## Estimating Daily Energy Requirements

A. Prediction of Basal Metabolic Rate (BMR)

Predictive equations of BMR (kcal/day) based on body weight (in kilograms) (kg = lbs/2.205)

| **Age (years)** | **Males** | **Females** |
|---|---|---|
| 0–2 | 60.9(Wt) – 54 | 61.0(Wt) – 51 |
| 3.0–9 | 27.7(Wt) + 495 | 22.5(Wt) + 499 |
| 10.0–17 | 17.5(Wt) + 651 | 12.2(Wt) + 746 |
| 18.0–29 | 15.3(Wt) + 679 | 14.7(Wt) + 496 |
| 30.0–59.9 | 11.6(Wt) + 879 | 8.7(Wt) + 829 |
| 60 & Older | 13.5(Wt) + 487 | 10.5(Wt) + 596 |

B. For Adults (>= 18 years): Multiply BMR by daily physical activity level (PAL):

**Total daily energy expenditure (TDEE) = (PAL)(BMR)**

General ranges of PALs for different lifestyles:

| | **Physical Activity Levels (PAL)** | | | |
|---|---|---|---|---|
| **Sex** | **"Survival"** | **Light** | **Moderate** | **Heavy** |
| Males | 1.4 | 1.55 | 1.78 | 2.10 |
| Females | 1.4 | 1.56 | 1.64 | 1.82 |

C. Reproductive costs (Adults):

1. Pregnancy = +285 kcal/day (added to total daily energy expenditure)
2. Lactation = +500 kcal/day (added to total daily energy expenditure)

D. Estimating Energy Requirements for children and Adolescents (< 18 years).

1. Children < 10 years: TEE = (Energy constant)(Wt)
2. Children 10 – 17 years: TEE = (PAL)(BMR)

| **Age (years)** | **Males** | **Females** |
|---|---|---|
| | ***Energy constant (kcal/kg body weight)*** | |
| <1.0 | 103 | 103 |
| 1.0–1.9 | 104 | 108 |
| 2.0–2.9 | 104 | 102 |
| 3.0–3.9 | 99 | 95 |
| 4.0–4.9 | 95 | 92 |
| 5.0–5.9 | 92 | 88 |
| 6.0–6.9 | 88 | 83 |
| 7.0–7.9 | 83 | 76 |
| 8.0–8.9 | 77 | 69 |
| 9.0–9.9 | 72 | 62 |
| | ***PAL*** | |
| 10.0–10.9 | 1.76 | 1.65 |
| 11.0–11.9 | 1.72 | 1.62 |
| 12.0–12.9 | 1.69 | 1.60 |
| 13.0–13.9 | 1.67 | 1.58 |
| 14.0–14.9 | 1.65 | 1.57 |
| 15.0–15.9 | 1.62 | 1.54 |
| 16.0–16.9 | 1.60 | 1.52 |
| 17.0–17.9 | 1.60 | 1.52 |

**Estimating Recommended Protein Intake Levels (grams/day)**

A. Basic Needs:

| Age | Recommended protein intake (g/kg/day) | |
|---|---|---|
| | ***Combined sexes*** | |
| <3.0 months | 2.20 | |
| 3.0–5.9 months | 1.85 | |
| 6.0–8.9 months | 1.65 | |
| 9.0–11.9 months | 1.50 | |
| 1.0–1.9 years | 1.20 | |
| 2.0–2.9 years | 1.15 | |
| 3.0–4.9 years | 1.10 | |
| 5.0–6.9 years | 1.00 | |
| 7.0–9.9 years | 1.00 | |
| | ***Males*** | ***Females***[a] |
| 10.0–11.9 years | 1.00 | 1.00 |
| 12.0–13.9 years | 1.00 | 0.95 |
| 14.0–15.9 years | 0.95 | 0.90 |
| 16.0–17.9 years | 0.90 | 0.80 |
| 18.0+ years | 0.80 | 0.80 |

B. Reproductive costs:

1. Pregnancy: +6.0 g/day
2. Lactation: <6 months: +17.5 g/day; 6+ months: +13.0 g/day

**Sources:**

FAO/WHO/UNU (1985) *Protein and Energy Requirements*. WHO Technical Report Series, no. 724. Geneva: WHO .

WPT James & EC Schofield (1990) *Human Energy Requirements*. Oxford University Press.

**Estimating Daily Energy Expenditure from Time Allocation Data**

A. Assign energy costs to individual daily activities

Energy costs assigned as a "multiple of BMR": Physical Activity Ratio (PAR)

***Physical Activity Ratio (PAR) = (Energy Cost per task)/(Basal Energy Costs)***

**Physical Activity Ratios (PAR) for Different Work levels**

| Activity Level | PAR | Examples |
|---|---|---|
| Basal | 1.0 | Sleep |
| Light | 1.2 | Sitting quietly |
| | 1.4 | Visiting/talking; watching TV; standing quietly |
| | 1.6 | Washing, dressing; washing dishes; walking slowly (~1.5 mph) on a level surface (w/ no load) |
| Moderate | 2.1 | Light household chores, cooking food |
| | 2.8 | More intense houshold chores -- sweeping, laundry; walking down stairs |
| | 3.8 | Walking on level @3-3.5 mph; walking uphill (~2.5 mph); carrying a load; calisthenics. |
| Heavy | 5.1 | Running/jogging; cycling |
| Very Heavy | 6.7 | Running (rapidly), playing football, cutting sugar cane... |
| VERY VERY Heavy | 10.0 | Pulling a rickshaw (~400 lb load)! |

B. Calculate daily Physical Activity Level (PAL) by summing PARs for all daily activities:

$$\mathbf{PAL = \{\Sigma\ PAR_i(T_i)\}/24}$$

where: $PAR_i$ = Physical Activity Ratio of each activity "i"
$T_i$ = Time spent (hours) in each activity "i"

C. Total energy expenditure (TEE; kcal/day) is determined as:

$$\mathbf{TEE = (PAL)(BMR)}$$

**Source:** James & Schofield (1990) *Human Energy Requirements*. Oxford University Press.

## Example: Estimating Energy Needs from Activity Recall

Man & Woman:
Same age (20 yr), weight (60 kg) & activity level

1. $BMR_{female}$ = 14.7(60) + 496 = 1378 kcal/day
   $BMR_{male}$ = 15.3(60) + 679 = 1597 kcal/day

**2. Activity Diary:**

| Activity Category (PAR) | Time (hrs) | PAR x Time |
|---|---|---|
| Sleep (1.0) | 8.5 | 8.5 |
| Sitting (1.2) | 6.0 | 7.2 |
| Standing (1.4) | 1.5 | 2.1 |
| Light-Moderate Activity (2.1) | 5.0 | 10.5 |
| Mod work (2.8) | 2.5 | 7.0 |
| Heavy Exercise (5.1) | 0.5 | 2.55 |
| TOTAL | 24.0 | 37.85 |

**Daily Physical Activity Level (PAL) = $\{\Sigma\ PAR_i(T_i)\}/24$**

**PAL = 37.85/24 = 1.58**

**3. TDEE = PAL x BMR**

$TDEE_{female}$ = 1.58 x 1378 = 2177 kcal/day
$TDEE_{male}$ = 1.58 x 1597 = 2523 kcal/day