

# Feeding the Obese Patient

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# Nutrition in the hospitalized patient: Goals

- Preserve or minimize loss of lean body mass
- Provide protein, fuel (calories) and other nutrients to support vital functions, including immunity
- Prevent further deterioration in nutritionally depleted and/or severely catabolic patients
- Minimize risks of feeding (infections and metabolic complications)

# Nuances of feeding patients with obesity

- More difficult to estimate calorie and protein requirements due to altered body composition (LBM, fat mass, fluid retention) and metabolic response to stress
- High risk of metabolic (insulin resistance) and organ (cardiopulmonary) dysfunction
- Difficulties with catheter access and maintenance
- Paucity of medical literature devoted to topic

# How strong is the evidence that guides our decisions when feeding the obese patient?

- Primarily based on observational studies that often extrapolate data from obese and non-obese ICU patients
- Does not take into consideration nutritional status of patients prior to feeding
- Unintentional failure to provide adequate nutrition is often interpreted as permissive underfeeding
- Hypocaloric feeding studies in obesity are few in number, enrolled few patients, and primarily used nutritional outcomes instead of clinical outcomes

# Selected Topics for Review

- The problem of calculating calorie requirements
- Hypocaloric feeding (permissive underfeeding)
  - Rationale
  - Data
- Conclusions

# HOW TO YOU CALCULATE CALORIE REQUIREMENTS IN PATIENTS WITH OBESITY?

1. kcal per kg (actual wt)
2. kcal per kg (Ideal Body Weight)
3. Harris Benedict equation (actual wt)
4. Harris Benedict equation (adjusted wt)
5. Mifflin St. Jeor equation
6. Other



# Estimating RMR

- **Harris Benedict, 1919**

- Men:  $RMR = 66.5 + (13.8 \times \text{weight}) + (5 \times \text{height}) - (6.8 \times \text{age})$
- Women:  $RMR = 655.1 + (9.6 \times \text{weight}) + (1.8 \times \text{height}) - (4.7 \times \text{age})$

- **Mifflin-St. Jeor, 1990**

- Men:  $RMR = (10 \times \text{weight}) + (6.26 \times \text{height}) - (5 \times \text{age}) + 5$
- Women:  $RMR = (10 \times \text{weight}) + (6.26 \times \text{height}) - (5 \times \text{age}) - 161$

- **Fixed kcal per kg**

- 25 kcal/kg/d: American College of Chest Physicians (ACCP), 1997
- 20-25 kcal/kg/d: ESPEN Guidelines, 2006

# Predicting RMR from Equations

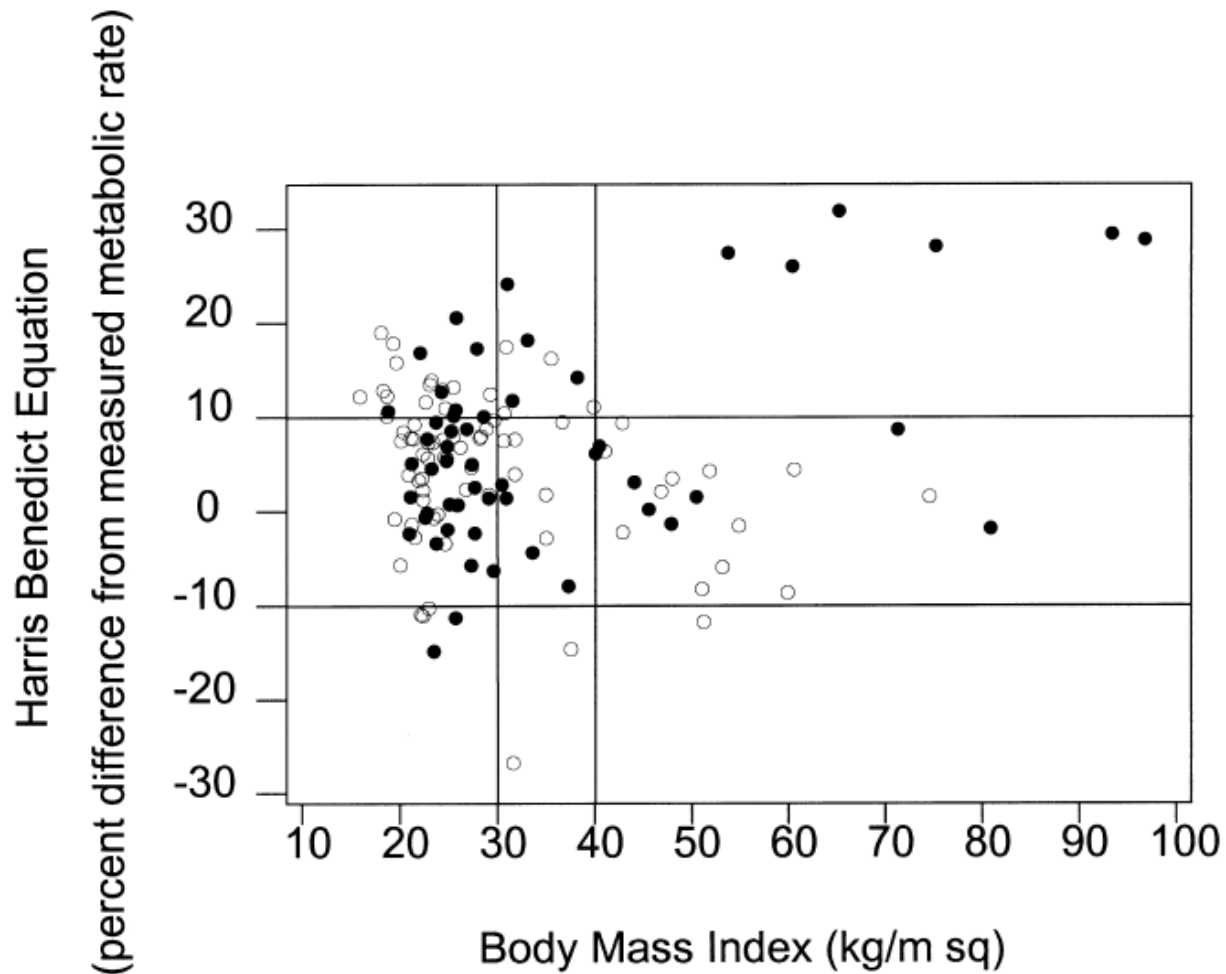


FIG 1. Accuracy of Harris-Benedict equation over the range of BMI. Horizontal band between +10% and -10% of measured resting metabolic rate indicates range considered accurate. Vertical lines at BMI 30 and 40 separate the obesity groups. Solid circles represent men, open circles represent women.

# Predicting RMR from Equations

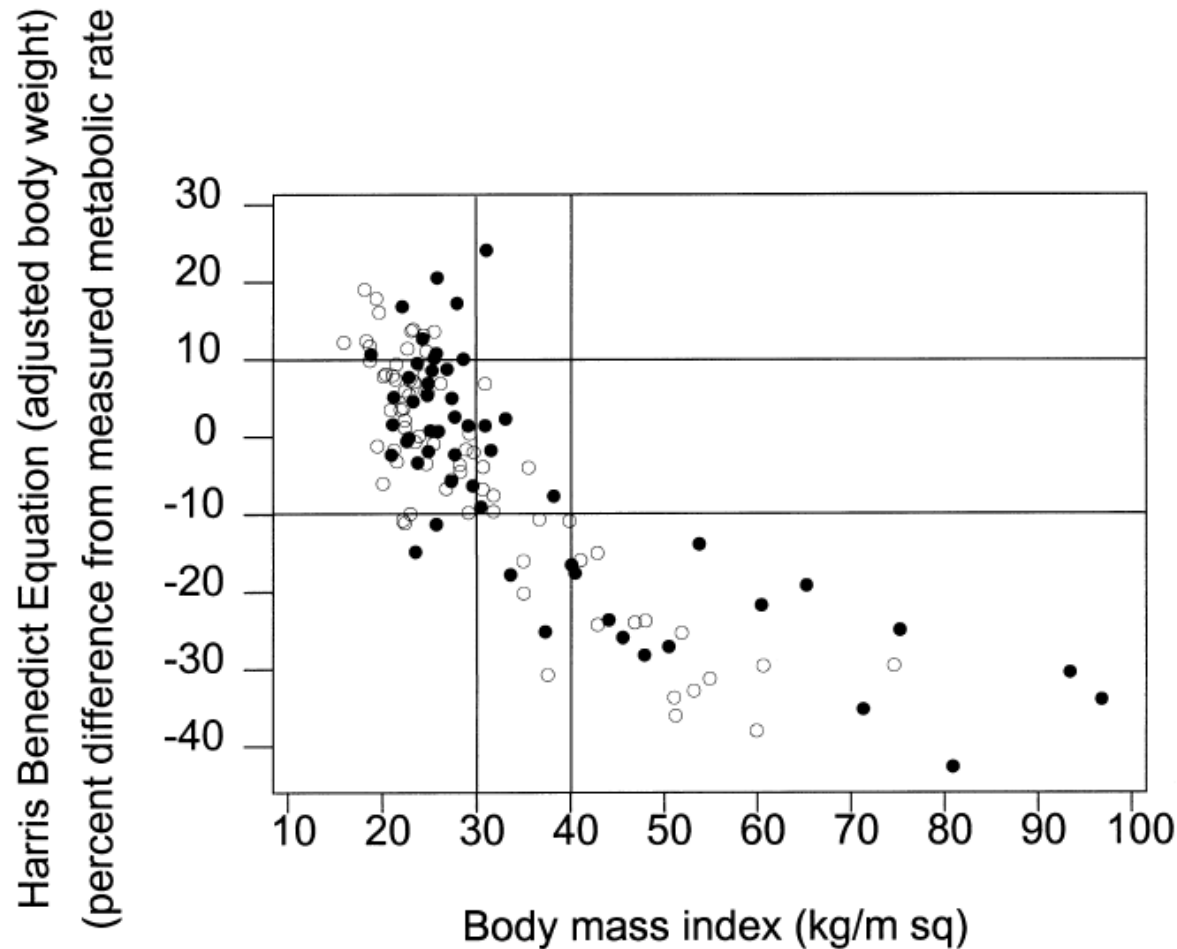


FIG 2. Accuracy of Harris-Benedict equation using adjusted body weight in obesity, over the range of BMI. Horizontal band between +10% and -10% of measured resting metabolic rate indicates range considered accurate. Vertical lines at BMI 30 and 40 separate the obesity groups. Solid circles represent men, open circles represent women.

# Predicting RMR from Equations

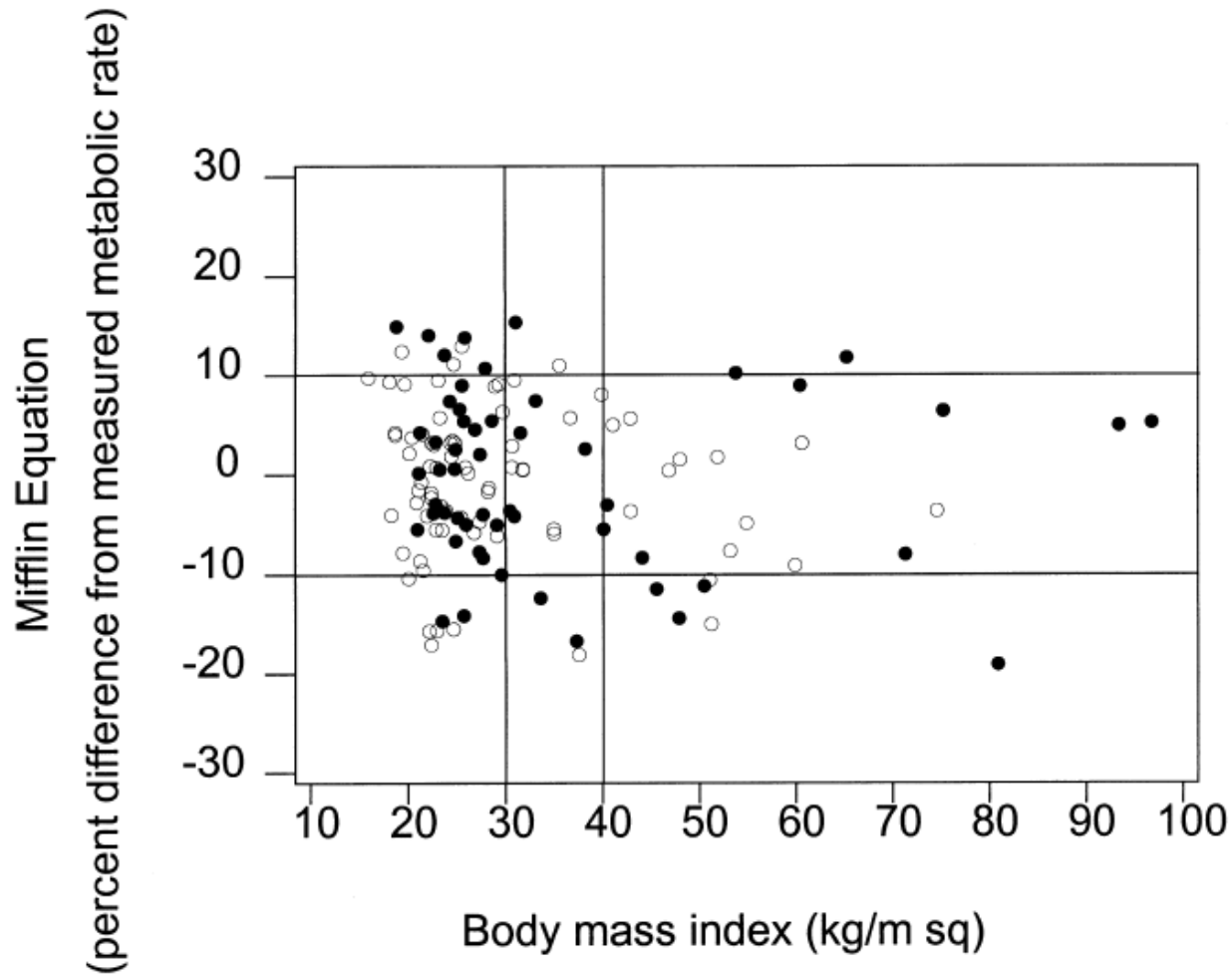
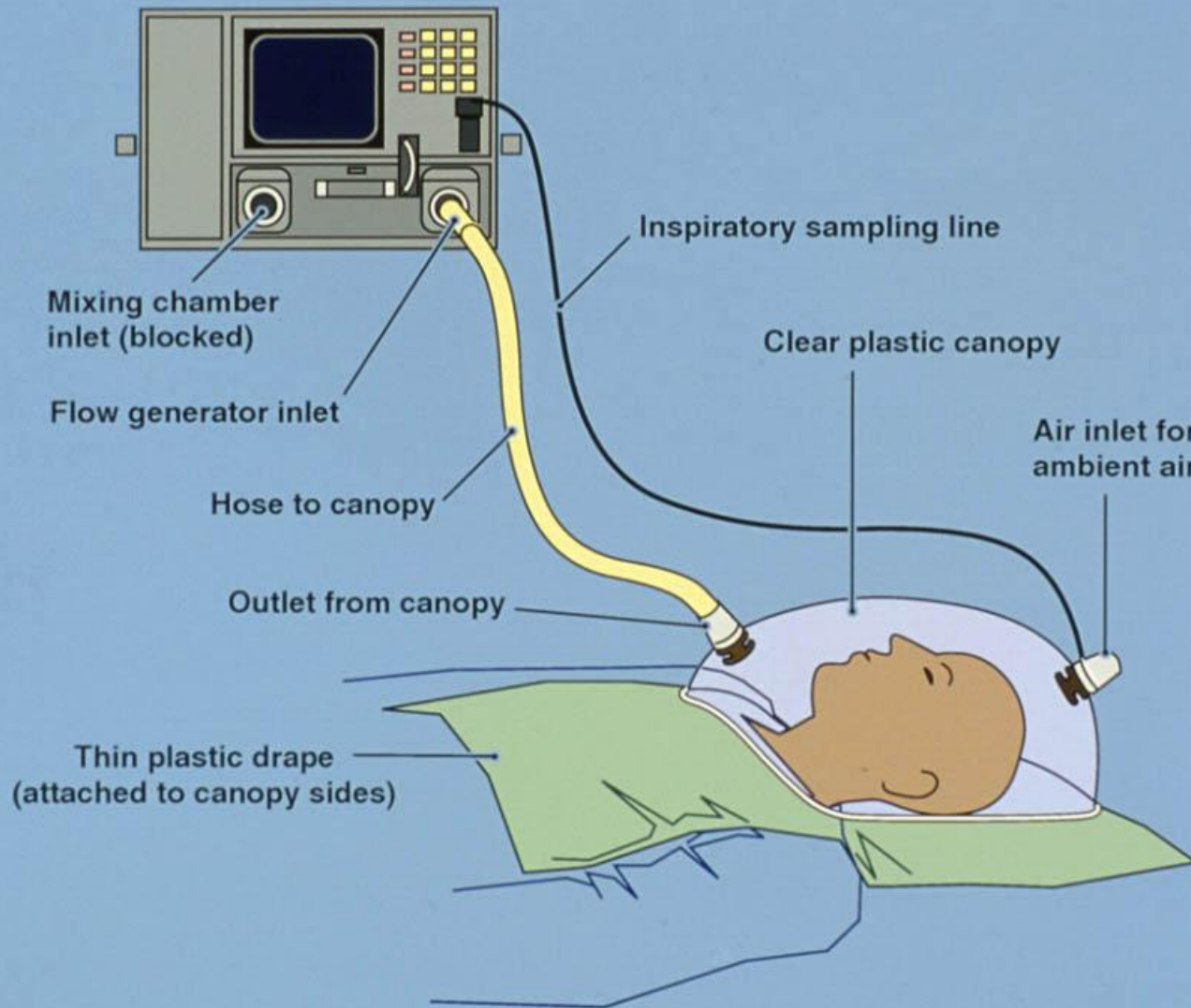


FIG 4. Accuracy of Mifflin equation over the range of BMI. Horizontal band between +10% and -10% of measured resting metabolic rate indicates range considered accurate. Vertical lines at BMI 30 and 40 separate the obesity groups. Solid circles represent men, open circles represent women.

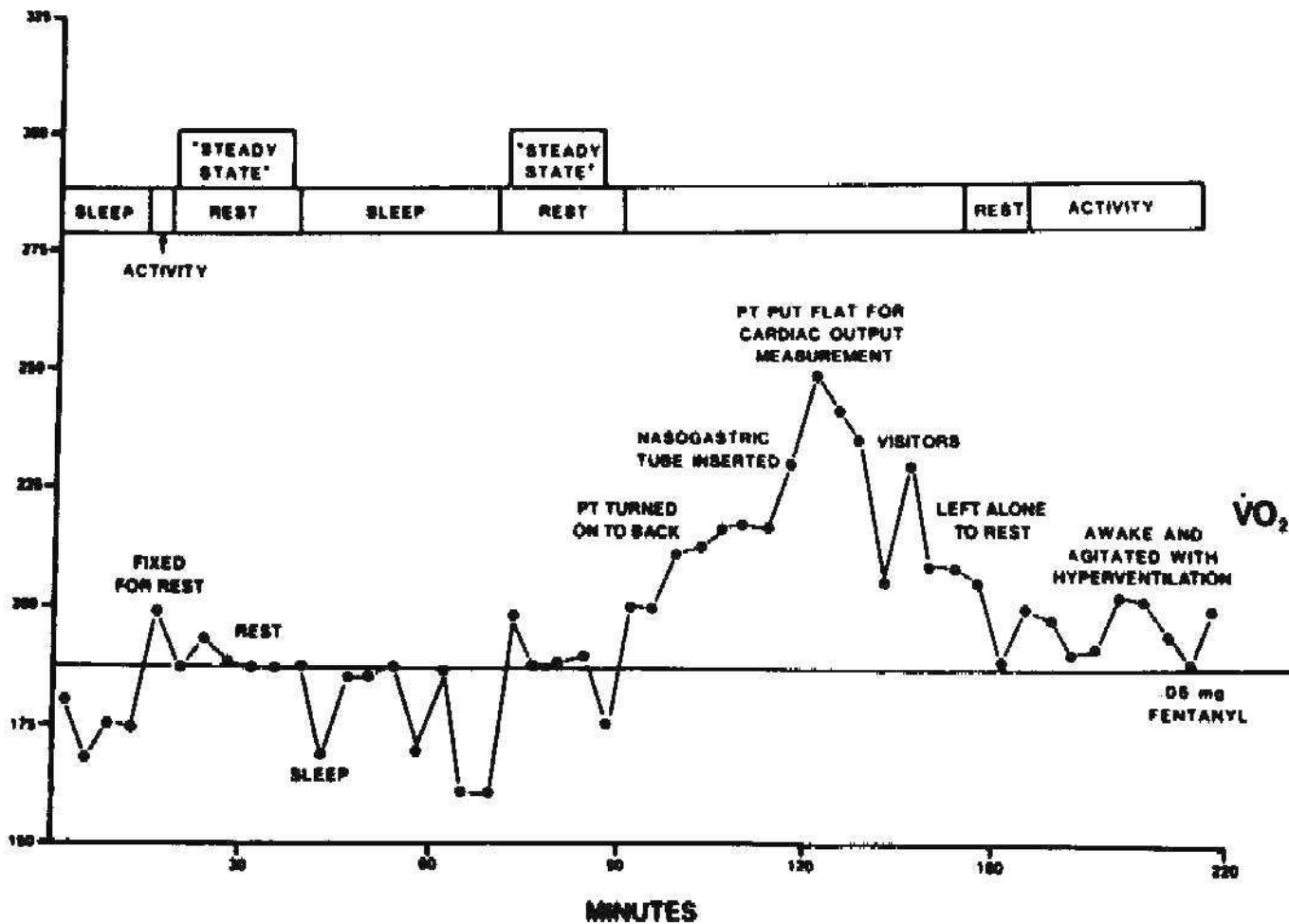
# Energy Expenditure in Hospitalized Patients

- 1256 patients in 19 studies
  - Postoperative (28%)
  - Trauma or sepsis (26%)
  - Cancer (18%)
  - Pulmonary disease (9%)
  - \*\*Excluded individuals with fever (11%/C), burns (140% to 150%), and head injuries (120% to 145%)
- Mean stress (SD) factor was 113% (10.9) above predicted by Harris Benedict equation

# Indirect Calorimetry Canopy Measurements with Room Air



# THE ENERGY EXPENDITURE OF A MECHANICALLY VENTILATED CRITICALLY ILL PATIENT



Weissman et al. Chest, 1986

$\dot{V}O_2$

$\dot{V}O_2$

## CONTRIBUTION OF ICU ACTIVITIES ON 24 HOUR ENERGY EXPENDITURE

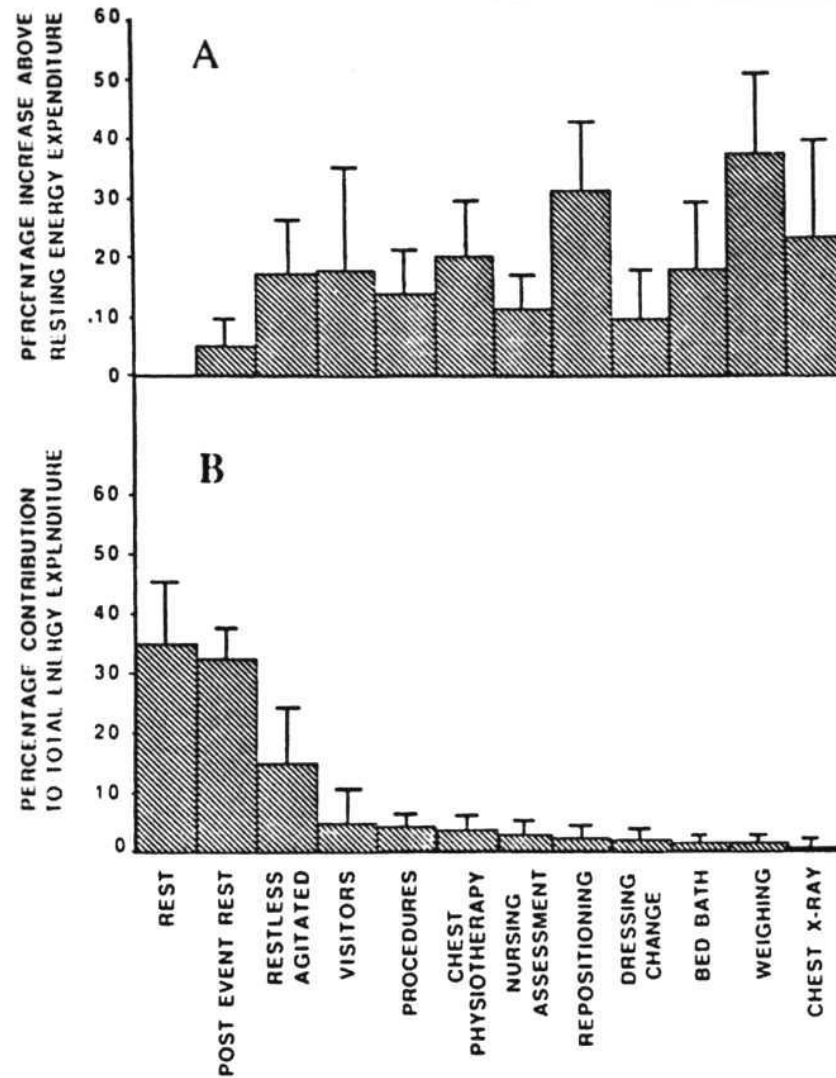


FIG. 2. (A) The percentage increase above the resting EE associated with various ICU activities; (B) the contribution of rest and various activities to the total EE (mean  $\pm$  SD).

# WHEN FEEDING PATIENTS WITH OBESITY, DO YOU

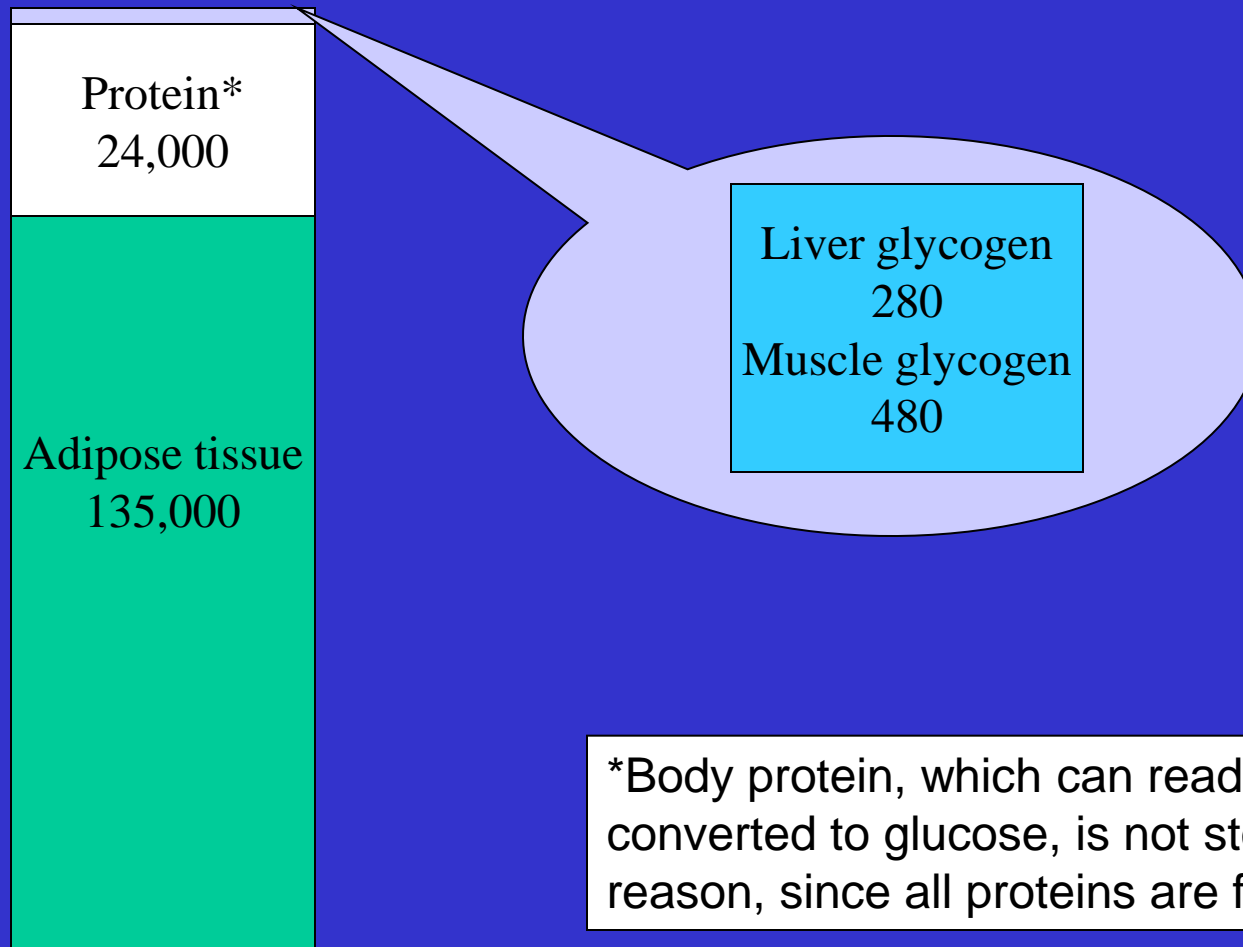
1. Try to achieve calculated calorie requirements
2. Use hypocaloric feeding (less than calculated requirements)



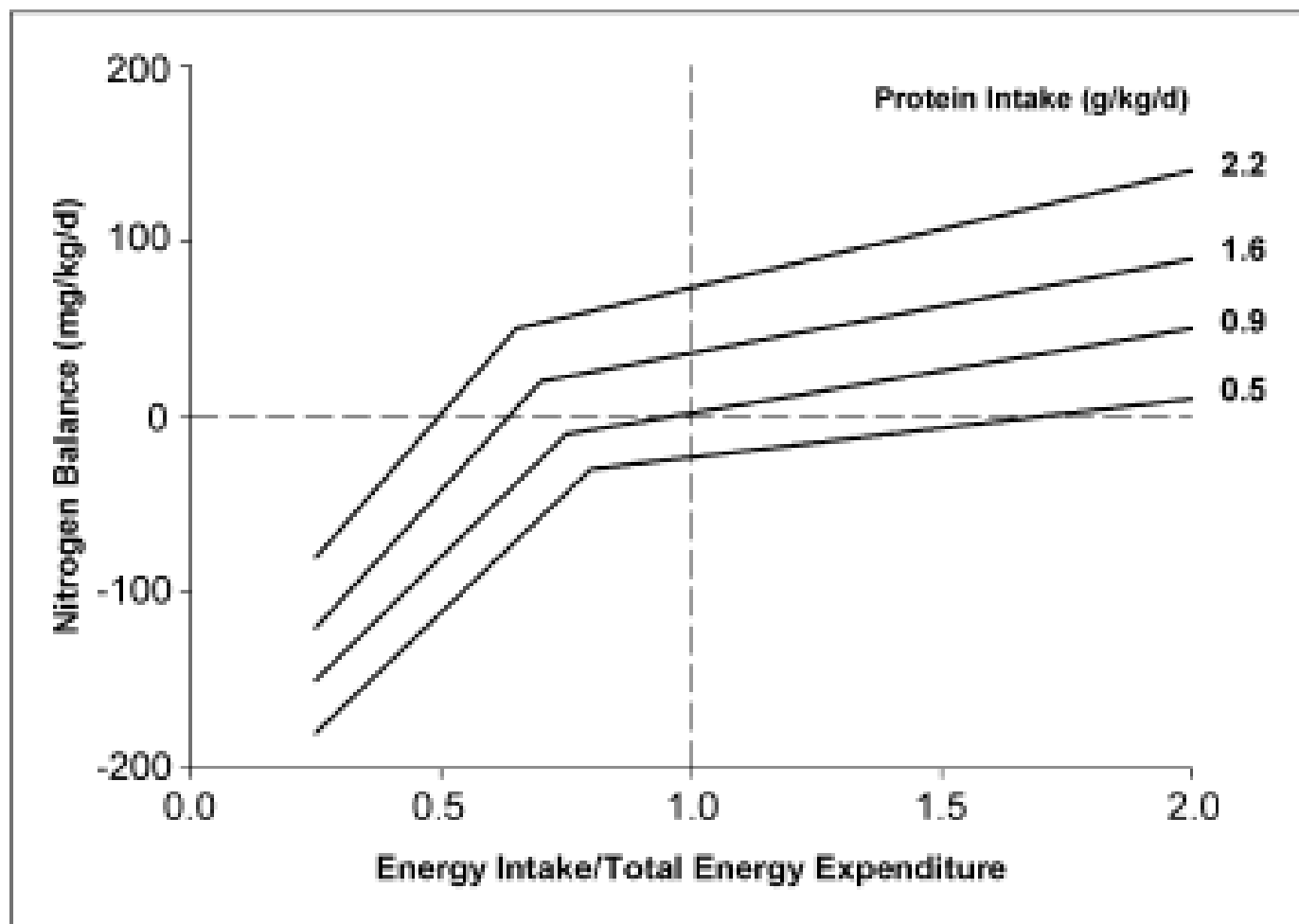
# Hypocaloric Feeding (Permissive Underfeeding)

- Protein is provided in adequate amounts with calorie (carbohydrate and fat) restriction
- Rationale
  - Preserve lean body mass (LBM)
  - Mobilize adipose (fat) stores
  - Reduce hyperglycemia and other metabolic complications
  - Lower infection rate

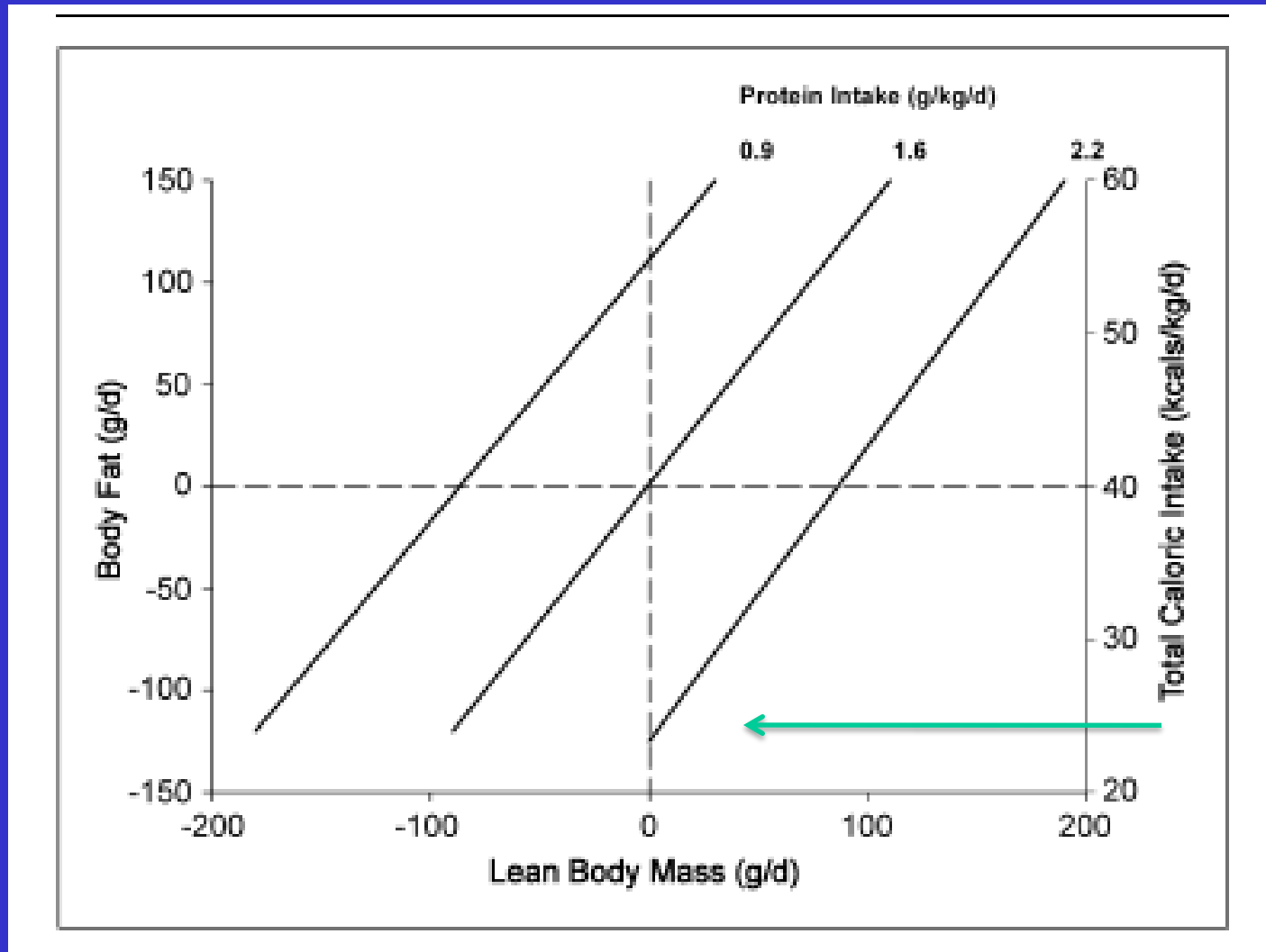
# Energy Reserves of a 70 kg man, expressed in kcal



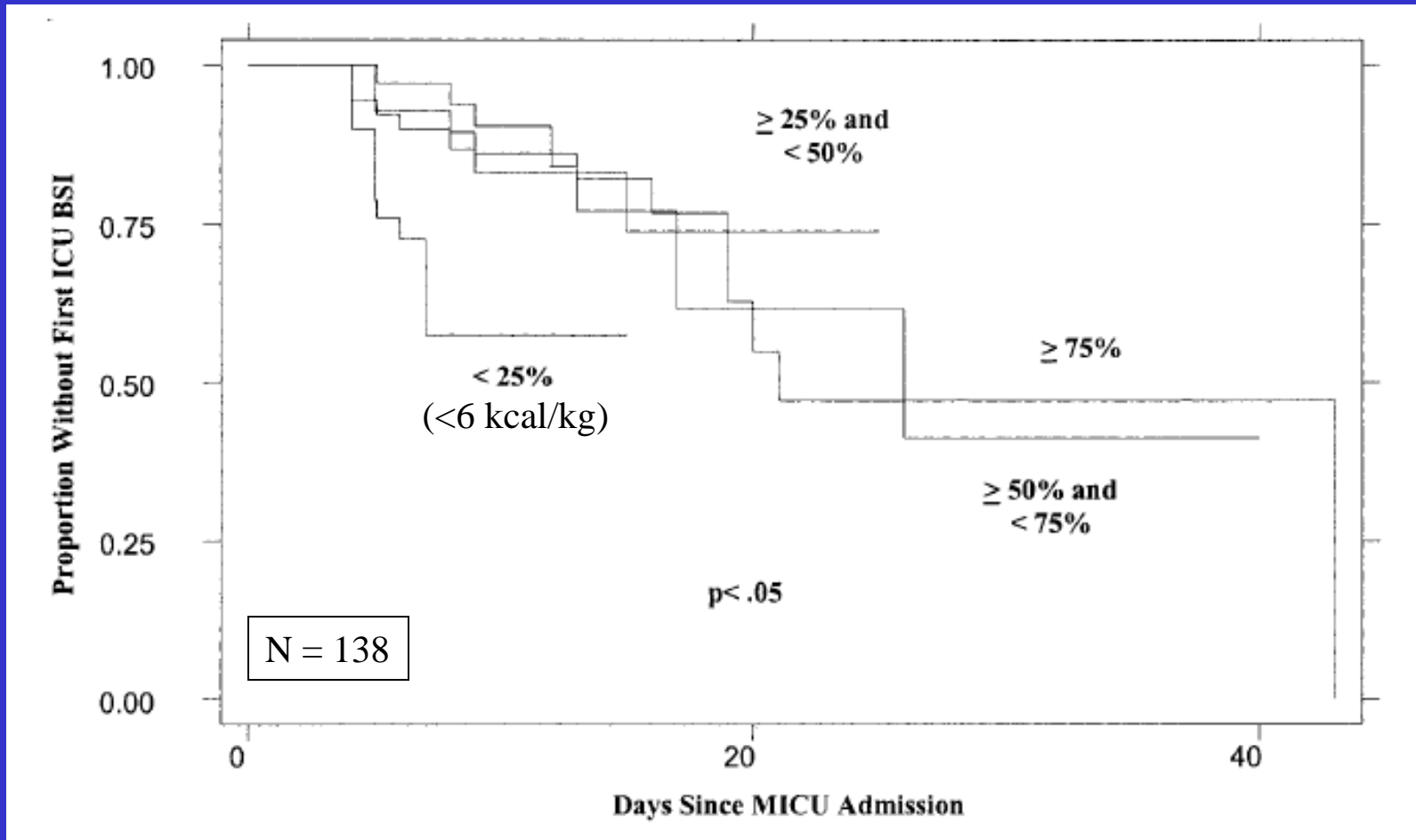
# The influence of caloric and protein intake upon nitrogen balance in unstressed depleted patients



# Preservation of lean body mass and reduction of body fat achieved by increasing protein intake

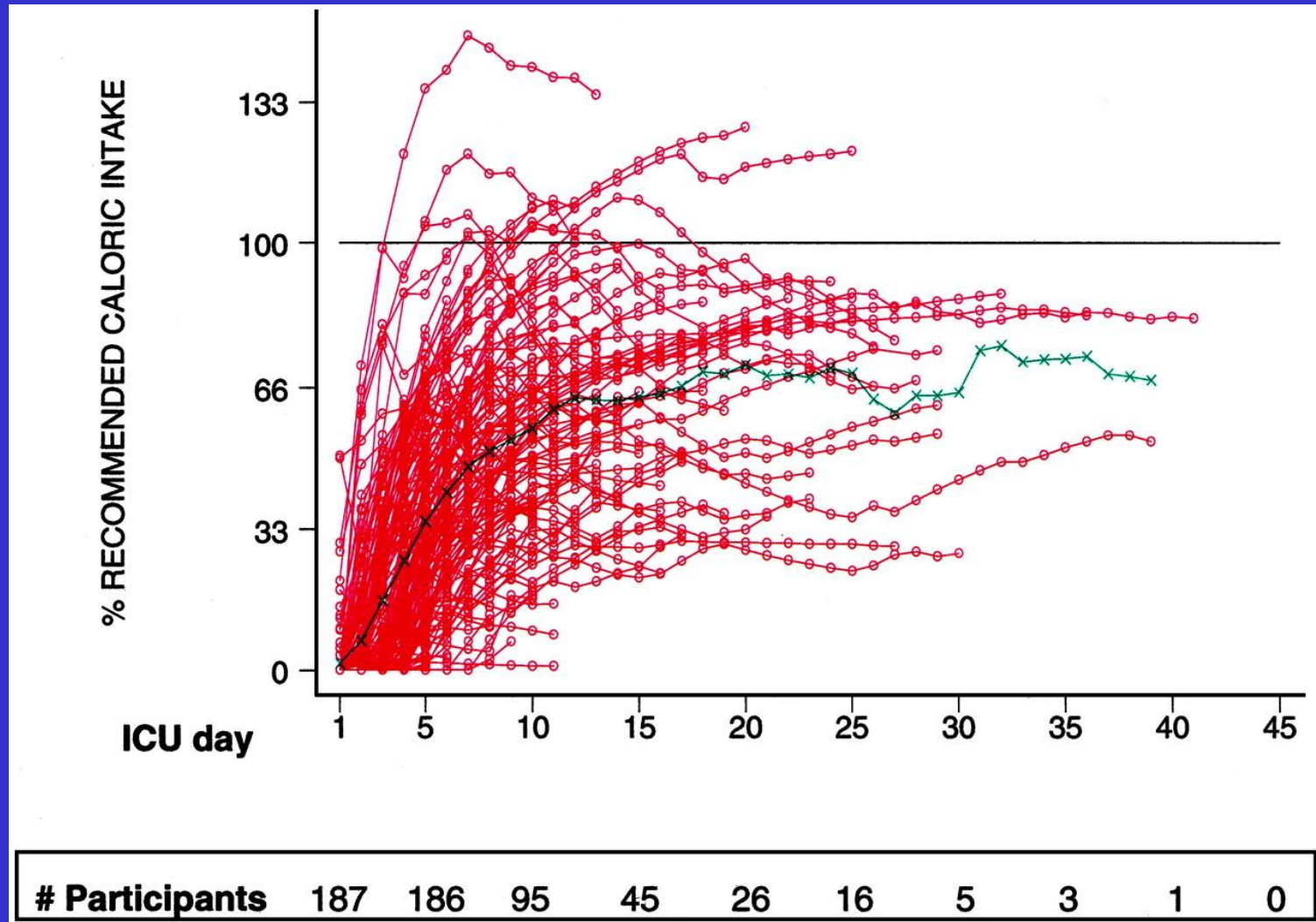


# Time to first MICU bloodstream infection categorized by % caloric intake



Calorie goal = 25-27.5 kcal/kg body weight (ACCP recommendations)

# The cumulative average caloric intake since ICU admission for each of 187 participants



# Relationship of clinical outcomes to tertiles of caloric intake.

187 patients in ICU for  $\geq 96$  h, observed for caloric intake (in tertiles) vs. clinical outcomes

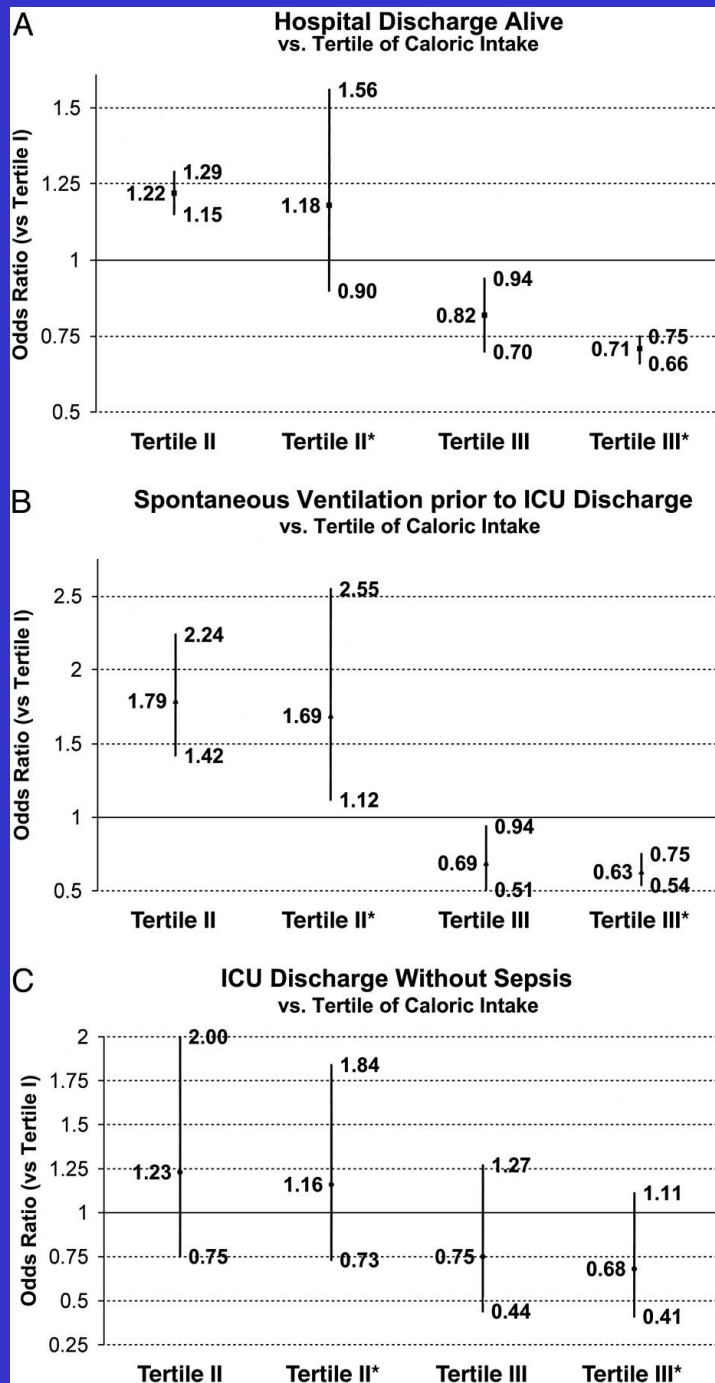
Finding: caloric intake  $> 66\%$  ACCP target ( $\sim 18$  kcal/kg/d) associated with excess M & M.

Moderate caloric intake ( $\sim 9$ - $18$  kcal/kg) associated with better outcomes

\*=adjusted for SAPS II score (simplified acute physiology score)

AACP = American College of Chest Physicians 1997 guidelines

Krishnan J A et al. Chest 2003;124:297-305



# Cumulative energy deficit is associated with increased infectious complications in ICU patients

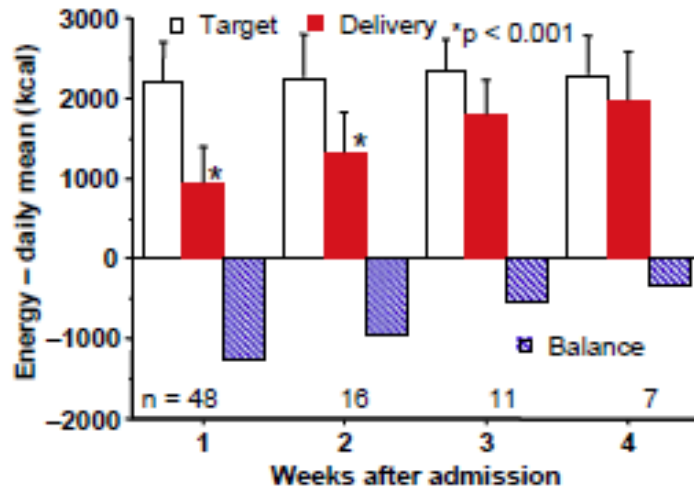


Figure 1 Progression of energy delivery compared to energy target over 4 weeks: the figure shows that energy delivery increases with time, reducing daily deficit.

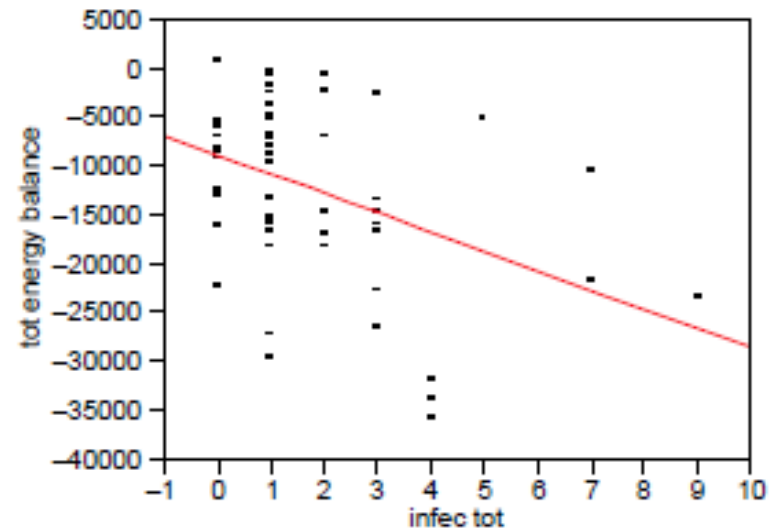
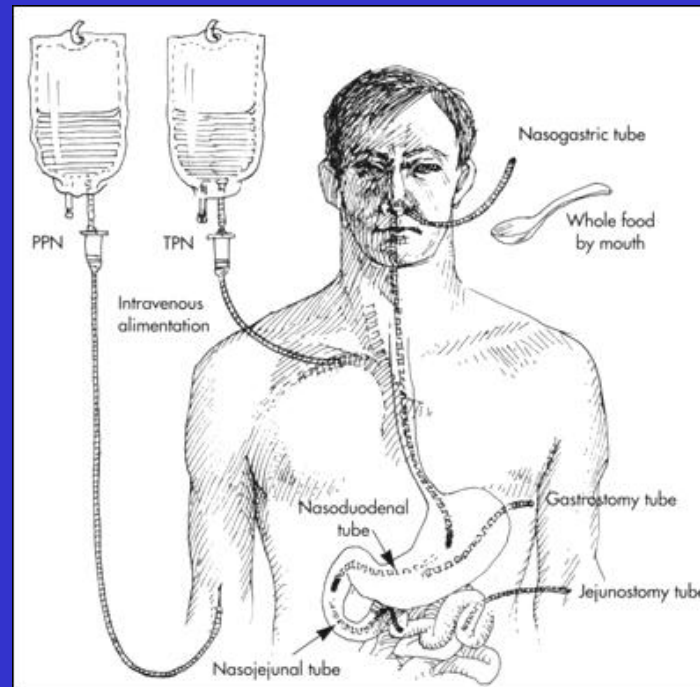


Figure 2 Relation between the progressive negative energy balance and the number of infectious complications.

# Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition: Executive Summary\*

Robert G. Martindale, MD, PhD; Stephen A. McClave, MD; Vincent W. Vanek, MD; Mary McCarthy, RN, PhD; Pamela Roberts, MD; Beth Taylor, RD; Juan B. Ochoa, MD; Lena Napolitano, MD; Gail Cresci, RD; American College of Critical Care Medicine; and the A.S.P.E.N. Board of Directors



# Guidelines for provision and assessment of nutrition support therapy in the adult critically ill patient

- In all ICU patients receiving parenteral nutrition, mild permissive underfeeding should be considered, at least initially. Once energy requirements are determined, 80% of these requirements should serve as the ultimate goal of feeding (Grade C).

# Studies using hypocaloric feeding in hospitalized obese patients

Study	Design	N	Nutritional outcome	Clinical outcome
Greenberg (1979)	P	12	-NB	-
Dickerson (1986)	P	13	+NB	Healed wounds; closed fistulae
Burge (1994)	PR	16	+NB	-
Choban (1997)	PR	30	+NB	Less insulin therapy; no difference M
Liu (2000)	Retro	30	+NB	No difference in M or M
Dickerson (2002)	Retro	40	-NB, improved serum prealbumin	Decreased ICU days, decreased antibiotic days

P=prospective; R=randomized; Retro = retrospective

# Guidelines for provision and assessment of nutrition support therapy in the adult critically ill patient (SCCM, ASPEN)

- In the critically ill obese patient, permissive underfeeding or hypocaloric feeding with enteral nutrition is recommended. For all classes of obesity where BMI > 30, the goal should not exceed 60% - 70% of target energy requirements or 11 – 14 kcal/kg actual body weight (22 – 25 kcal/kg IBW)
- Protein should be provided in a range  $\geq 2.0$  g/kg IBW for classes I and II obesity and  $\geq 2.5$  g/kg for class III obesity (grade D)

# Feeding critically ill patients: What is the optimal amount of energy?

- “Observational studies examining the association between amount of caloric intake and clinical outcomes suggest that providing somewhere in the range of 25% to 66% of calculated energy requirements is optimal.”
- “However, high-quality evidence from randomized trials investigating the optimal amount of energy intake in ICU patients is still needed.”

# Conclusion

- Caloric goals for patients with obesity remain poorly defined
- When possible, indirect calorimetry should be used to measure metabolic rate
- Feeding below ~25% predicted calorie needs may increase rate of nosocomial infections and worsen nutritional status
- Obese patients with severe protein malnutrition or under excessive metabolic stress should be fed calculated energy and protein needs

# Conclusion (con't)

- There is a limited literature suggesting that hypocaloric feeding (permissive underfeeding) is a reasonable approach for patients with obesity
- Protein should be provided at  $\geq 2$  g/kg IBW to attenuate loss of LBM
- More research is needed in how to feed the obese hospitalized patient