, pulmonary, or metabolic disease, or
    - Older (45 for men; 55 for women) or
    - Two or more risk factors
      - Family Hx of CVD
      - Cigarette smoking (current or quit in last 6 months)
      - Hypertension or on antihypertension meds
      - Hypercholesterolemia
      - Impaired fasting glucose
      - Obesity
      - Sedentary

Adapted from: American College of Sports Medicine, *ACSM's Guidelines for Exercise Testing and Prescription*, sixth edition, Media, PA: Williams and Wilkins, 2000

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## Energy Expenditures in Various Activities (based on a 150-pound person )

ACTIVITY	Total calories used per hour
Sitting and standing	25-35
Walking Slowly (2 1/2 mph)	210-230
Fast Walking (4 mph)	250-345
Jogging (6 mph)	315-480
Swimming	315-480
Tennis	315-480
Swimming	480-625

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## Small Changes Approach

- Big changes have not worked – poor success even at getting people to start extra exercise 20 minutes a day
- Small changes – start where people are now and more is better
- Additional 30 minutes of walking already enough to prevent future weight gain
- 60-90 minutes of walking may be required to maintain weight loss  
([www.americaonthemove.org](http://www.americaonthemove.org))

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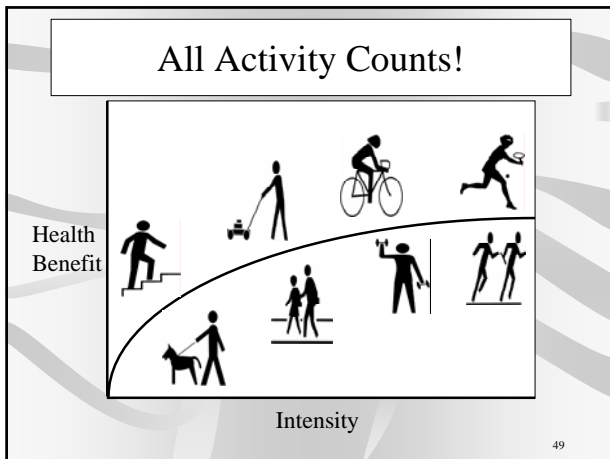
## DEVELOP PLAN FOR INCREASED ENERGY EXPENDITURE

### All Physical Activity Counts

- Make opportunities to increase physical activity<sup>1</sup>
  - Walk whenever possible
  - Take the stairs
  - Undertake household chores, such as cleaning and gardening
- Effects are cumulative<sup>1</sup>
- There is no threshold of activity necessary for a benefit<sup>2</sup>

1. Grilo et al. In: Stunkard, Wadden. *Obesity: Theory and Therapy*; 1993:chap 15.  
2. Wilfley et al. In: Dishman. *Advances in Exercise Adherence*; 1994:361-393.

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### 消耗熱量活動推介 約消耗150卡路里(3茶匙油)

- 抹車及打蠟45至60分鐘
- 抹窗及掃地45至60分鐘
- 在30分鐘內踏單車5公里
- 跳健康舞或社交舞30分鐘
- 游泳20分鐘

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### 消耗熱量活動推介 約消耗150卡路里(3茶匙油)

- 打籃球15至20分鐘
- 跳繩15分鐘
- 來回上落樓梯15分鐘
- 在15分鐘內跑步1.5公里(即四個圈運動跑步場)

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### Case Discussion– Ms. Lee

- Female/ 50, Clerk (GS)
- Referred by family doctor for weight reduction
- BW= 85.8 kg (190.3lb), Ht= 154 cm, BMI = 36.2, Body fat 46.7%, waist circumference= 99cm (39 in)
- Weight history:
  - Being overweight most of her life (30th anniversary for trying to lose weight)
  - Tried various weight loss methods, but never follow a structured medical weight management program
  - Adult lifetime lowest wt 149 lb, usual wt – 180 lb, ↑ wt significantly in past 1 year

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### Case Discussion– Ms. Lee

- Past medical history:
  - Serious OA knee, depression, Mild hypertension
  - Medications:
    - Nifedipine SR, Efexor XR, Remeron
- Pre- weight management program assessment
  - OGTT 6.4/ 7.7 (Impaired fasting glucose)
  - ↑ urate 0.45
  - ↑ lipids (Chol. 5.3, HDL 1.25, LDL 2.9, TG 2.43)
  - ↑ALT 72, ↑ Bilirubin 17
  - Endocrine disorder excluded

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### Case Discussion– Ms. Lee

Age=50, BW= 85.8 kg (190.3lb), Ht= 154 cm  
Sedentary lifestyle due to knee pain

$$\begin{aligned} \text{BMR} &= 655 + (9.6 \times W) + (1.9 \times H) - (4.7 \times A) \\ &= 655 + (9.6 \times 85.8) + (1.9 \times 154) - (4.7 \times 50) \\ &= 1532 \text{ kcal/d} \end{aligned}$$

Estimated daily energy requirement to lose weight:  
BMR x physical activity factor – 500 kcal

$$\begin{aligned} &= 1532 \times 1.2 - 500 \\ &= 1338 \text{ kcal/d} \end{aligned}$$

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## Case Discussion– Ms. Lee Diet History

- **Breakfast**
    - Fast food restaurant or home
    - breakfast set 1 whole or cereal 2/3 bowl + skim milk 1 cup
  - **Lunch**
    - Fast food restaurant
    - Plate rice 2/3 -1 whole or soup noodle 1 bowl
  - **Afternoon**
    - A variety of snacks (chips, cakes) bought by herself or co-workers
  - **Dinner**
    - Simple dinner prepared by her sister at home
    - Rice 1 bowl + stir-fried vegetable 1 bowl + steamed fish/meat/ chicken 5-6 teal
- (Estimated intake: > 2000 kcal, >75g fat per day)

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## Case Discussion– Ms. Lee

- **Intensive weight reduction phase**  
(12- week multi-disciplinary weight management program)
  - Medical assessment monthly (wk 1, 5, 12)
    - Xenical 120 mg BD
  - Dietitian consultation weekly
    - Goal setting- weight, diet, exercise, behaviors
    - Food/ weight/ mood record
    - Healthy eating education (e.g. home cooking, eating out, healthy snack choices)
    - Individualized meal plan
    - Food labeling and supermarket tour
    - Meal replacement 1x / day (Glucerna SR)
    - Behavioral modification techniques
  - Physical training weekly
    - Exercise record
    - Additional 30 min walking/d
    - Maintain swimming for 30-45 min 2-3x/week at clubhouse

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## Pre and post first 12 weeks –WMP assessment

	Baseline (12/03)	Post WMP assessment (3/04)
Weight (BMI)	86.5 kg (36.4)*	77.7 kg (32.8)*
Waist circumference	99 cm*	92 cm*
Body fat	46.7%*	40.8%*
Fasting glucose	6.4 mmol/l*	4.8 mmol/l
Cholesterol	5.3 mmol/l*	4.2 mmol/l
TG	2.43 mmol/l*	1.17 mmol/l
Urate	0.45 mmol/l*	0.32 mmol/l
ALT	72 IU/l*	51 IU/l
Blood pressure	126/73 mmHg (on HT med.)	128/78 mmHg (off med.)

\* Abnormal figure

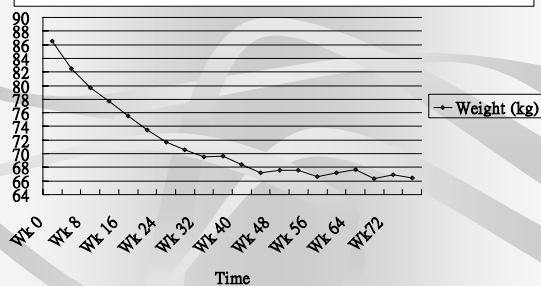
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## Case Discussion– Ms. Lee (4)

- **Weight maintenance phase**  
(step-down weight management program)
  - Medical assessment (Monthly to Quarterly)
    - Off Xenical
  - Dietitian consultation (Monthly to Quarterly)
    - Food/ weight/ mood record
    - Taped off meal replacement with healthy food choices
    - Advice on long-term behavioral changes for weight loss/maintenance
  - Physical training (bi-weekly )
    - Exercise record
    - Advance techniques

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## Weight changes over time



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## Case discussion– Ms. Lee

- **Medical improvement**
  - Wt loss of 19.6 kg (BMI 36.4 → 28.2) over 19 months
  - Decrease in body fat (46.7% → 35.5%) and increase in lean body mass
  - Off HT medication
  - ↓ depression medication
  - Normalized lipid profile, urate, and ALT
  - IGT (fasting 6.4/ 2 hr 7.7) → Normal glycemia (fasting 4.3/ 2 hr 5.8)

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### **Case discussion– Ms. Lee**

- Dietary improvement
  - Average intake: 1300-1400kcal/d (53%CHO, 17% protein, 30% fat)
  - Able to control food portions when eat-out
  - Able to prepare simple low fat low kcal dishes
  - Occasional treats with limited frequency and portion
  - Continue to keep food diary

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### **Case discussion– Ms. Lee**

- Subjective improvement
  - Feeling good about herself
  - Sense of achievement, better control of depression
  - Enjoy a sensible diet and regular exercise
  - “Can finally see her own toes from top down”
  - “Can walk up Pottinger Street without shortness of breath”

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