

# Daily energy expenditure through the human life course

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#### Published in "Science" 1 2 3 Daily Energy Expenditure through the Human Life Course 4 Herman Pontzer<sup>1,2</sup>†\*, Yosuke Yamada<sup>3,4</sup>†, Hiroyuki Sagayama<sup>5</sup>†, Philip N. Ainslie<sup>6</sup>, Lene F. 5 Andersen<sup>7</sup>, Liam J. Anderson<sup>6,8</sup>, Lenore Arab<sup>9</sup>, Issaad Baddou<sup>10</sup>, Kweku Bedu-Addo<sup>11</sup>, Ellen E. 6 Blaak<sup>12</sup>, Stephane Blanc<sup>13,14</sup>, Alberto G. Bonomi<sup>15</sup>, Carlijn V.C. Bouten<sup>12</sup>, Pascal Bovet<sup>16</sup>, 7 Maciej S. Buchowski<sup>17</sup>, Nancy F. Butte<sup>18</sup>, Stefan G. Camps<sup>12</sup>, Graeme L. Close<sup>6</sup>, Jamie A. 8 Cooper<sup>13</sup>, Richard Cooper<sup>19</sup>, Sai Krupa Das<sup>20</sup>, Lara R. Dugas<sup>19</sup>, Ulf Ekelund<sup>21</sup>, Sonja 9 Entringer<sup>22,23</sup>, Terrence Forrester<sup>24</sup>, Barry W. Fudge<sup>25</sup>, Annelies H Goris<sup>12</sup>, Michael Gurven<sup>26</sup>, 10 Catherine Hambly<sup>27</sup>, Asmaa El Hamdouchi<sup>10</sup>, Marjije B. Hoos<sup>12</sup>, Sumei Hu<sup>28</sup>, Noorjehan 11 Joonas<sup>29</sup>, Annemiek M. Joosen<sup>12</sup>, Peter Katzmarzyk<sup>30</sup>, Kitty P. Kempen<sup>12</sup>, Misaka Kimura<sup>3</sup>, 12 William E. Kraus<sup>31</sup>, Robert F. Kushner<sup>32</sup>, Estelle V. Lambert<sup>33</sup>, William R. Leonard<sup>34</sup>, Nader 13 Lessan<sup>35</sup>, Corby Martin<sup>30</sup>, Anine C. Medin<sup>7,36</sup>, Erwin P. Meijer<sup>12</sup>, James C. Morehen<sup>37,6</sup>, James P. 14 Morton<sup>6</sup>, Marian L. Neuhouser<sup>38</sup>, Theresa A. Nicklas<sup>18</sup>, Robert M. Ojiambo<sup>39,40</sup>, Kirsi H. 15 Pietiläinen<sup>41</sup>, Yannis P. Pitsiladis<sup>42</sup>, Jacob Plange-Rhule<sup>43\*\*</sup>, Guy Plasqui<sup>44</sup>, Ross L. Prentice<sup>38</sup>, 16 Roberto A. Rabinovich<sup>45</sup>, Susan B. Racette<sup>46</sup>, David A. Raichlen<sup>47</sup>, Eric Ravussin<sup>30</sup>, Rebecca M. 17 Reynolds<sup>48</sup>, Susan B. Roberts<sup>20</sup>, Albertine J. Schuit<sup>49</sup>, Anders M. Sjödin<sup>50</sup>, Eric Stice<sup>51</sup>, Samuel 18 S. Urlacher<sup>52</sup>, Giulio Valenti<sup>12,15</sup>, Ludo M. Van Etten<sup>12</sup>, Edgar A. Van Mil<sup>53</sup>, Jonathan C. K. Wells<sup>54</sup>, George Wilson<sup>6</sup>, Brian M. Wood<sup>55,56</sup>, Jack Yanovski<sup>57</sup>, Tsukasa Yoshida<sup>4</sup>, Xueying 19 20 Zhang<sup>27,28</sup>, Alexia J. Murphy-Alford<sup>58</sup>, Cornelia Loechl<sup>58</sup>, Amy H Luke<sup>59</sup>†, Jennifer Rood<sup>30</sup>†, 21 Dale A. Schoeller<sup>60</sup>†, Klaas R. Westerterp<sup>61</sup>†, William W. Wong<sup>18</sup>†, John R. 22 Speakman<sup>62,27,28,63</sup>\*† and the IAEA DLW database consortium#. 23 24 \*co-lead corresponding author 25 †co-corresponding author 26 \*\* deceased 27 # see supplementary materials 28 29 Evolutionary Anthropology, Duke University, Durham NC, USA 1. 30 2. Duke Global Health Institute, Duke University, Durham, NC, USA 31 Institute for Active Health, Kyoto University of Advanced Science, Kyoto, Japan. 3. 32 National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health 33 and Nutrition, Tokyo, Japan. 34 5 Faculty of Health and Sport Sciences, University of Tsukuba, Ibaraki, Japan. Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, 35 6 36 UK. 37 Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo, 0317 Oslo, 7

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Abstract: Total daily energy expenditure ("total expenditure", MJ/d) reflects daily energy needs and is a critical variable in human health and physiology, yet it is unclear how daily expenditure changes over the life course. Here, we analyze a large, globally diverse database of total expenditure measured by the doubly labeled water method for males and females aged 8 days to 95 yr. We show that total expenditure is strongly related to fat free mass in a power-law manner and identify four distinct metabolic life stages. Fat free mass-adjusted daily expenditure accelerates rapidly in neonates (0-1yr) to ~46% above adult values at ~1 yr, declines slowly throughout childhood and adolescence (1-20 yr) to adult levels at ~20 yr, remains stable in adulthood (20-60 yr) even during pregnancy, and declines in older adults (60+ yr). These changes in total expenditure shed new light on human development and aging and should help shape nutrition and health strategies across the lifespan.

One Sentence Summary: Expenditure varies as we age, with four distinct metabolic life stages reflecting changes in behavior, anatomy, and tissue metabolism.

**Main Text:** All of life's essential tasks, from development and reproduction to maintenance and movement, require energy. Total expenditure is thus fundamental to understanding both daily nutritional requirements and the body's investment among activities. Yet we know surprisingly little about the determinants of total expenditure in humans or how it changes over the lifespan. Most large (n>1,000) analyses of human energy expenditure have been limited to basal expenditure, the metabolic rate at rest (*1*), which accounts for only a portion (usually ~50-70%) of total expenditure, or have estimated total expenditure from basal expenditure and daily physical activity (2-5). Measurements of total expenditure in humans during daily life, outside of

the laboratory, became possible in the 1980's with the advancement of the doubly labeled water method, but doubly labeled water studies to date have been limited in sample size (n < 600), geographic and socioeconomic representation, and/or age (6-9).

Body composition, size, and physical activity change over the life course, often in concert, making it difficult to parse the determinants of energy expenditure. Total expenditure increases with age as children grow (10), but the relative effects of increasing physical activity (11-13) and age-related changes in tissue-specific metabolic rates, as have been reported for the brain (14), are unclear. Total and basal expenditure increase from childhood through puberty, but much of this increase is attributable to increased fat free mass, and the role of endocrine or other effects is uncertain (15). The decline in total expenditure beginning in the sixth decade of life corresponds with a decline in fat free mass (9) and "physical activity level", PAL (the ratio of total/basal expenditure), but may also reflect age-related reductions in organ metabolism.

We investigated the effects of age, body composition, and sex on total expenditure and its components, using a large (n = 6.421; 64% female), geographically and economical diverse (n = 29 countries) database of doubly labeled water measurements for subjects aged eight days to 95 years (16), calculating total expenditure from isotopic measurements using a single, validated equation for all subjects (17). Basal expenditure, measured via indirect calorimetry, was available for a n = 2.008 subjects, and we augmented the dataset with additional published meaures of basal expenditure in neonates and doubly labeled water-mesaured total expenditure in pregnant and post-partum women (Methods; Table S1).

We found that both total and basal expenditure increased with fat free mass in a power-law manner (TEE= 0.677FFM<sup>0.708</sup>, r<sup>2</sup>=0.83 Figures 1, S1, S2, Table S1). Thus, body size, particularly fat free mass, accounted for most (83%) of the variation in daily expenditure,

requiring us to adjust for body size in subsequent analyses of expenditure across subjects and cohorts to isolate potential effects of age, sex, and other factors. Notably, analyses indicated an exponent <1, meaning that the ratio of energy expenditure/mass does not adequately control for body size because the ratio inherently trends lower for larger individuals (Figure S1 (18)). Instead, we used regression analysis to control for body size (18). A general linear model with *In*-transformed values of energy expenditure (total or basal), fat free mass, and fat mass in adults 20-60 y (Table S2) was used to calculate residual energy expenditures for each subject. We converted these residuals to "adjusted" expenditures for clarity in discussing age-related changes: 100% indicates an expenditure that matches the expected value given the subject's fat free mass and fat mass, 120% indicates an expenditure 20% above expected, etc. (Methods). Using this approach, we also calculated the portion of adjusted total expenditure attributed to basal expenditure (Figure 2D; Methods). Segmented regression analysis of (Methods) revealed four distinct phases of adjusted (or residual) total and basal expenditure over the lifespan. <u>Neonates (0 to 1 y)</u>: Neonates in the first month of life had size-adjusted energy expenditures similar to adults, with adjusted total expenditure of  $99.0 \pm 17.2\%$  (n = 35) and adjusted basal expenditure of  $78.1 \pm 15.0\%$  (n = 34; Figure 2). Both measures increased rapidly in the first year. In segmented regression analysis, adjusted total expenditure rose  $84.7 \pm 7.2\%$  per year from birth to a break point at 0.7 years (95% CI: 0.6, 0.8); a similar rise (75.5  $\pm$  5.6%) and break point (1.0 y, 95% CI: 0.9, 1.1) were evident in adjusted basal expenditure (Table S4). For subjects between 9 and 15 months, adjusted total and basal expenditures were nearly ~50% elevated compared to adults (Figure 2). <u>Juveniles (1 to 20 y)</u>: Total and basal expenditure, along with fat free mass, continued to increase with age throughout childhood and adolescence (Figure 1), but body size-adjusted expenditures

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190 steadily declined. Adjusted total expenditure declined at a rate of  $-2.8 \pm 0.1\%$  per year from 191  $147.8 \pm 22.6\%$  for subjects 1 - 2 y (n = 102) to  $102.7 \pm 18.1\%$  for subjects 20 - 25 y (n = 314; 192 Tables S2, S4). Segmented regression analysis identified a breakpoint in adjusted total 193 expenditure at 20.5 y (95% CI: 19.8, 21.2), after which it plateaued at adult levels (Figure 2). A 194 similar decline (-3.8  $\pm$  0.2% per year) and break point (18.0 y, 95% CI: 16.8, 19.2) were evident 195 in adjusted basal expenditure (Figure 2, Text S1, Table S4). No pubertal increases in adjusted 196 total or basal expenditure were evident among subjects 10 - 15 y. In multivariate regression for 197 subjects 1 to 20 y, males had a higher total expenditure and adjusted total expenditure (Tables 198 S2, S3), but sex had no detectable effect on the rate of decline in adjusted total expenditure with 199 age (sex:age interaction p=0.30). 200 Adults (20 to 60 y): Total and basal expenditure and fat free mass were all stable from age 20 to 201 60 (Figure 1, 2; Tables S1, S2; Text S1). Sex had no effect on total expenditure in multivariate 202 models with fat free mass and fat mass, nor in analyses of adjusted total expenditure (Tables S2, 203 S4). Adjusted total and basal expenditures were stable even during pregnancy, the elevation in 204 unadjusted expenditures matching those expected from the gain in mothers' fat free mass and fat 205 mass (Figure 2C). Segmented regression analysis identified a break point at 63.0 y (95% CI: 206 60.1, 65.9), after which adjusted TEE begins to decline. This break point was somewhat earlier 207 for adjusted basal expenditure (46.5, 95% CI: 40.6, 52.4), but the relatively small number of 208 basal measures for 45 - 65 y (Figure 2D) reduces our precision in determining this break point. 209 <u>Older adults (>60 y)</u>: At ~60 y, total and basal expenditure begin to decline, along with fat free 210 mass and fat mass (Figures 1, S3, Table S1). Declines in expenditure are not only a function of 211 reduced fat free mass and fat mass, however. Adjusted total expenditure declined by -0.7  $\pm$  0.1% per year, and adjusted basal expendiure fell at a similar rates (Figure 2, Figure S3, Text S1, Table S4). For subjects in their nineties, adjusted TEE was ~26% below that of middle-aged adults.

In addition to providing empirical measures and predictive equations for total expenditure from infancy to old age (Tables S1, S2), our analyses bring to light major changes in metabolic rate across the life course. To begin, we can infer fetal metabolic rates from maternal measures during pregnancy: if body size-adjusted expenditures were elevated in the fetus, then adjusted expenditures for pregnant mothers, particularly late in pregnancy when the fetus accounts for a substantial portion of a mother's weight, would be likewise elevated. Instead, the stability of adjusted total and basal expenditures at ~100% during pregnancy (Figure 2B) indicates that the growing fetus maintains a fat free mass- and fat mass-adjusted metabolic rate similar to adults, which is consistent with adjusted expenditures of neonates (both ~100%; Figure 2) in the first weeks after birth. Total and basal expenditures, both absolute and size-adjusted values, then accelerate rapidly over the first year. This early period of metabolic acceleration corresponds to a critical period in early development in which growth often falters in nutritionally-stressed populations (19). Increasing energy demands could be a contributing factor.

After rapid acceleration in total and basal expenditure during the first year, adjusted expenditures progressively decline thereafter, reaching adult levels at ~20 yr. Elevated adjusted expenditures in this life stage may reflect the metabolic demands of growth and development. Adult expenditures, adjusted for body size and composition, are remarkably stable, even during pregnancy and post-partum. Declining metabolic rates in older adults could increase the risk of weight gain. However, neither fat mass nor percentage increased in this period (Figure S3), consistent with the hypothesis that energy intake is coupled to expenditure (20).

Following previous studies (21-25), we calculated the effect of organ size on basal expenditure over the lifespan (Methods). At rest, the tissue-specific metabolic rates (Watts/gram) of the heart, liver, brain, and kidneys are much greater than those of the muscles and other lean tissue or fat (21-25). Organs with a high tissue-specific metabolic rate, particularly the brain and liver, account for a greater proportion of fat free mass in young individuals, and thus organ-based basal expenditure, estimated from organ size and tissue-specific metabolic rate, follows a power-law relationship with fat free mass, roughly consistent with observed basal expenditures (Methods, Figure S6). Still, observed basal expenditure exceeded organ-based estimates by  $\sim$ 30% in early life (1 – 20 y) and was  $\sim$ 20% lower than organ-based estimates in subjects over 60 y (Figure S6), consistent with previous work indicating that tissue-specific metabolic rates are elevated in children and adolescents (22, 24) and reduced in older adults (21, 23, 25).

We investigated the contributions of daily physical activity and changes in tissue-specific metabolic rate to total and basal expenditure using a simple model with two components: activity and basal expenditure (Figure 3; Meethods). Activity expenditure was modeled as a function of physical activity and body mass, assuming activity costs are proportional to weight, and could either remain constant at adult levels over the lifespan or follow the trajectory of daily physical activity measured *via* accelerometry, peaking at 5 – 10 y and declining thereafter (*11*, *26*, *27*) (Figure 3). Similarly, basal expenditure was modeled as a power function of fat free mass (consistent with organ-based BEE estimates; Methods) multiplied by a "tissue specific metabolism" term, which could either remain constant at adult levels across the lifespan or follow the trajectory observed in adjusted basal expenditure (Figure 2). For each scenario, total expenditure was modeled as the sum of activity and basal expenditure (Methods).

Models that hold physical activity or tissue-specific metabolic rates constant over the lifespan do not reproduce the observed patterns of age-related change in absolute or adjusted measures of total or basal expenditure (Figure 3). Only when age-related changes in physical activity and tissue-specific metabolism are included does model output match observed expenditures, indicating that variation in both physical activity and tissue-specific metabolism contribute to total expenditure and its components across the lifespan. Elevated tissue-specific metabolism in early life may be related to growth or development (22, 24). Conversely, reduced expenditures in later life may reflect a decline in organ level metabolism (23, 25, 28).

Metabolic models of life history commonly assume continuity in tissue-specific metabolism over the life course, with cellular metabolic rates increasing in a power-law manner (Energy = aMass<sup>b</sup>) and the energy available for growth during the juvenile period made available for reproduction in adults (29, 30). Measures of humans here challenge this view, with size adjusted metabolism elevated ~50% in childhood compared to adults (including pregnant females), and ~25% lower in the oldest subjects. It remains to be determined whether these fluctuations occur in other species. In addition to affecting energy balance, nutritional needs, and body weight, these metabolic changes present a potential target for clinical investigation into the kinetics of disease, pharmaceutical activity, and healing, processes intimately related to metabolic rate. Further, there is considerable metabolic variation among individuals, with TEE and its components varying more than  $\pm$  20% even when controlling for fat free mass, fat mass, sex, and age (Figure 1, 2, Table S2). Elucidating the processes underlying metabolic changes across the life course and variation among individuals may help reveal the roles of metabolic variation in health and disease.

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# **Conflict of interest**

The authors have no conflicts of interest to declare.

#### **Data Availability**

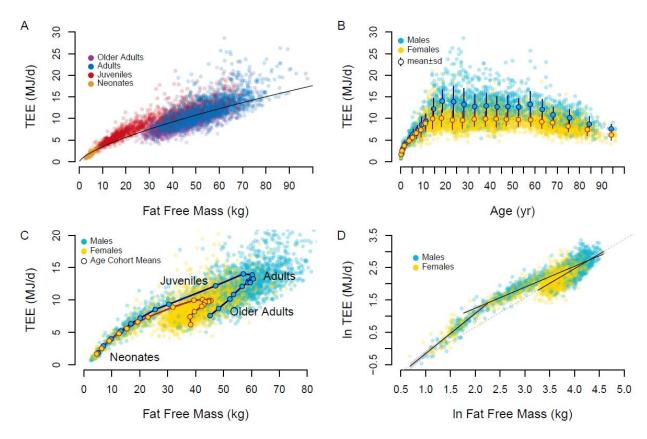
- All data used in these analyses is freely available via the IAEA Doubly Labelled Water Database
- 289 (https://doubly-labelled-water-database.iaea.org/home or https://www.dlwdatabase.org/).

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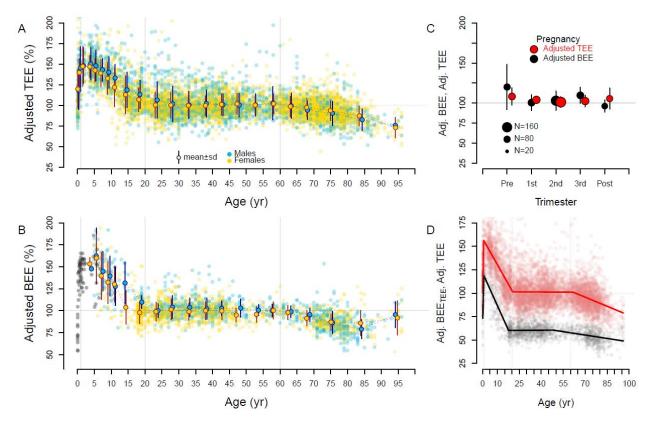
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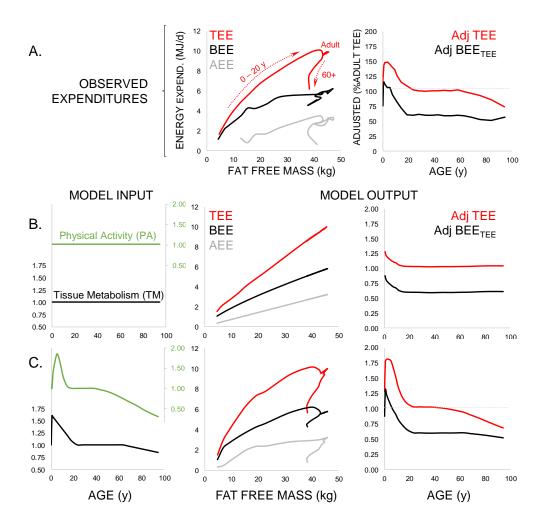
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**Figure 1. A.** Total expenditure (TEE) increases with fat free mass in a power-law manner, but age groups cluster about the trend line differently. **B.** Total expenditure rises in childhood, is stable through adulthood, and declines in older adults. Means±sd for age-sex cohorts are shown. **C.** Age-sex cohort means show a distinct progression of total expenditure and fat free mass over the life course. **D.** Neonate, juveniles, and adults exhibit distinct relationships between fat free mass and expenditure. The dashed line, extrapolated from the regression for adults, approximates the regression used to calculate adjusted total expenditure.



**Figure 2.** Fat free mass- and fat mass-adjusted expenditures over the life course. Individual subjects and age-sex cohort mean  $\pm$  SD are shown. For both total (Adj. TEE) (**A**) and basal (Adj. BEE) expenditure (**B**), adjusted expenditures begin near adult levels (~100%) but quickly climb to ~150% in the first year. Adjusted expenditures decline to adult levels ~20y, then decline again in older adults. Basal expenditures for infants and children not in the doubly labeled water database are shown in gray. **C.** Pregnant mothers exhibit adjusted total and basal expenditures similar to non-reproducing adults (Pre: prior to pregnancy; Post: 27 weeks post-partum). **D.** Segmented regression analysis of adjusted total (red) and adjusted basal expenditure (calculated as a portion of total; Adj. BEE<sub>TEE</sub>; black) indicates a peak at ~1 y, adult levels at ~20 y, and decline at ~60 y (see text).



**Figure 3.** Modeling the contribution of physical activity and tissue-specific metabolism to daily expenditures. **A.** Observed total (TEE, red), basal (BEE, black), and activity (AEE, gray) expenditures (Table S1) show age-related variation with respect to fat free mass (see Figure 1C) that is also evident in adjusted values (Table S3; see Figure 2D). **B.** These age effects do not emerge in models assuming constant physical activity (PA, green) and tissue-specific metabolic rate (TM, black) across the life course. **C.** When physical activity and tissue-specific metabolism follow the life course trajectories evident from accelerometry and adjusted basal expenditure, respectively, model output is similar to observed expenditures.

#### 435 **Supplementary Materials:**

436 Pontzer et al. Daily Energy Expenditure through the Human Life Course

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#### 450 Material and Methods

#### 451 1. Doubly Labeled Water Database

Data were taken from IAEA Doubly Labelled Water (DLW) Database, version 3.1,

completed April, 2020 (16). This version of the database comprises 6,743 measurements of total

expenditure using the doubly labeled water method. Of these, a total of 6,421 had valid data for

total expenditure, fat free mass, fat mass, sex, and age. These 6,421 measurements were used in

this analysis. This dataset was augmented with published basal expenditure measurements for

n=136 neonates and infants (31-36) that included fat free mass and fat mass. Malnourished or

preterm infants were excluded. For sources that provided cohort means rather than individual subject measurements (*33*, *36*) means were entered as single values into the dataset without reweighting to reflect sample size. This approach resulted in 77 measures of basal expenditure, fat free mass, and fat mass for n=136 subjects. We also added to the dataset published basal and total expenditure measurements of n=141 women before, during, and after pregnancy (*37-39*) that included fat free mass and fat mass. These measurements were grouped as pre-pregnancy, 1<sup>st</sup> trimester, 2<sup>nd</sup> trimester, 3<sup>rd</sup> trimester, and post-partum for analysis.

In the doubly labeled water method (5), subjects were administered a precisely measured dose of water enriched in  $^2$ H<sub>2</sub>O and H<sub>2</sub><sup>18</sup>O. The subject's body water pool is thus enriched in deuterium ( $^2$ H) and  $^{18}$ O. The initial increase in body water enrichment from pre-dose values is used to calculate the size of the body water pool, measured as the dilution space for deuterium ( $N_d$ ) and  $^{18}$ O ( $N_o$ ). These isotopes are then depleted from the body water pool over time: both isotopes are depleted *via* water loss, whereas  $^{18}$ O is also lost *via* carbon dioxide production. Subtracting the rate ( $^{6}$ /d) of deuterium depletion ( $k_d$ ) from the rate of  $^{18}$ O depletion ( $k_o$ ), and multiplying the size of the body water pool (derived from  $N_d$  and  $N_o$ ) provided the rate of carbon doxide production, rCO<sub>2</sub>. Entries in the DLW database include the original k and N values for each subject, which were then used to calculate  $CO_2$  using a common equation that has been validated in subjects across the lifespan ( $^{17}$ ). The rate of  $CO_2$  production, along with each subject's reported food quotient, was then used to calculate energy expenditure ( $^{17}$ ) using the Weir equation ( $^{40}$ ). We used the food quotients reported in the original studies to calculate total energy expenditure from rCO<sub>2</sub> for each subject.

The size of the body water pool, determined from  $N_d$  and  $N_o$ , was used to establish FFM, using hydration constants for fat free mass taken from empirical studies. Other anthropometric

variables (age, height, body mass, sex) were measured using standard protocols. Fat mass was calculated as (body mass) – (fat free mass).

#### 2. Basal Expenditure, Activity Expenditure, and Physical Activityl Level (PAL)

A total of 2,008 subjects in the database had associated basal expenditure, measured *via* respirometry. For these subjects, we analyzed basal expenditure, activity expenditure, and "physical activity level" (PAL). Activity expenditure was calculated as [0.9(total expenditure) – (basal expenditure)] which subtracts basal expenditure and the assumed thermic effect of food [estimated at 0.1(total expenditure)] from total expenditure. The PAL ratio was calculated as (total expenditure)/(basal expenditure). As noted above, the basal expenditure dataset was augmented with measurements from neonates and infants, but these additional measures do not have associated total expenditure and could not be used to calculate activity expenditure or PAL.

# 3. Predictive Models for Total, Basal, and Activity Expenditures and PAL

We used general linear models to regress measures of energy expenditure against anthropometric variables. We used the base package in R version 4.0.3 (41) for all analyses. General linear models were implemented using the 1m function. These models were used to develop predictive equations for total expenditure for clinical and research applications, and to determine the relative contribution of different variables to total expenditure and its components. Given the marked changes in metabolic rate over the lifespan (Figure 1, Figure 2) we calculated these models separately for each life history stage: infants (0-1 y), juveniles (1-20 y), adults (20-60 y), and older adults (60+ y). These age ranges were identified using segmented regression analysis. Results of these models are shown in Table S2.

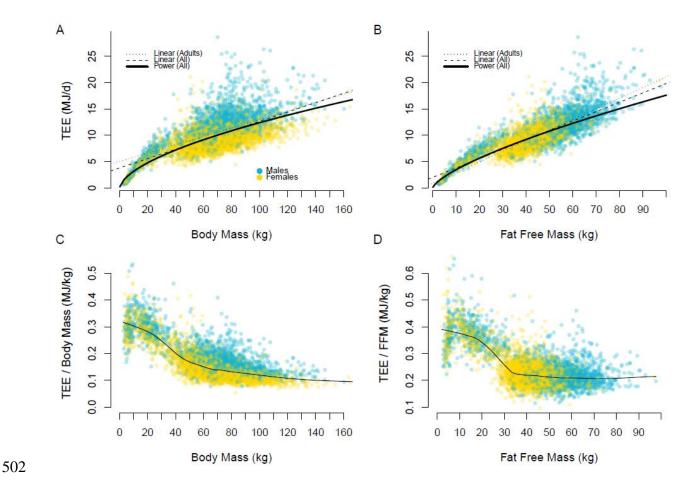


Figure S1. Total expenditure (TEE) increases with body size in a power-law manner. For the entire dataset (n = 6,407): **A.** the power-law regression for total body mass ( $InTEE = 0.593 \pm 0.004 InMass - 1.000 InMass - 1.000$  $0.214 \pm 0.018$ , p < 0.001, adj.  $r^2 = 0.73$ , model std. err. = 0.223, df = 6419) is less predictive than the regression for **B.** fat free mass (InTEE =  $0.708 \pm 0.004$  InFFM  $- 0.391 \pm 0.015$ , p < 0.001, adj.  $r^2 = 0.83$ , model std. err. = 0.176, df = 6419). For both body mass and fat free mass regressions, power-law regressions outperform linear models, particularly at the smallest body sizes. For all models, for both body mass and fat free mass, children have elevated total expenditure, clustering above the trend line. Children also exhibit elevated basal and activity expenditures (Figure S2). Power-law regressions have an exponent < 1.0, and linear regressions (dashed: linear regression through all data; dotted: linear regression through adults only) have a positive intercept, indicating that simple ratios of C. (total expenditure)/(body mass) or D. (total expenditure)/(fat free mass) do not adequately control for differences in body size (18) as smaller individuals will tend to have higher ratios. Lines in C and D are lowess with span 1/6. In body mass regressions (panel A, power and linear models) and the ratio of (total expenditure)/(body mass) (C), adult males cluster above the trend line while females cluster below due to sex differences in body composition. In contrast, males and females fit the fat free mass regressions (B) and ratio (D) equally well.

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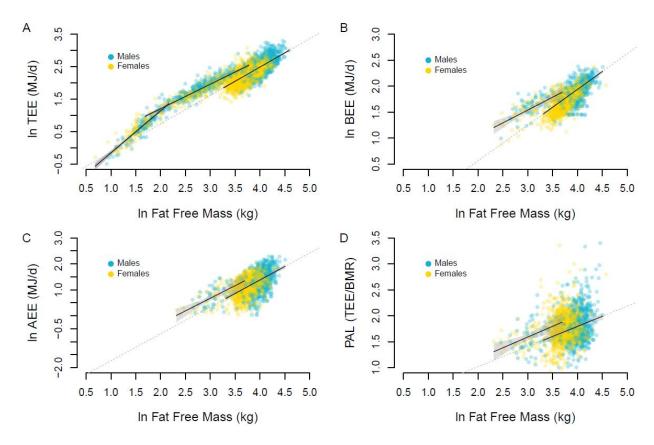
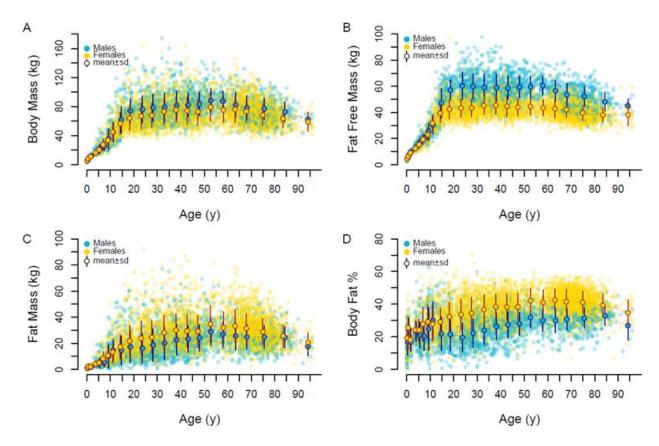


Figure S2. Infants and children exhibit different relationships between fat free mass and expenditure and the PAL ratio. **A:** For total expenditure (TEE), regressions for infants (age <1 y, left regression line) and adults (right regression line) intersect for neonates, at the smallest body size. However, the slopes differ, with the infants' regression and 95% CI (gray region) falling outside of that for adults (age 20 – 60 y, extrapolated dashed line). Juvelines (age 1 – 20 y, middle regression line) are elevated, with a regression outside the 95% CI of adults. Juvenile (1 – 20 y) regressions (with 95%CI) are also elevated for basal expenditure (BEE) (B), activity expenditure (AEE) (C), and PAL (D) compared to adults (20 – 60 y). Sex differences in expenditure (A-D) are attributable to differences in fat free mass. Note that total and basal expenditures are measured directly. Activity expenditure is calculated as (0.9TEE – BEE), and PAL is calculated as (TEE/BEE); see Methods.



**Figure S3.** Changes in body composition over the lifespan: **A.** Body mass; **B.** Fat free mass; **C.** Fat Mass; and **D.** Body fat percentage.

### 4. Adjusted Expenditures

We used general linear models with fat free mass and fat mass in adults (20 - 60 y) to calculate adjusted total expenditure and adjusted basal expenditure. The 20 - 60 y age range was used as the basis for analyses because segmented regression analysis consistently identified this period as stable with respect to size-adjusted total expenditure (see below).

We used models 2 and 5 in Table S2, which have the form  $ln(Expenditure) \sim ln(FFM) + ln(Fat Mass)$  and were implemented using the 1m function in base R version 4.0.3 (41). We used ln-transformed variables due to the inherent power-law relationship between body size and both total and basal expenditure (ref. 2; see Figure 1, Figure S1). Predicted values for each subject, given their fat free mass and fat mass, were calculated from the model using the pred() function; these ln-transformed values were converted back into MJ as exp(Predicted). Residuals for each subject were calculated as (Observed – Predicted) expenditure, and were then used to calculate adjusted expenditures as:

The advantage of expressing residuals as a percentage of the predicted value is that it allows us to compare residuals across the range of age and body size in the dataset. Raw residuals (MJ) do not permit direct comparison because the relationship between size and expenditure is heteroscedastic; the magnitude of residuals increases with size (see Figure S1). Ln-transformed residuals (*ln*MJ) avoid this problem but are more difficult to interpret. Adjusted expenditures, used here, provide an easily interpretable measure of deviation from expected values. An adjusted expenditure value of 100% indicates that a subject's observed total or basal expenditure matches the value predicted for their fat free mass and fat mass, based on the general linear

model derived for adults. An adjusted expenditure of 120% indicates an observed total or basal

[1]

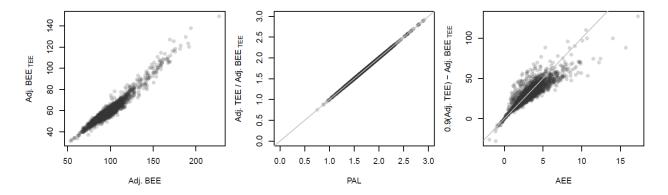
Adjusted Expenditure = 1 + Residual / Predicted

expenditure value that exceeds the predicted value for their fat free mass and fat mass by 20%. Similarly, an adjusted expenditure of 80% means the subject's measured expenditure was 20% lower than predicted for their fat free mass and fat mass using the adult model. Adjusted total expenditure and adjusted basal expenditure values for each age-sex cohort are given in Table S3. Within each metabolic life history stage we used general linear models (1m function in R) to investigate the effects of sex and age on adjusted total and basal expenditure.

This same approach was used to calculate adjusted basal expenditure as a proportion of total expenditure (Figure 2D), hereafter termed adjusted  $BEE_{TEE}$ . Residual<sub>BEE-TEE</sub>, the deviation of observed basal expenditure from the adult total expenditure regression (eq. 2 in Table S2), was calculated as (Observed Basal Expenditure – Predicted Total Expenditure) and then used to calculate adjusted  $BEE_{TEE}$  as

Adjusted BEE<sub>TEE</sub> = 1 + Residual<sub>BEE-TEE</sub> / Predicted Total Expenditure [2]

When adjusted BEE<sub>TEE</sub> = 80%, observed basal expenditure is equal to 80% of predicted total expenditure given the subject's fat free mass and fat mass. Adjusted BEE<sub>TEE</sub> is equivalent to adjusted basal expenditure (Figure S4) but provides some analytical advantages. The derivation of adjusted BEE<sub>TEE</sub> approach applies identical manipulations to observed total expenditure and observed basal expenditure and therefore maintains them in directly comparable units. The ratio of (adjusted total expenditure)/(adjusted basal expenditure) is identical to the PAL ratio of (total expenditure)/(basal expenditure), and the difference (0.9adjusted total expenditure—adjusted basal expenditure) is proportional to activity expenditure (Figure S4). Plotting adjusted total expenditure and adjusted BEE<sub>TEE</sub> over the lifespan (Figure 2D) therefore shows both the relative magnitudes of total and basal expenditure and their relationship to one another in comparable units.



**Figure S4.** Left: Adjusted BEE<sub>TEE</sub> corresponds strongly to adjusted basal expenditure (Adj. BEE). Center: The ratio of adjusted total expenditure (adj. TEE) to adjusted BEE<sub>TEE</sub> is identical to the PAL ratio. Right: The difference (0.9adjusted total expenditure – adjusted BEE<sub>TEE</sub>) is proportional to activity energy expenditure (AEE). Gray lines: center panel: y = x, right panel: y = 10x.

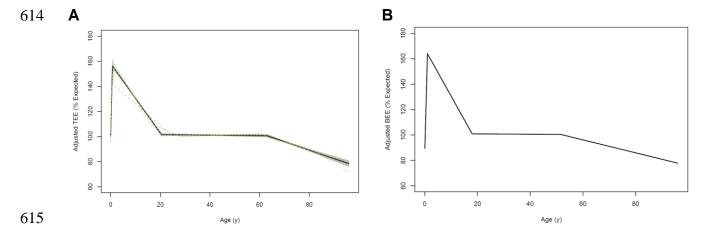
#### 5. Segmented Regression Analysis

We used segmented regression analysis to determine the change points in the relationship between adjusted expenditure and age. We used the Segmented (version 1.1-0) package in R (42). For adjusted total expenditure, we examined a range of models with 0 to 5 change points, using the npsi=term in the segmented() function. This approach does not specify the location or value of change points, only the number of them. Each increase in the number of change points from 0 to 3 improved the model adj. R<sup>2</sup> and standard error considerably.

Increasing the number of change points further to 4 or 5 did not improve the model, and the additional change points identifed by the segmented() function fell near the change points for the 3-change point model. We therefore selected the 3-change point model as the best fit for adjusted total expenditure in this dataset. Segmented regression results are shown in Table S4. A similar 3-change point segmented regression approach was conducted for adjusted basal expenditure (Figure S4) and adjusted BEE<sub>TEE</sub> (Figure 2D). We note that the decline in adjusted basal expenditure and adjusted BEE<sub>TEE</sub> in older adults begins earlier (as identified by segmented

regression analysis) than does the decline in adjusted total expenditure among older adults. However, this difference may reflect the relative paucity of basal expenditure measurements for subjects 40 - 60 y. Additional measurements are needed to determine whether the decline in basal expenditure does in fact begin earlier than the decline in total expedinture. Here, we view the timing as essentially coincident and interpret the change point in adjusted total expenditure ( $\sim 60$  y), which is determined with a greater number of measurements, as more accurate and reliable.

Having established that 3 break points provided the best fit for this dataset, we examined whether changes in the age range used to calculate adjusted total energy expenditure affected the age break-points identified by segmented regression. When the age range used to calculate adjusted expenditure was set at 20 - 60 y, the set of break point (95% CI) was: 0.69 (0.61-0.76), 20.46 (19.77-21.15), 62.99 (60.14-65.85). When the age range was expanded to 15 - 70 y, break points determined through segmented regression were effectively unchanged: 0.69 (0.62 - 0.76), 21.40 (20.60-22.19), 61.32 (58.60-64.03). Break points were also unchanged when the initial age range for adjusted expenditure was limited to 30 - 50 y: 0.69 (0.62-0.77), 20.56 (19.84-21.27), 62.85 (59.97-65.74).



**Figure S5.** Segmented regression analysis of adjusted TEE (**A**) and adjusted BEE (**B**). In both panels, the black line and gray shaded confidence region depicts the 3 change-point regression. For adjusted TEE, segmented regressions are also shown for 2 change points (red), 4 change points (yellow), and 5 change points (green). Segmented regression statistics are given in Table S4.

# 6. Organ Size and Basal Expenditure

Measuring the metabolic rate of individual organs is notoriously challenging, and the available data come from only a small number of studies. The available data indicate that organs differ markedly in their mass-specific metabolic rates at rest (*43*). The heart (1848 kJ kg<sup>-1</sup> d<sup>-1</sup>), liver (840 kJ kg<sup>-1</sup> d<sup>-1</sup>), brain (1008 kJ kg<sup>-1</sup> d<sup>-1</sup>), and kidneys (1848 kJ kg<sup>-1</sup> d<sup>-1</sup>) have much greater mass-specific metabolic rates at rest than do muscle (55 kJ kg<sup>-1</sup> d<sup>-1</sup>), other lean tissue (50 kJ kg<sup>-1</sup> d<sup>-1</sup>), and fat (19 kJ kg<sup>-1</sup> d<sup>-1</sup>). Consequently, the heart, liver, brain, and kidneys combined account for ~60% of basal expenditure in adults (*21*, *22*, *44*, *45*). In infants and children, these metabolically active organs constitute a larger proportion of body mass. The whole body mass-specific basal expenditure [i.e., (basal expenditure)/(body mass), or (basal expenditure)/(fat free mass)] for infants and children is therefore expected to be greater than adults' due to the greater proportion of metabolically active organs early in life adults (*21*, *22*, *44*, *45*). Similarly, reduced organ sizes in elderly subjects may result in declining basal expenditure (*21*).

To examine this effect of organ size on basal expenditure in our dataset, we used published references for organ size to determine the mass of the metabolically active organs (heart, liver, brain, and kidneys) as a percentage of body mass or fat free mass for subjects 0 - 12 y (22, 44-46), 15 to 60 y (21, 22), and 60 to 100 y (21, 47). We used these relationships to estimate the combined mass of the metabolically active organs (heart, liver, brain, kidneys) for each subject in our dataset. We then subtracted the mass of the metabolically active organs from measured fat free mass to calculate the mass of "other fat free mass". These two measures, along with measured fat mass, provided a three-compartment model for each subject: metabolically active organs, other fat free mass, and fat (Figure S6A).

Following previous studies (21-25), we assigned mass-specific metabolic rates to each compartment and estimated basal expenditure for each subject. We used reported mass-specific metabolic rates for the heart, liver, brain, and kidneys (see above; (43)) and age-related changes in the proportions of these organs for subjects 0 – 12 y (22, 46), 15 to 60 y (21-25), and 60 to 100 y (21, 23, 25, 47) to calculate an age-based weighted mass-specific metabolic rate for the metabolically active organ compartment. We averaged the mass-specific metabolic rates of resting muscle and other lean tissue (see above; (21, 22)) and assigned a value of 52.5 kJ kg<sup>-1</sup> d<sup>-1</sup> to "other fat free mass", and we used a mass-specific metabolic rate of 19 kJ kg<sup>-1</sup> d<sup>-1</sup> for fat.

Results are shown in Figure S6. Due to the greater proportion of metabolically active organs in early life, the estimated basal expenditure from the three-compartment model follows a power-law relationship with FFM (using age cohort means, BEE= 0.38 FFM<sup>0.75</sup>; Figure S6B) that is similar to that calculated from observed basal expenditure in our dataset (see Table S2 and 7. *Modeling the Effects of Physical Activity and Tissue Specific Metabolism*, below). Estimated BEE from the three-compartment model produced mass-specific metabolic rates that are considerably higher for infants and children than for adults and roughly consistent with observed age-related changes in (basal expenditure)/(fat free mass) (Figure S6C). Thus, changes in organ size can account for much of the variation in basal expenditure across the lifespan observed in our dataset.

Nonetheless, observed basal expenditure was ~30% greater early in life, and ~20% lower in older adults, than estimated basal expenditure from the three-compartment model (Figure S6D). The departures from estimated basal expenditure suggest that the mass-specific metabolic rates of one or more organ compartments are considerably higher early in life, and lower late in life, than they are in middle-aged adults, consistent with previous assessments (21-25). It is

notable, in this context, that observed basal expenditure for neonates is nearly identical to basal expenditure estimated from the three-comparment model, which assumes adult-like tissue metabolic rates (Figure S6B,C,D). Observed basal expenditure for neonates is thus consistent with the hypothesis that the mass-specific metabolic rates of their organs are similar to those of other adults, specifically the mother.

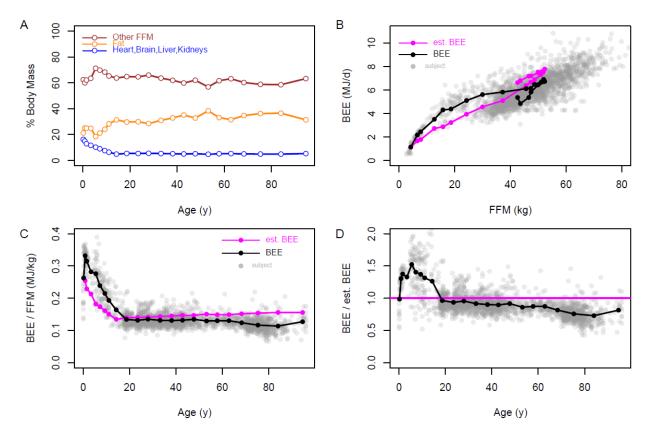


Figure S6. Organ sizes and BEE. A. The relative proportions of metabolically active organs (heart, brain, liver, kidneys), other fat free mass (FFM), and fat changes over the life course. Age cohort means are shown. B. Consequently, estimated basal expenditure (BEE) from the three-compartment model increases with fat free mass (FFM) in a manner similar to observed basal expenditure, with C. greater whole body mass-specific basal expenditure (BEE/FFM) early in life. D. Observed basal expenditure is ~30% greater early in life, and ~20% lower after age 60 y, than estimated basal expenditure from the three-compartment model (shown as the ratio of BEE/est.BEE). In panels B, C, and D, age-cohort means for observed (black) and estimated (magenta) basal expenditure are shown.

#### 7. Modeling the Effects of Physical Activity and Tissue Specific Metabolism

We constructed two simple models to examine the contributions of physical activity and variation in tissue metabolic rate to total and basal expenditure. In the simplest version, we used the observed relationship between basal expenditure and tat free mass for all adults 20 - 60 y determined from linear regression of ln(basal expenditure) and ln(fat free mass) (untransformed regression equation: basal expenditure = 0.32 (fat free mass)<sup>0.75</sup>, adj.  $r^2 = 0.60$ , df = 1684, p < 0.0001) to model basal expenditure as

Basal expenditure =  $0.32 \text{ TM}_{age} \text{ (fat free mass)}^{0.75}$  [3]

The  $TM_{age}$  term is tissue metabolic rate, a multiplier between 0 and 2 reflecting a relative increase ( $TM_{age} > 1.0$ ) or decrease ( $TM_{age} < 1.0$ ) in organ metabolic rate relative that expected from the power-law regression for adults. Note that, even when  $TM_{age} = 1.0$ , smaller individuals are expected to exhibit greater mass-specific basal expenditure (that is, a greater basal expenditure per kg body weight) due to the power-law relationship between basal expenditure and fat free mass. Further, we note that the power-law relationship between basal expenditure and fat free mass for adults is similar to that produced when estimating basal expenditure from organ sizes (see *Organ Size and Basal Expenditure*, above). Thus, variation in  $TM_{age}$  reflects modeled changes in tissue metabolic rate *in addition* to power-law scaling effects, and also, in effect, in addition to changes in basal expenditure due to age-related changes in organ size and proportion. To model variation in organ activity over the lifespan, we either 1) maintained  $TM_{age}$  at adult levels ( $TM_{age} = 1.0$ ) over the entire lifespan, or 2) had  $TM_{age}$  follow the trajectory of adjusted basal expenditure with age (Figure S8).

To incorporate effects of fat mass into the model, we constructed a second version of the model in which basal expenditure was modeled following the observed relationship with FFM and fat mass for adults  $20-60~\rm y$ ,

Basal expenditure =  $0.32 \text{ TM}_{age} \text{ (fat free mass)}^{0.7544} \text{ (fat mass)}^{0.0003}$  [4]

As with the fat free mass model (eq. 3), we either maintained  $TM_{age}$  at 1.0 over the life span or modeled it using the trajectory of adjusted basal expenditure.

Activity expenditure was modeled as a function of physical activity and body mass assuming larger indivduals expend more energy during activity. We began with activity expenditure, calculated as [0.9(total expenditure) - (basal expenditure)] as described above. The observed ratio of (activity expenditure)/(fat free mass) for adults 20 - 60 y was 0.07 MJ d<sup>-1</sup> kg<sup>-1</sup>.

710 We therefore modeled activity expenditure as

711 Activity expenditure = 
$$0.07 \text{ PA}_{age}$$
 (fat free mass) [5]

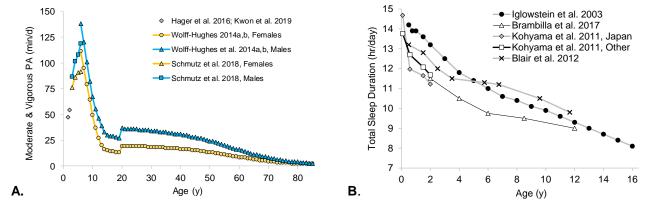
To incorporate effects of fat mass, we constructed a second version using the ratio of (activity expenditure)/(body weight) for adults 20 – 60y,

Activity expenditure = 
$$0.04 \text{ PA}_{age}$$
 (body weight) [6]

In both equations, PA<sub>age</sub> represents the level of physical activity relative to the mean value for 20 – 60 y adults. PA<sub>age</sub> could either remain constant at adult levels (PA<sub>age</sub>=1.0) over the lifespan or follow the trajectory of physical activity measured *via* accelerometry, which peaks between 5 – 10 y, declines rapidly through adolescence, and then declines more slowly beginning at ~40 y (11-13, 26, 27, 48-51). Different measures of physical activity (*e.g.*, moderate and vigorous PA, mean counts per min., total accelerometry counts) exhibit somewhat different trajectories over the lifespan, but the patterns are strongly correlated; all measures show the greatest activity at 5-10 y and declining activity in older adults (Figure S7). We chose total accelerometry counts (11,

26), which sum all movement per 24-hour period, to model age-related changes in PA<sub>age</sub>. We chose total counts because activity energy expenditure should reflect the summed cost of all activity, not only activity at moderate and vigorous intensities. Further, the amplitude of change in moderate and vigorous activity over the lifespan is considerably larger than the observed changes in adjusted total expenditure or adjusted activity expenditure (Figure S10). Determining the relative contributions of different measures of physical activity to total expenditure is beyond the scope of the simple modeling approach here and remains an important task for future research.





**Figure S7.** Modeling physical activity across the lifespan. **A.** Across studies and countries, accelerometer-measured physical activity rises through infancy and early childhood, peaking between 5 and 10y before declining to adult levels in the teenage years (11-13, 26, 27, 48-51). Physical activity declines again, more slowly, in older adults. The onset of decline in older adults varies somewhat across studies, beginning between ~40 y and ~60 y. Here, physical activity is shown as minutes/day of moderate and vigorous physical activity. Other measures (e.g., total accelerometer counts; mean counts/min, vector magnitude) follow a similar pattern of physical activity over the life span (11, 26). **B.** The increase in physical activity from 0 to ~10 y is mirrored by the steady decline in total daily sleep duration during this period (52-55).

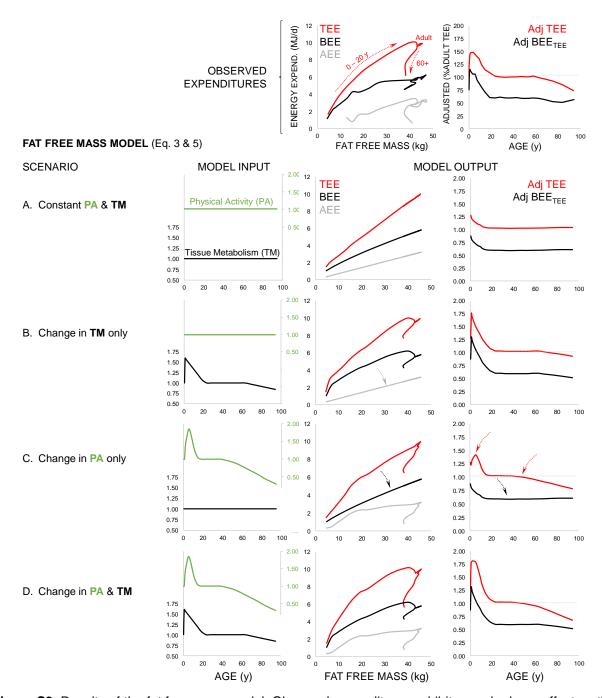
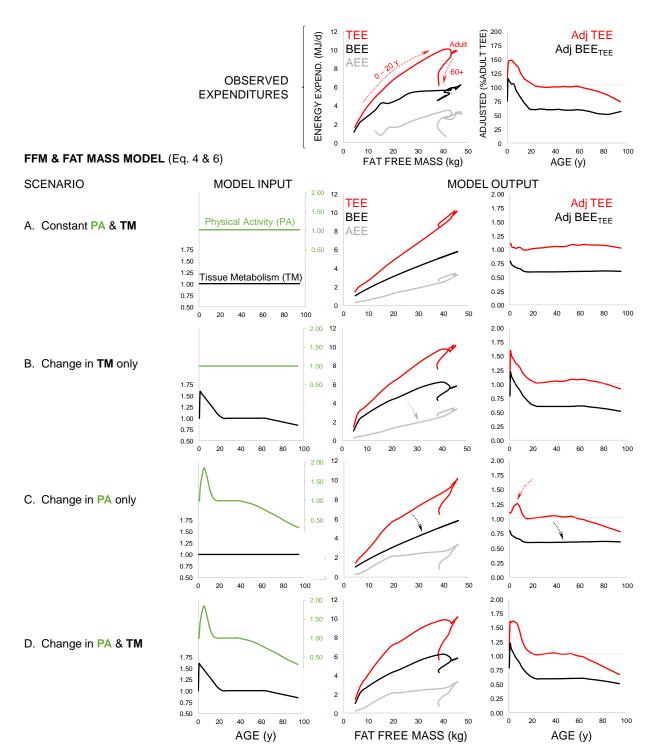


Figure S8. Results of the fat free mass model. Observed expenditures exhibit a marked age effect on the relationship between expenditure and fat free mass that is evident in both absolute (Figure 1C) and adjusted (Figure 2D) measures. A. If physical activity (PA) and cellular metabolism (TM) remain constant at adult levels, age effects do not emerge from the model. B. When only TM varies, age effects emerge for total expenditure (TEE) and basal expenditure (BEE), but not activity expenditure (AEE; gray arrow). C. Conversely, if only physical activity varies age effects emerge for AEE and TEE but not BEE (black arrows). Adjusted TEE also peaks later in childhood and declines earlier in adulthood (red arrows) than observed. D. Varying both PA and TM gives model outputs similar to observed expenditures.



**Figure S9.** Results of the fat free mass and fat mass model. Model outputs are similar to those of the fat free mass model (Figure S8). The scenario that best matches the observed relationships between fat free mass, age, and expenditure is D, in which AEE is influenced by age-related variation in both physical activity and cellular metabolism. Abbreviations as in Fig S8.

### 8. Physical Activity, Activity Expenditure and PAL

To further interrogate our simple model of expenditure and the contribution of physical activity, we examined the agreement between accelerometery-measured physical activity, adjusted activity expenditure, and modeled PAL over the lifespan. First, as noted in our discussion of the simple expenditure model (see above; Figures 3, S8, S9), moderate and vigorous physical activity and total accelerometry counts show a similar shape profile when plotted against age, but moderate and vigorous physical activity shows a greater amplitude of change over the lifespan (Figure S10). Moderate and vigorous physical activity reach a peak ~4-times greater than the mean values observed for 20-30 y men and women, far greater than the amplitude of change in adjusted total expenditure.

We used adjusted total and basal expenditures to model activity expenditure and PAL over the lifespan for comparison with published accelerometry measures of physical activity. Modeling activity expenditure and PAL was preferable because our dataset has no subjects less than 3 y with measures of both total and basal expenditure, and only 4 subjects under the age of 6 y with both measures (Table S1). Using values of adjusted total expenditure and adjusted BEE<sub>TEE</sub> (basal expenditure expressed as a percentage of total expenditure) for age cohorts from Table S3 enabled us to model activity expenditure and PAL for this critical early period of development, in which both physical activity and expenditure change substantially. We modeled adjusted activity expenditure as [(adjusted total expenditure) – (adjusted BEE<sub>TEE</sub>)] and PAL as [(adjusted total expenditure) / (adjusted BEE<sub>TEE</sub>)], which as we show in Figure S4 corelate strongly with unadjusted measures of activity expenditure and PAL, respectively.

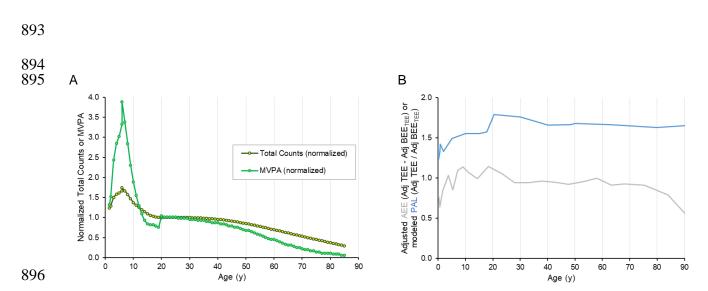
Modeled adjusted activity expenditure and PAL showed a somewhat different pattern of change over the lifecoure than either total counts or moderate and vigorous activity measured via

accelerometry (Figure S10). Modeled activity expenditure was most similar to total counts, rising through childhood, peaking between 10 and 20 y before falling to a stable adult level; the adult level was stable from  $\sim 30-75$  y before declining (Figure S10). Modeled PAL rose unevenly from birth through age 20, then remained largely stable thereafter.

The agreement, and lack thereof, between the pattern of accelerometry-measured physical activity and modeled activity expenditure and PAL must be assessed with caution. These measures are from different samples; we do not have paired accelerometry and energy expenditure measures in the present dataset. The life course pattern of accelerometry-measured physical activity, particularly total counts, is broadly consistent with that of modeled activity expenditure. However, more work is clearly needed to determine the effects of physical activity and other factors to variation in activity expenditure and PAL over the lifecourse.

802	9.IAEA DLW database consortium
803 804 805 806	This group authorship contains the names of people whose data were contributed into the database by the analysis laboratory but they later could not be traced, or they did not respond to emails to assent inclusion among the authorship. The list also includes some researchers who did not assent inclusion because they felt their contribution was not sufficient to merit authorship
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**Figure S10. A.** Physical activity measured via accelerometry from published analyses (-13, 26, 27, 48-51) and **B.** modeled activity expenditure and PAL calculated from cohort means for adjusted total expenditure and adjusted BEE<sub>TEE</sub> in Table S3. Accelerometry measures and modeled activity expenditure are normalized to mean values for 20 – 30 y subjects.

Hat Free Mass  N F  N F  N F  N F  N F  N F  N F  N	1.5	1.00	0 1	1 6	1.00	1 0	7.41	25.9	25./ 8			3	0 0			2
Age   V	,	3CT XX 7	7 77 193	2	A 55 0 81	л					7 3 4	200	27.7	X 4 2 3		84.0
Age   V    Fedgy    Fedgy    Fedgy	1.7.	3.30 1.37	2.62 1.14	9	4.76 0.71	32.14 6.27	6.78	26.3 8.6			39.22 6.23	14.0	67.1 14.6	75.42 2.96		75.2
Age   W	1.7.	3.37 1.21	2.87 0.88	6.53 0.93	5.30 0.61	28.78 5.58	7.67	22.4 7.3	28.6 1	53.98 9.37	42.61 5.96	걸	71.2 16.3	68.66 1.45		68.0
Age   W	1.6	4.16 1.43	2.68 0.79	7.02 0.79	5.49 0.82	28.22 6.25	4.80		25.3 5	56.76 5.89	ÇΠ	12.6		63.11 1.66	0 1.44	62.5
Age   W	1.6	4.35 1.50	2.55 0.76	7.56 0.72	5.92 0.83	28.68 5.83		25.3 7.2	27.6 8	61.72 6.29	43.40 4.84	10.2	71.0 12.6	57.52 1.24	8 1.40	58.
Horizon   Hori		4.49 1.39	3.11 0.91	7.64 0.96	5.84 0.81	31.98 7.19		30.6 13.5	35.3	61.65 7.44	45.18 5.96	19.6	80.5 20.7	53.46 1.20	6 1.57	53
Maje   M.   Hengin   Mass   Maje	_	5.06 1.99	3.27 0.79	7.99 1.16	73	29.89 8.78	38.08 10.35	29.1 13.7	30.5	63.72 6.48	45.01 7.42	6	75.5 20.7	48.20 1.37	9 1.27	47.
May N	+	4.46 2.03	3.35 1.32	7.50 1.09	6.24 1.02	26.35 9.81	8.82	23.0 12.5	33.8	59.28 9.50	47.08 8.20	<u>ф</u>	80.8 22.2	42.57 1.29	133	42.9
May	-	4.40 1.79	3.09 1.25	7.32 1.17	6.22 0.83	25.86 8.49		22.0	31.5	58.10 9.93	46.96 7.57	20.2	<b>78.5</b> 20.6	38.17 1.45	0 1.41	8
Age V)    Height (cm)   Hadds (cg)   Hadds (		4.40 2.21	3.20 1.17	7.47 1.09	6.03 0.94	23.09 8.65	36.97 9.70	18.9 11.8	29.3 1	58.52 9.23	45.46 6.95	ਲ 3	<b>74.8</b> 20.3	33.10 1.47	1.34	μ
Age V)		4.62 2.92	2.85 1.58	7.50 1.17	5.83 0.87	20.50 8.21	33.50 10.86	16.7 15.1		58.82 9.21	42.37 7.04	20.9	65.9 17.4	27.98 1.44	1.46	27.9
Age (y)		4.99 2.39	3.12 1.75	7.34 1.24	5.77 0.81	21.25 8.61	32.62 9.55	17.4	23.1 1	60.09 11.38	43.32 7.03	19.3	66.4 19.2	23.70 1.37	1.40	23.4
Age (y)		5.74 1.59	3.51 1.26	7.86 0.90	53	21.65 8.25	31.95 8.30		21.3 1	57.96 7.28	42.43 7.32	12.5	63.7 15.9	18.92 0.75	0.83	18.5
Maye	1.8	2.34 1.51	3.43 1.83	6.10 1.08	5.65 1.18	24.17 8.02	35.77 12.72		25.7 1	32.51 7.19	40.05 11.53	14.0	65.8 26.5	13.95 0.87	17 1.33	14.4
Age	1.6	2.74 1.24	2.38 0.71	5.66 0.65	5.43 0.87	29.96 10.88	22.44 8.25	14.7	8.4 4	30.56 6.44	27.77 3.42	45.3 13.9	36.2 6.3	11.07 0.28	2 0.61	=
May	ري ن	2.74 1.25	1.72 1.02	5.53 0.95	4.67 0.87	22.26 13.20	25.80 13.92	9	9.4 1	26.32 6.07	22.19 4.08	35.6 12.9	31.6 13.0	9.49 0.61	9 0.64	9
Maye   Maye   Mayer	1 5	2.04 1.22	1.62 0.78	4.71 0.59	4.24 0.85	17.41 10.59		4.4 4.6 3.8	6.4 4	20.01 2.50	ω	24.7 4.6	24.5 6.5	7.38 0.72	9 0.58	7.1
May born	<u>ئ</u>	1.16 0.60	0.81 0.84	4.69 1.05	4.26 0.82	15.04 4.77	20.41 8.91	1.8 3.1 1.5	3.9 1	16.81 2.61	15.16 2.78	9	19.1 2.9	5.41 0.47	4 0.34	5.7
Age V    Height (m)	1.4	1.37 NA	1.27 0.45		4.07 0.67	16.91 NA	29.54 6.26	1.0 3.0 NA	6.7 4	14.96 NA	14.87 4.25		21.6 8.3	4.00 NA	0 0.35	3.8
Age V    Height (m)				044	2.44	327	24.96	2.6 0.69		22.7	7.72	173	10.33	0.32	1.56	
Age   W				0.29	2.17	3.78		2			6.55	27.7	8.76	0.74	0.85	
Age by Height Cm) Mass (kg) Fat Mass (kg) Fa					1.14	8.94	-	1.3 0.80		0.81	4.17	18		017	0.21	Ī
Mass (rg)	mea	mean sd		mean sd	g.	mean sd	SA.	nean		mean sd		a.	a.	mean sd		mea
May		3	-	3	-	3	- 11	3	-	3	-	3	П	3	П	
Mark		(MJ/d)	Ē	(MJ/d)	BEE	<b>t</b> %	Fat	t Mass (kg)	Fai	Mass (kg)	Fat Free	s (kg)	Mass	(y)	Age	
Mass		20.0 0.0	ē	0	1.20	2	0.00	Ċ	20.03	02.00	10.01		00.0	Š		9
Height		26 9 8 9	34 7 79	3 6	3 8	3 8		ة رح	236	62 60 9 47	8		158 0 91	3 8		0 0
Height (m)	7 4	30 9 62	39 3 70	24.50 0.14	25 59 8 70	48 22 7 07	38 02 5 22	2 20	25.7	70 76 13 80	63 61 12 29	ло	7 -	2 5	0 10	23 2
Age (y)         Height (rm)         Mass (kg)         Fat Height (rm)	٥ <u>د</u>	31 / 63	1110	24.00 0.00	28 88 10 13	50.01 0.02	30 63 5 65	0.30	0 20	77 19 1/1 92	68 50 44 43	0 -	n 9	75 40 292	2 2 2	75.0
Age (y)         Height (cm)         Mass (kg)         Fath response (kg)         <	9 0	30 8 6.4	41672	24 89 955	31 47 1113	53 61 8 62	1		28 2	78 50 18 64	73.67 15.55	7 :	161 4 6 7	67 98 137	147	200
Age (y)         Height (cm)         Mass (kg)         Fat Free Mass (kg)         Fat Free Mass (kg)         Fat Mass (kg)         Add (kg) <td>9 2</td> <td>29 9 7.4</td> <td>42 5 6 7</td> <td>2</td> <td>33 29 12 58</td> <td>56 70 807</td> <td>683</td> <td>27 2 4 5</td> <td>29 3 6</td> <td>82 34 17 11</td> <td></td> <td>174.5 7.4</td> <td>161.5 7.1</td> <td>63 16 155</td> <td>2 1.47</td> <td>8</td>	9 2	29 9 7.4	42 5 6 7	2	33 29 12 58	56 70 807	683	27 2 4 5	29 3 6	82 34 17 11		174.5 7.4	161.5 7.1	63 16 155	2 1.47	8
Height (cm)	9 7	30 0 6 7	41077	8	31 93 12 22	60 67 713	8	27 8 3 7	28.3 5	87 53 13 91	75 35 17 07		163 6 62	57 76 138	4 148	25
Height (cm)	9.7	31.8 6.1	42.2 7.8	20	34.72 14.08	59.54 8.29	6.51	28.4 4.8	29.7 7	88.38 16.51	79.37 19.42	6.7	163.5 5.9	52.59 1.48	1.48	52.8
type (y)         Height (cm)         Mass (kg)         Fe with the mean sd         mea	9.8	28.0 7.1	38.3 8.3	24.21 9.91		59.52 8.15	6.44	27.2 4.3	27.4 6	83.74 15.81		176.8 7.2	61	47.76 1.46	3 1.46	47.4
Hay	9.9	27.4 7.9	38.2 8.0	23.33 9.98	29.47 12.78	58.79 8.91	7.56	26.4 4.3	27.6 6	82.12 15.90	74.23 18.78	176.3 7.7	7.2	42.92 1.37	1.36	42.8
Age (y)         Height (cm)         Hass (kg)         Fat Free Mass (kg)         Fat Free Mass (kg)         Fat Mass (kg)         Mass (kg)         Mass (kg)         Fat Mass (kg)         Fat Mass (kg)         All States	9.9	26.4 8.3	38.4 7.7	22.64 11.78	30.03 12.59	58.91 10.51			28.0	81.55 19.88	75.50 17.68	176.7 7.6	164.2 6.5	38.01 1.42	5 1.45	38.0
Age (y)         Height (cm)         Height (cm)         Mass (kg)         Fat was (kg)         A           61         4         mean d         mean d <td< td=""><td>9.8</td><td>24.0 8.7</td><td>36.7 9.0</td><td>20.07 12.18</td><td>28.18 12.96</td><td>59.07 10.23</td><td>6.63</td><td>25.1 5.4</td><td>27.2</td><td>79.14 19.56</td><td>73.39 17.78</td><td>.80</td><td>164.5 6.2</td><td>32.88 1.41</td><td>99 1.36</td><td>32.9</td></td<>	9.8	24.0 8.7	36.7 9.0	20.07 12.18	28.18 12.96	59.07 10.23	6.63	25.1 5.4	27.2	79.14 19.56	73.39 17.78	.80	164.5 6.2	32.88 1.41	99 1.36	32.9
lige (y)         Height (cm)         Mass (kg)         Feat reset Mass (kg)         Mass (kg)         Feat reset Mass (kg)         All State Mass (kg)         Feat reset Mas	9.6	22.3 8.6	34.4 9.8	18.58 12.54	24.63 12.51	59.97 9.63	6.81 81	24.9 4.8	25.2 5	78.56 18.51	67.99 16.72		164.1 6.9	28.05 1.40	7 1.48	27.7
Height   Height   Height   Hass	9.6	19.6 8.9	33.6 9.6	16.06 11.14	23.82 13.08	60.29 10.53	43.26 6.97		24.8 6	76.35 18.60	67.08 17.92		164.6 7.4	23.48 1.38	1.40	23.2
Height   Height   Height   Hass	10.0	21.5 10.0	32.3 8.9	17.25 12.26	21.82 11.76	57.11 7.58		5.8 23.5 4.9	23.9		64.31 16.34	7.7	163.9 7.4	18.37 1.11	0.99	18:3
Index (Ng)         Height (cm)         Mass (kg)         Fat Free Mass (kg)         Fat Free Mass (kg)         Fat Ma	9.9	21.9 10.4	29.2 8.3	14.58 10.95	17.34 9.25	47.15 11.42	_	1.8 21.5 5.6	21.9		56.72 14.67	77	160.6 8.4	14.53 1.14	1.18	14.3
lege (y)         Height (cm)         Mass (kg)         Father Mass (kg)         Fa	8.9	30.1 11.2	27.8 10.3	14.50 8.25		30.42 6.63	31.85 6.35		20.3 4	44.91 13.45	45.15 11.65		148.5 8.0	11.01 0.47	4 0.58	=======================================
ge (y)         Height (cm)         Mass (kg)         Father Mass (kg)         Fathe	7.3	24.7 13.1	29.1 10.9	10.23 8.76	10.66 7.74	25.53 6.09	22.96 5.01	_	18.2 4	35.76 13.69	33.62 11.50	Ö.	<b>133.5</b> 9.3	9.14 0.53	0 0.48	9
ge (y)         Height (cm)         Mass (kg)         FMI         FMI         Fet Free Mass (kg)         Fat Free Mass (kg)         Fet Mass (kg)         Fat Mass (kg) <th< td=""><td>6.6</td><td>20.3 8.7</td><td>27.8 10.3</td><td>5.57 3.62</td><td>8.34 5.33</td><td>20.14 2.75</td><td>19.28 3.97</td><td>3.9 16.2 2.4</td><td>18.0 3</td><td>25.71 5.49</td><td>27.62 8.49</td><td>125.2 8.8</td><td>122.5 10.2</td><td>7.25 0.62</td><td>3 0.65</td><td>7.0</td></th<>	6.6	20.3 8.7	27.8 10.3	5.57 3.62	8.34 5.33	20.14 2.75	19.28 3.97	3.9 16.2 2.4	18.0 3	25.71 5.49	27.62 8.49	125.2 8.8	122.5 10.2	7.25 0.62	3 0.65	7.0
ge (y)         Height (cm)         Mass (kg)         FMI         FRANCE         FR	5.5	21.1 8.0	24.1 6.8	4.91 3.55	5.06 2.43	16.83 2.92	15.34 2.31	2.0 16.6 2.9	16.0 2	21.74 5.73	20.41 3.86	113.7 7.5	112.7 6.7	5.31 0.68	0.63	5.3
ge (y)         Height (cm)         Mass (kg)         EMIN         F         Mass (kg)         Fathree Mass (kg)         All Sathree Mass (kg)         All Sathree Mass	4.8	23.2 5.8	24.2 5.5	4.14 1.69	4.15 1.91	13.24 1.85	12.51 1.85	1.7 16.6 2.4	15.9 1	17.38 3.03	ω	102.1 6.1	101.2 4.6	3.78 0.31	0.28	3.8
Age (y)         Height (cm)         Mass (kg)         bM         F at Free Mass (kg)         Fat Week Mass	3.7	16.7 5.7	18.1 7.5	1.96 0.76	2.02 0.87	9.74 1.41		1.0 16.8 1.0	16.3 1	11.69 1.65		83.2 5.9	82.3 5.0	1.64 0.48	0 0.46	=
Mge (y)         Height (cm)         Mass (kg)         BMI         Feathree Mass (kg)         Feathree Mass (kg)         Feathwas (kg)	2.5	w	25.6 6.4	2.23 0.65	2.23 0.80		6.32 0.91	2.1 17.7 1.3	17.8 2	9.17 1.33	8.54 1.40	71.8 4.6	69.1 4.3	0.72 0.20	0.18	0.6
Age (y) Height (cm) Mass (kg) BMI Fat Free Mass (kg) Fat M	1.6	16.6 7.8	2 7.7	1.09 0.66	1.14 0.63	5.03 1.09	4.56 0.87	16 16.4 19	15.8 1		5.71 1.28	60.4 5.4	59.7 4.6	0.24 0.13	4 0.13	0.2
(y) Height (cm) Mass (kg) HMI Fat Free Mass (kg) Fat Mass	meal			mean sd		mean sd	mean sd	id nean sd	nean s	mean sd	mean sd	mean sd	mean sd	mean sd	an Sd	mea
(y) Height (cm) Mass (kg) BMI Fat Free Mass (kg) Fat Mass (kg)		Z	П	Z	П	3	П	Z	П	Z	П	3	П	Z	П	
		it%	Fa	ass (kg)	Fat Ma	Mass (kg)	Fat Free N	BMI		s (kg)	Mas	it (cm)	Heigh	(y)	Age	

Total Exne	Model parameters enditure (TEE)	, , &			s (0 -			veniles					20 - 60	v)	Old	er Adı	ılts (60	)+ v)
Model	enditure (TLL)	Factors	<u>β</u>		t-value	D D	<u>β</u>	std.err.	•	D D	β		t-value	D D	<u>β</u>		t-value	<b>P</b>
	ly Mass+Sex+Age	Intercept (MJ/d)	0.255	0.111		0.022	2.592		22.032	0.000	5.984	0.197	30.427	0.000	10.917		29.130	0.00
		Body Mass (kg)	0.205	0.025	8.061	0.000	0.080		22.494	0.000	0.065	0.002	30.274	0.000	0.048	0.002		0.00
		Sex(M)	0.090	0.046	1.953	0.052	1.436		15.145	0.000	2.669	0.081	33.036	0.000	1.659	0.070		0.00
		Age (y)	0.951	0.205	4.632	0.000	0.183	0.015	11.832	0.000	-0.025	0.004	-6.635	0.000	-0.080	0.004	-18.451	0.00
		model	N 235	SEE 0.343	231	adjR2 0.733	N 1403	SEE 1.719	1399	adjR2 0.726	N 2805	SEE 2.032	2801	adjR2 0.482	<i>N</i> 1978	SEE 1.311	1974	0.50
			<u>B</u>	std.err.			<u>B</u>	std.err.			<u>B</u>	std.err.			<u>B</u>			
In(TFF)~Ir	n(FFM)+In(FM)	Intercept (MJ/d)	-1.270		-17.130	0.000	-0.121	0.028	<u>t-value</u> -4.259	0.000	-1.102	0.050	<u>t-value</u> -22.038	0.000	-0.773	std.err. 0.062		0.00
	11(1111)1111(1111)	In(Fat Free Mass; kg)	1.163	0.046			0.696	0.011	60.758	0.000	0.916	0.013	71.248	0.000	0.797	0.002		0.00
		In(Fat Mass; kg)	0.053	0.014	3.862	0.000	-0.041	0.007	-5.714	0.000	-0.030	0.005	-5.986	0.000	-0.016	0.009	-1.828	0.06
		model	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjR
			235	0.160	232	0.796	1403	0.154	1400	0.842	2805	0.142	2802	0.646	1978	0.139	1975	0.53
			<u>B</u>	std.err.		D	<u>B</u>	std.err.	t-value	D	<u>B</u>	std.err.	t-value	<u>p</u>	В	std.err.		D
3. In(TEE)~Ir	n(FFM)+ln(FM)+Sex+Aç		-1.122	0.089			-0.348	0.044	-7.956	0.000	-1.118	0.069	-16.129	0.000	0.092	0.089	1.032	0.30
		In(Fat Free Mass; kg) In(Fat Mass; kg)	1.025	0.067	15.215 2.294	0.000	0.784 -0.019	0.021	38.119 -2.622	0.000	0.920 -0.032	0.020	45.942 -5.149	0.000	0.736	0.025	29.883 -3.118	0.00
		Sex(M)	-0.034		-0.644		0.067	0.007	7.592	0.009	-0.002	0.000	-0.249	0.803	0.011	0.010		0.00
		Age (y)	0.254	0.082		0.002	-0.012	0.002	-6.630	0.000	0.000	0.000	0.765	0.444	-0.008		-19.038	
		model	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjF
			235	0.157	230	0.804	1403	0.147	1398	0.857	2805	0.142	2800	0.646	1978	0.128	1973	0.60
	enditure (BEE)							veniles					20 - 60				ılts (60	)+ y)
Model Dod	h. Maaa . Ca A					Factors	<u>β</u>	std.err.	t-value	<u>p</u>	<u>β</u>	std.err.		<u>p</u>	<u>β</u>	std.err.		<u>p</u>
. BEE~BOD	ly Mass+Sex+Age					ot (MJ/d)	2.965		18.785	0.000	3.649	0.104	34.943	0.000	5.905	0.379		0.00
-				- 1	Jouy IVE	ass (kg) Sex(M)	0.034 1.185	0.003	11.004 11.733	0.000	0.036 1.263	0.001	32.494 27.915	0.000	0.031	0.002	14.277	0.00
						Age (y)	0.033	0.015	2.212	0.000	-0.008	0.002	-3.487	0.000	-0.041	0.004	-9.501	0.00
						model	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjF
							345	0.848	341	0.581	1036	0.694	1032	0.682	621	0.761	617	0.52
							<u>β</u>	std.err.	t-value	<u>p</u>	<u>β</u>	std.err.	t-value	<u>p</u>	<u>B</u>	std.err.		<u>p</u>
5. In(BEE)~Ir	n(FFM)+In(FM)					t (MJ/d)	0.055	0.078	0.706	0.480	-0.954	0.059	-16.176	0.000	-0.923	0.099	-9.350	0.00
				In(Fat	Free Ma	ass; kg)	0.535	0.028	19.103	0.000	0.707	0.016	45.353	0.000	0.656	0.027	24.640	0.00
				lr	n(Fat Ma		-0.095	0.014	-6.784	0.000	0.019	0.006	3.408	0.001	0.028	0.015	1.819	0.06
						model	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjF
							345	0.153	342	0.573	1036	0.103	1033	0.688	621	0.135	618	0.53
) (DEE) I	(FF1.0 1 (F1.0 0 A					1 (B 4 1 ( B	<u>B</u>	std.err.	t-value	<u>p</u>	<u>β</u>	std.err.	t-value	<u>p</u>	<u>B</u>	std.err.		<u>p</u>
6. In(BEE)~	n(FFM)+ln(FM)+Sex+A(					t (MJ/d)	-0.270	0.100	-2.704	0.007	-0.497	0.079	-6.281	0.000	-0.089	0.151	-0.587	0.55
					Free Ma	ass; kg) ass; kg)	0.663	0.044	15.167 -4.005	0.000	0.561	0.023	24.008 7.809	0.000	0.549	0.040	13.663 2.619	0.00
			_	- "	I(Fat IV	Sex(M)	-0.054 0.090	0.014	4.780	0.000	0.054	0.007	8.297	0.000	0.042	0.016		0.00
						Age (y)	-0.018	0.003	-5.102	0.000	-0.001	0.000	-2.124	0.000	-0.006	0.001	-8.814	0.02
						model	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjR.
							345	0.137	340	0.658	1036	0.100	1031	0.708	621	0.128	616	0.58
A - 4 is side of Free										n		114 - 7	00 00		01-1	0 -1-		
	kpenditure (AEE)							veniles	_				20 - 60				ılts (60	
Model 7 AFF~Bod	ly Mass+Sex+Age					Factors ot (MJ/d)	<u>β</u> -0.481	std.err. 0.237	<u>t-value</u> -2.030	<u>p</u> 0.043	<u>β</u> 1.822	std.err. 0.252	<u>t-value</u> 7.231	<u>p</u> 0.000	<u>β</u> 5.835	std.err. 0.604		0.00
r. ALL-Bod	ly Wassington					ass (kg)	0.032	0.005	6.774	0.000	0.023	0.003	8.870	0.000	0.014	0.004		0.00
					Joury IVIC	Sex(M)	0.999	0.152	6.581	0.000	1.308	0.109	11.983	0.000	0.661	0.105	6.264	0.00
						Age (y)	0.113	0.022	5.133	0.000	-0.012	0.006	-2.216	0.027	-0.058	0.007	-8.354	0.00
						model	N	SEE	df	adjR2	N	SEE	df	adjR2	N	SEE	df	adjR.
							345	1.275	341	0.476	1036	1.675	1032	0.201	621	1.212	617	0.21
							<u>B</u>	std.err.	t-value	<u>p</u>	<u>B</u>	std.err.	t-value	<u>p</u>	<u>B</u>	std.err.	t-value	<u>p</u>
									-14.447	0.000	-4.124	0.248	-16.627	0.000	-2.556	0.401	-6.381	0.00
3. ln(AEE)~lr	n(FFM)+ln(FM)					t (MJ/d)	-3.330											
8. ln(AEE)~lr	n(FFM)+In(FM)			In(Fat	Free Ma	ass; kg)	1.301	0.082	15.776	0.000	1.476	0.065	22.614	0.000	0.952	0.108	8.807	0.00
8. In(AEE)~Ir	n(FFM)+ln(FM)			In(Fat		ass; kg) ass; kg)	1.301 -0.099	0.082 0.041	15.776 -2.414	0.016	-0.142	0.023	-6.130	0.000	0.952 -0.042	0.108 0.062	-0.685	0.00
3. ln(AEE)~lr	n(FFM)+In(FM)			In(Fat	Free Ma	ass; kg)	1.301 -0.099 <i>N</i>	0.082 0.041 SEE	15.776 -2.414 df	0.016 adjR2	-0.142 N	0.023 SEE	-6.130 df	0.000 0.000 adjR2	0.952 -0.042 <i>N</i>	0.108 0.062 SEE	-0.685 df	0.00 0.49 adjR
8. In(AEE)~Ir	n(FFM)+in(FM)			In(Fat	Free Ma	ass; kg) ass; kg)	1.301 -0.099 <i>N</i> 338	0.082 0.041 SEE 0.445	15.776 -2.414 df 335	0.016 adjR2 0.550	-0.142 N 1023	0.023 SEE 0.423	-6.130 df 1020	0.000 0.000 adjR2 0.333	0.952 -0.042 <i>N</i> 612	0.108 0.062 SEE 0.546	-0.685 df 609	0.00 0.49 adjR 0.11
				In(Fat	Free Man(Fat Ma	ass; kg) ass; kg) model	1.301 -0.099 N 338 <u>β</u>	0.082 0.041 SEE 0.445 std.err.	15.776 -2.414 <i>df</i> 335 <u>t-value</u>	0.016 adjR2 0.550 <u>p</u>	-0.142 <i>N</i> 1023 <u>β</u>	0.023 SEE 0.423 std.err.	-6.130 df 1020 <u>t-value</u>	0.000 0.000 adjR2 0.333 <u>p</u>	0.952 -0.042 N 612 <u>β</u>	0.108 0.062 SEE 0.546 std.err.	-0.685 df 609 <u>t-value</u>	0.00 0.49 adjR: 0.11
	n(FFM)+ln(FM) n(FFM)+ln(FM)+Sex+Aç			In(Fat	Free Man(Fat Man)	ass; kg) ass; kg) model ot (MJ/d)	1.301 -0.099 N 338 <u>β</u> -3.437	0.082 0.041 SEE 0.445 std.err. 0.332	15.776 -2.414 <i>df</i> 335 <u>t-value</u> -10.366	0.016 adjR2 0.550 <u>p</u> 0.000	-0.142 N 1023 <u>β</u> -5.194	0.023 SEE 0.423 std.err. 0.342	-6.130 df 1020 <u>t-value</u> -15.187	0.000 0.000 adjR2 0.333 <u>p</u> 0.000	0.952 -0.042 N 612 <u>B</u> 0.222	0.108 0.062 SEE 0.546 std.err. 0.625	-0.685 df 609 <u>t-value</u> 0.355	0.00 0.49 adjR 0.11 <u>p</u> 0.72
				In(Fat	Free Mann (Fat Mann) Intercepting Free Mann (Fat Mann)	ass; kg) ass; kg) model ot (MJ/d) ass; kg)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349	0.082 0.041 SEE 0.445 std.err. 0.332 0.145	15.776 -2.414 df 335 <u>t-value</u> -10.366 9.295	0.016 adjR2 0.550 <u>p</u> 0.000 0.000	-0.142 N 1023 <u>β</u> -5.194 1.816	0.023 SEE 0.423 <u>std.err.</u> 0.342 0.100	-6.130 df 1020 <u>t-value</u> -15.187 18.079	0.000 0.000 adjR2 0.333 <u>p</u> 0.000 0.000	0.952 -0.042 N 612 <u>B</u> 0.222 0.674	0.108 0.062 SEE 0.546 std.err. 0.625 0.165	-0.685 df 609 <u>t-value</u> 0.355 4.088	0.00 0.49 adjR 0.11 <u>p</u> 0.72 0.00
				In(Fat	Free Mann (Fat Mann) Intercepting Free Mann (Fat Mann)	ass; kg) ass; kg) model ot (MJ/d)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093	0.082 0.041 SEE 0.445 std.err. 0.332	15.776 -2.414 <i>df</i> 335 <u>t-value</u> -10.366	0.016 adjR2 0.550 <u>p</u> 0.000	-0.142 N 1023 <u>β</u> -5.194	0.023 SEE 0.423 std.err. 0.342	-6.130 df 1020 <u>t-value</u> -15.187	0.000 0.000 adjR2 0.333 <u>p</u> 0.000	0.952 -0.042 N 612 <u>B</u> 0.222	0.108 0.062 SEE 0.546 std.err. 0.625	-0.685 df 609 <u>t-value</u> 0.355	0.00 0.49 adjR 0.11 <u>p</u> 0.72 0.00 0.88
				In(Fat	Free Mann (Fat Mann) Intercepting Free Mann (Fat Mann)	ass; kg) ass; kg) model bt (MJ/d) ass; kg) ass; kg)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044	15.776 -2.414 df 335 <u>t-value</u> -10.366 9.295 -2.097	0.016 adjR2 0.550 <u>p</u> 0.000 0.000 0.037	-0.142 N 1023 <u>β</u> -5.194 1.816 -0.221	0.023 SEE 0.423 <u>std.err.</u> 0.342 0.100 0.029	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598	0.000 0.000 adjR2 0.333 <u>p</u> 0.000 0.000	0.952 -0.042 N 612 <u>B</u> 0.222 0.674 -0.010	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066	-0.685 df 609 <u>t-value</u> 0.355 4.088 -0.151	0.00 0.49 adjR 0.11 <u>p</u> 0.72 0.00 0.88 0.23
				In(Fat	Free Mann (Fat Mann) Intercepting Free Mann (Fat Mann)	ass; kg) model  ot (MJ/d) ass; kg) ass; kg) ass; kg) Sex(M)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093 0.006 -0.005 N	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE	15.776 -2.414 df 335 <u>t-value</u> -10.366 9.295 -2.097 0.090 -0.474 df	0.016 adjR2 0.550 <u>P</u> 0.000 0.000 0.037 0.928 0.636 adjR2	-0.142 N 1023 β -5.194 1.816 -0.221 -0.198 0.002 N	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246 adjR2	0.952 -0.042 N 612 <u>β</u> 0.222 0.674 -0.010 0.079 -0.025 N	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df	0.00 0.49 adjR: 0.11 0.72 0.00 0.88 0.23 0.00 adjR:
				In(Fat	Free Mann (Fat Mann) Intercepting Free Mann (Fat Mann)	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) Sex(M) Age (y)	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 -0.005	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011	15.776 -2.414 df 335 <u>t-value</u> -10.366 9.295 -2.097 0.090 -0.474	0.016 adjR2 0.550 <u>p</u> 0.000 0.000 0.037 0.928 0.636	-0.142 N 1023 <u>β</u> -5.194 1.816 -0.221 -0.198 0.002	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246	0.952 -0.042 N 612 <u>B</u> 0.222 0.674 -0.010 0.079 -0.025	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852	0.000 0.494 adjR2 0.110 0.723 0.000 0.880 0.233 0.000 adjR2
9. ln(AEE)~lr	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Mann (Fat Mann) Intercepting Free Mann (Fat Mann)	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) Sex(M) Age (y)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093 0.006 -0.005 N 338	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 <u>β</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df 1018	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246 adjR2 0.345	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607	0.000 0.494 0.116 0.723 0.000 0.886 0.236 0.000 adjR2 0.196
9. ln(AEE)~lr PAL (TEE/	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Mann (Fat Mann) Intercep Free Mann (Fat Mann)	ass; kg) ass; kg) model at (MJ/d) ass; kg) ass; kg) Sex(M) Age (y) model	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093 0.006 -0.005 N 338	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 <u>B</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df 1018	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246 adjR2 0.345	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607	0.000 0.499 adjR. 0.111 0.722 0.000 0.888 0.233 0.000 adjR. 0.199
9. ln(AEE)~lr PAL (TEE/ Wodel	n(FFM)+In(FM)+Sex+Aç			In(Fat Ir	Free Man (Fat Man)	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) ass; kg) Age (y) model	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093 0.006 -0.005 N 338	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446 veniles std.err.	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 6(1 - 2) t-value	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 <u>β</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420 dults (	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 <u>t-value</u>	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246 adjR2 0.345	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 JHS (60 t-value	0.000 0.49- adjR2 0.110 0.723 0.000 0.880 0.233 0.000 adjR2 0.190
PAL (TEE/	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Intercep	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) Sex(M) Age (y) model  Factors ot (MJ/d)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093 0.006 -0.005 N 338 <b>Ju</b> <u>B</u>	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446 veniles std.err. 0.048	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 6(1 - 2) t-value 26.913	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 <u>β</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023 <b>A</b> <u>β</u> 1.668	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420 dults ( std.err. 0.041	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 <u>t-value</u> 40.739	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.246 adjR2 0.345 y) p 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 Olde B 2.209	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 Jtts (60 t-value 15.348	0.000 0.49 adjR: 0.111 0.72: 0.000 0.88 0.23: 0.000 adjR: 0.19: 0.000
PAL (TEE/	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Intercep	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) ass; kg) Age (y) model	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 -0.005 N 338 Ju B 1.290	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446 veniles std.err.	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 6(1 - 2) t-value	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 <u>β</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420 dults (	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 <u>t-value</u> 40.739 2.058	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246 adjR2 0.345	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 Jits (60 t-value 15.348 -0.239	0.00 0.49 adjR 0.11 p 0.72 0.00 0.88 0.23 0.00 adjR 0.19 p 0.00 0.81
). In(AEE)~Ir PAL (TEE/	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Intercep	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) Sex(M) Age (y) model  Factors ot (MJ/d) ass (kg)	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 -0.005 N 338 Ju B 1.290	0.082 0.041 SEE 0.445 std.err. 0.332 0.044 0.062 0.011 SEE 0.446 veniles std.err. 0.048 0.001	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 6(1 - 2 t-value 26.913 2.093	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547  Dy) p 0.000 0.037	-0.142 N 1023 <u>B</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023 <b>A</b> <u>B</u> 1.668 0.001	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420 dults ( std.err. 0.041 0.000	-6.130 df 1020 <u>t-value</u> -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 <u>t-value</u> 40.739 2.058	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.000 0.246 adjR2 0.345  y) p 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 Old B 2.209 0.000	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144 0.001	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 Lits (60 t-value 15.348 -0.239 2.298	0.00 0.49 adjR 0.11  0.72 0.00 0.88 0.23 0.00 adjR 0.19  1 0.00 0.81 0.02
). In(AEE)~Ir PAL (TEE/	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Intercep	ass; kg) ass; kg) model  ot (MJ/d) ass; kg) ass; kg) ass; kg) Sex(M) Age (y) model  Factors ot (MJ/d) ass (kg) Sex(M)	1.301 -0.099 N 338 B B-3.437 1.349 -0.093 0.006 -0.005 N 338 1.290 0.002 0.005 0.022 N	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446 veniles std.err. 0.048 0.001 0.004 SEE	15.776 -2.414 df 335 <u>t-value</u> -10.366 -9.295 -2.097 0.090 -0.474 df 333 -2.093 1.641 4.933 df	0.016 adjR2 0.550  p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547   Dy) p 0.000 0.037 0.102 0.000 adjR2	-0.142 N 1023 β -5.194 1.816 -0.221 -0.198 0.002 N 1023 A β 1.668 0.001 0.094 -0.001 N	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420 dults ( std.err. 0.041 0.008 0.001 SEE	-6.130 df 1020 t-value -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 t-value 40.739 2.058 5.312 -1.260 df	0.000 0.000 adjR2 0.333  p 0.000 0.000 0.000 0.246 adjR2 0.345  y) p 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 Oldi B 2.209 0.000 0.058 -0.007 N	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144 0.001 0.025 0.002 SEE	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 Jits (60 t-value 15.348 -0.239 2.298 -4.142 df	0.00 0.49 adjR 0.11  p 0.72 0.00 0.88 0.23 0.00 adjR 0.19 p 0.00 0.81 0.02 0.00 adjR
). In(AEE)~Ir PAL (TEE/	n(FFM)+In(FM)+Sex+Aç			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Intercep	ass; kg) ass; kg) model  at (MJ/d) ass; kg) ass; kg) ass; kg) Sex(M) Age (y) model  Factors at (MJ/d) Ages (kg) Sex(M) Age (y)	1.301 -0.099 N 338 <u>B</u> -3.437 1.349 -0.093 0.006 -0.005 N 338 Ju <u>B</u> 1.290 0.002 0.050 0.002	0.082 0.041 SEE 0.445 0.332 0.145 0.044 0.062 0.011 SEE 0.446 veniles std.err. 0.048 0.001 0.0031 0.004	15.776 -2.414 df 335 -10.366 9.295 -2.097 0.090 -0.474 df 333 6(1 - 2 t-value 26.913 2.093 1.641 4.933	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.547	-0.142 N 1023 <u>B</u> -5.194 1.816 -0.221 -0.198 0.002 N 1023 A <u>B</u> 1.668 0.001 0.094 -0.001	0.023 SEE 0.423 std.err. 0.342 0.100 0.029 0.044 0.001 SEE 0.420 dults ( std.err. 0.041 0.000 0.018	-6.130 df 1020e -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 1-value 40.739 2.058 5.312 -1.260	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.246 adjR2 0.345  y) p 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 <b>Oldi</b> B 2.209 0.000 0.058 -0.007	0.108 0.062 SEE 0.546 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144 0.001 0.025 0.002	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142	0.000 0.499 adjR 0.111  P 0.722 0.000 0.888 0.233 0.000 adjR 0.199 0.000 0.811 0.022 0.000 adjR
PAL (TEE/ Wodel 10. PAL-Box	n(FFM)+In(FM)+Sex+Aç  (BEE)  dy Mass+Sex+Age			In(Fat	Free Man(Fat Man) Intercep Free Man(Fat Man) Intercep Body Man)	ass; kg) ass; kg) model  t (MJ/d) ass; kg) sex(M) Age (y) model  Factors t (MJ/d) ass (kg) Sex(M) Age (y) model	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 -0.005 N 338 Ju B 1.290 0.002 0.050 0.0022 N 345 B	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446 veniles std.err. 0.048 0.001 0.004 SEE	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 6(1 - 2 t-value 26.913 2.093 1.641 4.933 df 341 t-value	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 β -5.194 1.816 -0.221 -0.198 0.002 N 1023 A β 1.668 0.001 0.094 -0.001 N	0.023 SEE 0.429 0.100 0.029 0.044 0.001 SEE 0.420  dults ( std.err. 0.001 0.018 0.001 SEE 0.272 std.err.	-6.130 df 1020 -15.187 18.079 -7.598 -4.480 1.162 df 1018  20 - 60  1-value 40.739 2.058 5.312 -1.260 df 1032 1-value	0.000 0.000 adjR2 0.333 P 0.000 0.000 0.000 0.246 adjR2 0.345 y) P 0.000 0.000 0.000 0.000 0.246 adjR2 0.345	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 Oldi B 2.209 0.000 0.058 -0.007 N	0.108 0.062 SEE 0.546 std.err. 0.625 0.065 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144 0.001 0.025 0.002 SEE 0.289 std.err.	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value	0.00 0.49 adjR 0.11  p 0.72 0.00 0.88 0.23 0.00 adjR 0.19 p 0.00 0.81 0.02 0.00 adjR
PAL (TEE/ Vodel 0. PAL-Box	n(FFM)+In(FM)+Sex+Aç			In(Fat Ir	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Body Man)	ass; kg) ass; kg) model  tt (MJ/d) ass; kg) ass; kg) ass; kg) sex(M) Age (y) model  Factors tt (MJ/d) ass (kg) Sex(M) Age (y) model	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 -0.005 N 338  1.290 0.002 0.050 0.022 N 345 B 0.420	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.062 0.011 SEE 0.446 veniles std.err. 0.004 SEE 0.001 0.031 0.004 SEE 0.258 std.err.	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 (1 - 2 t-value 26.913 2.093 1.641 4.933 df 341 t-value 3.252	0.016 adjR2 0.550 p 0.000 0.000 0.037 0.928 0.636 adjR2 0.547	-0.142 N 1023 B -5.194 1.816 -0.221 -0.198 0.002 N 1023 A B 1.668 0.001 0.094 -0.001 N 1036 B 0.174	0.023 SEE 0.423 0.423 0.100 0.029 0.044 0.001 SEE 0.420  dults ( std.err. 0.041 0.000 0.018 0.001 SEE 0.272 std.err. 0.148	-6.130 df 1020 1020 1-24 lue -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 1-value 40.739 2.058 5.312 -1.260 df 1032 1-value 1.178	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.246 adjR2 0.345 y) p 0.000 0.040 0.040 0.040 0.040 0.032 0.208 adjR2 0.323	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 Oldi B 2.209 0.000 0.058 -0.007 N E 2.209 1.215	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144 0.001 0.002 SEE 0.289 std.err. 0.212	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 Jts (60 t-value 15.348 -0.239 -2.298 -4.142 df 617 t-value 5.736	0.00 0.49 adjR 0.11  0.72 0.00 0.83 0.00 adjR 0.19  0.00 0.81 0.00 0.81 0.00 0.81
PAL (TEE/ Vodel 0. PAL-Box	n(FFM)+In(FM)+Sex+Aç  (BEE)  dy Mass+Sex+Age			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Body Man) Intercep Free Man)	ass; kg) ass; kg) model  tt (MJ/d) ass; kg) ass; kg) ass; kg) sex(M) Age (y) model  Factors tt (MJ/d) ass (kg) Sex(M) Age (y) model	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 -0.005 N 338  Ju B 1.290 0.002 0.050 0.022 N 345 B 0.420 0.386	0.082 0.041 SEE 0.445 std.err. 0.332 0.145 0.044 0.062 0.011 SEE 0.446 Veniles std.err. 0.048 0.001 0.031 0.004 SEE 0.258 std.err. 0.129 0.046	15.776 -2.414 df 335 t-value -10.366 9.295 0.090 -0.474 df 333  (1 - 2) t-value 26.913 2.093 1.641 4.933 df 341 t-value 3.252 8.348	0.016 adjR2 0.550  P 0.000 0.000 0.037 0.928 0.636 adjR2 0.547  Dy)  P 0.000 0.037 0.102 0.102 0.000 adjR2 0.234 P 0.001 0.000	-0.142 N 1023 B -5.194 1.816 -0.221 -0.198 0.002 N 1023 A B 1.668 0.001 N 1036 B 0.174 0.477	0.023 SEE 0.423 0.100 0.029 0.044 0.001 SEE 0.420  dults ( std.err. 0.041 0.000 0.018 SEE 0.272 std.err. 0.148 0.039	-6.130 df 1020 t-value -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 t-value 40.739 2.058 5.312 -1.260 df 1032 t-value 1.178 12.221	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.246 adjR2 0.345 p 0.000 0.000 0.246 adjR2 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 Old B 2.209 0.000 0.058 -0.007 N 621 B 1.215 0.201	0.108 0.062 SEE 0.546 std.err. 0.625 0.165 0.066 0.067 0.003 SEE 0.521 er Adu std.err. 0.144 0.001 0.025 0.289 std.err. 0.289 0.289	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 Lt-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524	0.00 0.49 adjR 0.11  0.72 0.00 0.88 0.23 0.23 0.23 0.20 adjR 0.19 0.00 0.81 0.02 0.00 0.00 0.00 0.00 0.00 0.00
PAL (TEE/ Wodel 10. PAL-Box	n(FFM)+In(FM)+Sex+Aç  (BEE)  dy Mass+Sex+Age			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Body Man)	ass; kg) ass; kg) model  of (MJ/d) ass; kg) ass; kg) ass; kg) Age (y) model  Factors of (MJ/d) ass (kg) Age (y) model  of (MJ/d) ass; kg)	1.301 -0.099 N N 338 B 3.3437 1.349 0.005 N 338 1.290 0.002 0.050 0.002 0.050 0.022 N 345 B 0.420 0.386 0.386 0.386 0.030	0.082 0.041 SEE 0.445 std.err. 0.332 0.044 0.062 0.011 SEE 0.446 veniles std.err. 0.091 0.001 0.031 0.004 SEE 0.258 std.err. 0.145	15.776 -2.414 df 335 t-value -10.366 9.295 -2.097 0.090 -0.474 df 333 6 (1 - 2 t-value 26.913 2.093 1.641 4.933 df 341 t-value 3.252 8.348 -0.817	0.016 adjR2 0.550 0.500 0.000 0.0037 0.928 0.636 adjR2 0.547  0.000 0.037 0.102 0.000 adjR2 0.234 p 0.001 0.000 0.415	-0.142 N 1023 E -5.194 1.816 -0.221 -0.198 N 1023 A E 1.668 0.001 N 1036 E 0.174 -0.098	0.023 SEE 0.423 0.423 0.100 0.029 0.044 0.001 SEE 0.420 dults ( std.err. 0.041 0.000 0.018 0.001 SEE 0.272 std.err. 0.148 0.039 0.014	-6.130 df 1020 t-value -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 t-value 40.739 2.058 5.312 -1.260 df 1032 t-value 1.178 12.221 -6.999	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.246 adjR2 0.345 p 0.000 0.040 0.000 0.208 0.000 0.208 0.000 0.208 0.000 0.208 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 O.000 0.058 -0.007 N 621 B 1.215 0.201 0.201	0.108 0.062 SEE 0.546 std.err, 0.625 0.066 0.067 0.003 SEE 0.521 er Adu std.err, 0.1444 0.001 0.0025 0.002 SEE 0.258 std.err, 0.1212 0.002	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 lt-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524 -2.605	0.000 0.49 adjR 0.11 p 0.72 0.00 0.88 0.23 0.000 adjR 0.02 0.000 adjR 0.000 0.81 0.000 0.000 0.000 0.000 0.000
PAL (TEE/ Vodel 0. PAL-Box	n(FFM)+In(FM)+Sex+Aç  (BEE)  dy Mass+Sex+Age			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Body Man) Intercep Free Man)	ass; kg) ass; kg) model  tt (MJ/d) ass; kg) ass; kg) ass; kg) sex(M) Age (y) model  Factors tt (MJ/d) ass (kg) Sex(M) Age (y) model	1.301 -0.099 N 338 B 2-3.437 -0.093 0.006 -0.005 N 338 JU B 1.290 0.050	0.082 0.041 0.041 0.032 0.145 0.044 0.062 0.011 0.044 0.062 0.011 0.048 0.001 0.004 SEE 0.258 std.err. 0.129 0.046 0.023 SEE	15.776 -2.414 df 335 t-value -10.366 -2.097 -0.090 -0.474 df 333 -1.410	0.016 adjR2 0.550  0.000 0.000 0.000 0.037 0.0547  0.000 0.037 0.102 0.000 0.037 0.102 0.000 0.034 0.000 0.034 0.000 0.034 0.0415 adjR2	-0.142 N 1023 B -5.194 1.816 -0.221 -0.198 0.002 N 1023 A B 1.668 0.001 0.094 -0.001 N 1036 B 0.174 0.477 -0.098 N	0.023 SEE 0.423 3td.err, 0.342 0.100 0.029 0.420 SEE 0.420  dults ( std.err, 0.041 0.001 0.000 0.018 0.001 0.014 0.001 SEE 0.272 Std.err, 0.148 0.039	-6.130 df 1020 t-value -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 t-value 40.739 2.058 5.312 -1.260 df 1032 t-value 1.178 12.221 -6.999 df	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 0.345  P 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.248 0.000 0.000 0.208 0.000 0.000 0.208 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.027 -0.010 0.079 -0.025 N 612 -0.000 N 62 -0.007 N 62 -0.000 N 62 -0.000 N 0.058 -0.000 N 0.058 -0.000 N 0.058 N 0 N 0 N 0 0 N 0 0 N 0 0 N 0 0 N 0 N	0.108 0.062 0.546 std.err. 0.625 0.066 0.067 0.003 0.521 er Adu.err. 0.104 0.001 0.025 0.002 0.025 0.002 0.025 0.002 0.025 0.029 0.025 0.029 0.025 0.029 0.025 0.029 0.025 0.029 0.025 0.029 0.025 0.029 0.0	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524 -2.605 df	0.000 0.49 adjF 0.11  p 0.72 0.000 0.88 0.23 0.000 adjF 0.000 0.81 0.02 0.000 0.000 0.000 0.000 0.000 0.000 0.000
PAL (TEE/ lodel 0. PAL-Box	n(FFM)+In(FM)+Sex+Aç  (BEE)  dy Mass+Sex+Age			In(Fat	Free Man (Fat Man) Intercep Free Man (Fat Man) Intercep Body Man) Intercep Free Man)	ass; kg) ass; kg) model  of (MJ/d) ass; kg) ass; kg) ass; kg) Age (y) model  Factors of (MJ/d) ass (kg) Age (y) model  of (MJ/d) ass; kg)	1.301 -0.099 N 338 B -3.437 1.349 -0.093 0.006 N 338 Ju B 1.290 0.002 0.052 N 345 B 0.022 N 345 N 0.033 0.033 0.006 N 0.002 0.002 0.002 0.002 0.002 N 0.003 0.003 0.003 0.006 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.003	0.082 0.041 0.65 SEE 0.445 0.332 0.041 0.062 0.446 0.061 0.45 0.048 0.001 0.031 0.048 0.001 0.031 0.048 0.001 0.031 0.048 0.048 0.048 0.048 0.048 0.055 0.258	15.776 -2.414 df -335 -1-value -10.366 -9.295 -2.097 0.090 333 -1.641 -2.093 1.641 4.933 df 341 -1-value 3.252 8.348 -0.817 df 342	0.016 adjR2 0.550 0.500 0.000 0.0037 0.928 0.636 adjR2 0.547  0.000 0.037 0.102 0.000 adjR2 0.234 p 0.001 0.000 0.415	-0.142 N 1023 § -5.194 1.816 -0.221 -0.198 0.002 N 1023 A § 1.668 0.001 N 1036 0.094 -0.001 N 1036 N 1036 N 1036 N 1036 N 1036	0.023 SEE 0.270 0.0148 0.039 0.0148 0.039 0.0148 0.039 0.0148 0.039 0.0148 0.039 0.0148 0.039 0.0148 0.039 0.014	-6.130 df 1020 t-value -15.187 18.079 -7.598 -4.480 1.162 df 1018 20 - 60 t-value 40.739 2.058 5.312 -1.260 df 1032 t-value 1.178 12.221 -6.999 df 1033	0.000 0.000 adjR2 0.333 p 0.000 0.000 0.000 0.246 adjR2 0.345 p 0.000 0.040 0.000 0.208 0.000 0.208 0.000 0.208 0.000 0.208 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 -0.000 0.058 -0.000 N 622 -0.000 0.058 -0.000 N 622 -0.000 0.000 0.000 0.000 N 622 -0.000 0.0000 0.000	0.108 0.062 0.546 0.546 0.165 0.066 0.067 0.521 er Adu 0.021 0.025 0.282 0.001 0.025 0.002 0.003 0.003 0.003 0.004 0.001 0.025 0.004 0.005 0.004 0.005 0.004 0.005 0.004 0.005	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524 -2.605 df 618	0.000 0.48 adjF 0.11 p 0.72 0.00 0.88 0.23 0.00 adjF 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.0
PAL (TEE/ Model 10. PAL-Boo	n(FFM)+ln(FM)+Sex+Ac  (BEE)  dy Mass+Sex+Age  FFM)+ln(FM)			In(Fat In In(Fat In(Fat In In(Fat In In(Fat In In(Fat In(F	htercep Free Minimum Intercep Free Minimum Intercep Gody Minimum Intercep Free Minimum Intercep Free Minimum Intercep Free Minimum Intercep Free Minimum Intercep Int	ass; kg) model  t (MJ/d) ass; kg) model  t (MJ/d) ass; kg) model  Factors for (MJ/d) Age (y) model  t (MJ/d) ass (kg) model	1.301 -0.099 N 338 B -3.437 -0.093 0.006 N 338 1.290 0.002 0.050 0.022 0.050 0.022 N 345 B 0.420 0.386 0.019 N	0.082 0.041 SEE 0.445 Std.err, 0.332 0.044 0.062 0.446 0.044 0.062 0.446 0.001 0.001 0.001 0.001 0.001 0.001 0.0023 SEE 0.258 Std.err, 0.129 0.253 Std.err, 0.129 0.253	15.776 -2.414 df -335 -1-value -10.366 -2.097 0.090 0.090 -4.474 df -333 -4.414 -4.934 -4.934	0.016 adjR2 0.550 p 0.000 0.000 0.000 0.037 0.928 0.636 adjR2 0.000 0.037 0.102 0.000 adjR2 0.234 p 0.001 0.000 0.0415 adjR2 0.415	-0.142 N 1023 § -5.194 1.816 -0.221 -0.198 0.002 N 1023 A § 1.668 0.001 N 1036 § 0.174 0.477 -0.098 N 1036 § 1036 §	0.023 SEE 0.420 SEE 0.100 0.029 0.044 0.001 SEE 0.420 0.000 0.008 0.001 SEE 0.420 0.001 0.001 SEE 0.272 SEE 0.400 0.018 SEE 0.272 SEE 0.039 0.014 SEE SEE 0.272 SEE 0.039 0.014 SEE SEE 0.0257 SEE 0.0	6.130 df 1020 1-value 1-15.187 1-5.98 4.480 1.162 df 1018 20 - 60 1-4018 5.312 1-260 df 1032 1-value 1.178 1-2221 6.999 df 1033 1-value 1033 1-value 1033 1-value 1033	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 adjR2 0.345 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.208 0.208 0.209 0.209 0.239 0.239 0.239 0.239 0.239 0.000 0.000	0.952 -0.042 N 612	0.108 0.062 0.546 0.546 0.625 0.065 0.066 0.067 0.521  er Adu sid.err. 0.144 0.025 0.002 0.003 SEE 0.289 sid.err. 0.038 SEE 0.057 0.038 SEE 0.057 0.038	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524 -2.605 df 618 t-value t-value 5.736 df 618 t-value t-value 5.736 df 618 t-value t-value t-value 5.736 df 618 t-value t-valu	0.000 0.48 adjF 0.111 p 0.72 0.000 0.88 0.23 0.000 adjF 0.019 0.000 0.81 0.000
PAL (TEE/ Model 10. PAL-Boo	n(FFM)+In(FM)+Sex+Aç  (BEE)  dy Mass+Sex+Age			In(Fat Ir	Interception of the Market Mar	ass; kg) model  t (MJ/d)	1.301 -0.099 N 338 B 3.437 1.349 -0.093 0.006 N 338 Ju 1.290 0.052 0.052 0.022 N 345 0.0420 0.386 0.019 N 345 0.022 N 345 0.021 N 345 0.022 N 0.022 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0.02 N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.082 0.041 0.041 0.032 0.040 0.0145 0.044 0.062 0.446 0.048 0.001 0.011 SEE 0.446 0.048 0.001 0.011 0	15.776 -2.414 df -335 -1-4810e -9.295 -2.097 -0.090 -0.474 df -333 -1.641 -1.4810e -3.252 -8.348 -0.817 -4.493 -4.	0.016 adjR2 (0.550 p. 0.000 p. 0.000 p. 0.000 0.	-0.142 N 1023	0.023 SEE 0.420 SIGLER 0.001 SEE 0.021 SIGLER 0.001 SEE	6.130 df 1020 t-value 115.187 17.598 4.480 1.162 df 1018 20 - 60 t-value 1.120 df 1032 2.058 5.312 1.260 df 1032 1.178 12.221 1.178 12.221 1.178	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 adjR2 0.345  y)  p 0.000 0.046 0.000 0.246 0.000 0.046 0.000 0.046 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000 0.246 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 612 B 2.209 0.000 0.000 N 621 E 2.209 0.000 N 621 E 2.209 0.000 N 621 B 1.215 0.201 N 621 B 1.215 0.201 N 621 E 1.215 0.201 N 621 E 1.215 0.201 N 621 E 1.215 0.201 N 621 E 1.215 0.201 E 1.215 0.201 N 621 E 1.215 0.201 E 1.215 0.201	0.108 0.062 0.546 0.546 0.625 0.066 0.066 0.067 0.003 SEE 0.521 0.025 0.025 0.027 0.003 SEE 0.289 0.292 0.052 0.293 SEE 0.289 0.293 0.292 0.057	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 JHS (60 1-value 15.348 -0.239 2.298 -4.142 df 617 -1.7852 df 618 t-value 5.476	0.000 0.49 adjR 0.11 0.72 0.00 0.88 0.23 0.00 0.69 0.19 P+ y) p 0.00 0.81 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.0
PAL (TEE/ Wodel 10. PAL~Boo	n(FFM)+ln(FM)+Sex+Ac  (BEE)  dy Mass+Sex+Age  FFM)+ln(FM)			In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir	Free Mintercepe Free Mintercepe Body Mintercepe Free Mintercepe	ass; kg) model  t (MJ/d) sas; kg) model  t (MJ/d) sas; kg) sas; kg) sas; kg) sas; kg) model  Factors t (MJ/d) model  t (MJ/d) sas; kg) model  t (MJ/d) sas; kg) model	1.301 1.0099 N 338 B -3.437 1.349 -0.093 0.006 N 338 Ju B 1.290 0.002 N 345 B 0.420 0.386 -0.019 N 345 0.002 N 347 1.290 0.002 N 347 1.290 0.002 N 347 1.290 0.002 N 347 1.290 0.002 N 347 1.290 0.002 0.003 0.00	0.082 0.041 0.041 0.032 0.145 0.044 0.062 0.446 0.011 SEE 0.446 0.001 0.031 0.031 0.048 0.001 0.031 0.048 0.001 0.031 0.048 0.048 0.023 0.129 0.046 0.023 0.129 0.046 0.023 0.129 0.046 0.023 0.129 0.046 0.023 0.129 0.046 0.023 0.129 0.046 0.023	15.776 -2.414 df -335 -1-value -10.366 -9.295 -2.097 0.090 333	0.016 adjR2 0.000 0.000 0.037 0.928 0.636 adjR2 0.547  P 0.000 0.037 0.028 0.037 0.002 0.037 0.002 0.037 0.102 0.003 0.001 0.000 0.415 0.001 0.006 0.415 0.006 0.006	-0.142 N 1023 B 5-194 N 1023 A	0.023 SEE 0.420 0.000 0.	6.130 df 1020 1-value 1-15.187 1-7.598 4.480 1.162 df 1018 20 - 60 1-value 40.739 2.058 5.312 1.260 df 1032 1-value 40.739 1032 1-value 40.739 1032 1-value 40.739 11.178	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 adjR2 0.345  P 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.100 0.000 0.000 0.208 adjR2 0.032 0.208 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 C 0.010 0.079 -0.025 N 612 C 0.000 0.058 B 1.215 0.201 -0.085 N 621 B 1.215 0.201 -0.085	0.108 0.062 0.546 0.546 0.650 0.065 0.066 0.067 0.521  er Adu 0.021 0.022 SEE 0.289 0.057 0.033	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524 -2.605 df 618 t-value 5.417 1.814	0.000 0.494 0.11 0.72 0.000 0.881 0.02 0.000 0.81 0.02 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
PAL (TEE/ Wodel 10. PAL~Boo	n(FFM)+ln(FM)+Sex+Ac  (BEE)  dy Mass+Sex+Age  FFM)+ln(FM)			In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir	Free Mintercepe Free Mintercepe Body Mintercepe Free Mintercepe	ass; kg) gass; kg) model  t (MJ/d) sass; kg) model  t (MJ/d) sass; kg) model  Factors  Factor	1.301 1.301 1.301 1.301 1.349 1.349 1.349 1.349 1.349 1.290 1.005 1.	0.082 0.041 SEE 0.445 std.err. 0.042 0.011 SEE 0.446 0.041 0.046 0.031 0.046 0.031 0.004 SEE std.err. 0.129 0.046 0.023 SEE 0.046 0.023 SEE 0.046 0.023 SLE 0.046 0.025	15.776 (2.414 df 335 (2.925 (2	0.016 adjR2   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.001   0.000   0.415   adjR2   0.001   0.000   0.415   0.000   0.040   0.0630   0.0630   0.0630   0.0630   0.0630   0.0630   0.000   0	-0.142 N 1023 E 5.194 1.816 -0.221 -0.198 0.002 N 1023 A E 1.668 0.001 0.094 -0.001 N 1036 B 0.174 0.098 N 1036 E -0.744 1.036 B -0.747 -0.098 N 1036 C -0.717 -0.164	0.023 SEE 0.420 Std.err. 0.342 SEE 0.100 O.029 O.044 O.001 SEE 0.420 O.000 O.018 O.000 O.018 SEE 0.272 Std.err. 0.148 SEE 0.272 Std.err. 0.148 SEE 0.039 O.014 SEE 0.039 O.014 SEE 0.039 O.014 SEE 0.050 O.050 O.017	6.130 df 1020 1-value 1-15.187 1-5.98 4.480 1.162 df 1018 20 - 60 1-4010e 40.739 61 1032 1-value 1.178 1032 1-value 1.178 1033 1-value 1.178 1033 1-value 4.739 4.731 1033 1-value 4.731 1033	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 adjR2 0.0345 0.000 0.046 0.000 0.046 0.000 0.040 0.000 0.040 0.000 0.032 0.032 0.032 0.032 0.032 0.030 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612	0.108 0.062 0.526 0.546 0.546 0.625 0.165 0.066 0.067 0.003 SEE er Adu sid.err, 0.144 0.001 0.025 0.002 SEE 0.057 0.033 SEE 0.154 0.001 0.259 sid.err, 0.212 0.240 0.340 0.340 0.090	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 df 618 t-value 5.447 1.814 -2.405	0.00 0.499 adjRR 0.11 p 0.722 0.00 0.881 0.023 0.000 adjRR 0.000 0.81 0.002 0.000 adjR 0.002 p 0.000
PAL (TEE/ Wodel 10. PAL~Boo	n(FFM)+ln(FM)+Sex+Ac  (BEE)  dy Mass+Sex+Age  FFM)+ln(FM)			In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir	Free Mintercepe Free Mintercepe Body Mintercepe Free Mintercepe	ass; kg) model  tt (MJ/d) ass; kg) model  tt (MJ/d) ass; kg) model  Factors  factors	1.301 1.301 1.0099 N 338 § 8 2.437 1.349 1.093 0.006 N 338 1.290 0.002 N 345 6 0.022 N 345 1.290 0.050 0.022 N 345 1.290 0.050 0.022 N 345 1.290 0.050	0.082 0.041 0.041 0.032 0.040 0.011 SEE 0.446 0.062 0.040 0.011 SEE 0.446 0.002 0.048 0.001 0.031 0.004 SEE 0.258 0.048 0.001 0.011	15.776 -2.414 df -335 -1-4814 -9.295 -2.097 -0.090 -0.474 df -333 -1.641 -1.933 df -1.414 -3.252 -8.348 -0.817 -4.414 -4.2860 -4.179 -4.104 -4.179 -4.0250	0.016 adjR2 0.000 0.000 0.037 0.928 adjR2 0.547  P 0.000 0.037 0.928 adjR2 0.547  P 0.000 0.037 0.102 0.000 0.037 0.102 0.000 0.037 0.102 0.001 0.000 0.001	0.142 N 1023 B -5.194 1.816 -0.221 -0.198 0.002 N 1023 A B 0.001 0.094 0.001 N 1036 0.017 0.477 0.477 0.477 0.477 0.477 0.777 0.098 B -0.744 0.777	0.023 SEE 0.200 0.014 SEE 0.272 Std.err. 0.041 SEE 0.270 0.014 SEE 0.270 0.001 SEE 0.272 0.005 0.001 SEE 0.272 0.005 0.0	6.130 df 1020 t-value 15.187 15.187 16.079 17.598 4.480 1162 df 1018 20 - 60 t-value 1.162 df 1032 2.058 5.312 1.260 df 1032 1.178 12.221 1.178 12.231 12.371 13.140 13.140 13.140 13.140 13.140 13.140 14.141 15.14	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 adjR2 0.345  y) 2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.01 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612 B 0.222 0.674 -0.010 0.079 -0.025 N 612 E 2.209 0.000 0.000 0.058 -0.058 -0.057 N 621 1.215 0.201 B 1.215 0.201 B 1.215 0.001 B 1.215 0.001 0.000	0.108 0.062 0.546 0.546 0.625 0.065 0.066 0.066 0.521 0.025 0.521 0.025 0.521 0.025 0.521 0.025 0.521 0.025 0.289 0.291 0.025 0.289 0.292 0.057 0.033 SEE 0.289 0.291 0.033 SEE 0.290 0.030 0.030 0.030	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 JHS (60 1-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 3.524 -2.605 df 618 t-value 5.417 1.814 -2.405 0.007	0.00 0.49 adjR 0.11 p 0.722 0.000 0.88 0.23 0.000 adjR 0.03 p 0.000 adjR 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
PAL (TEE/ //odel 0. PAL-Boo	n(FFM)+ln(FM)+Sex+Ac  (BEE)  dy Mass+Sex+Age  FFM)+ln(FM)			In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir In(Fat Ir	Free Mintercepe Free Mintercepe Body Mintercepe Free Mintercepe	ass; kg) gass; kg) model  t (MJ/d) sass; kg) model  t (MJ/d) sass; kg) model  Factors  Factor	1.301 1.301 1.301 1.301 1.349 1.349 1.349 1.349 1.349 1.290 1.005 1.	0.082 0.041 SEE 0.445 std.err. 0.042 0.011 SEE 0.446 0.041 0.046 0.031 0.046 0.031 0.004 SEE std.err. 0.129 0.046 0.023 SEE 0.046 0.023 SEE 0.046 0.023 SLE 0.046 0.025	15.776 (2.414 df 335 (2.925 (2	0.016 adjR2   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.001   0.000   0.415   adjR2   0.001   0.000   0.415   0.000   0.040   0.0630   0.0630   0.0630   0.0630   0.0630   0.0630   0.000   0	-0.142 N 1023 E 5.194 1.816 -0.221 -0.198 0.002 N 1023 A E 1.668 0.001 0.094 -0.001 N 1036 B 0.174 0.098 N 1036 E -0.744 1.036 B -0.747 -0.098 N 1036 C -0.717 -0.164	0.023 SEE 0.420 Std.err. 0.342 SEE 0.100 O.029 O.044 O.001 SEE 0.420 O.000 O.018 O.000 O.018 SEE 0.272 Std.err. 0.148 SEE 0.272 Std.err. 0.148 SEE 0.039 O.014 SEE 0.039 O.014 SEE 0.039 O.014 SEE 0.050 O.050 O.017	6.130 df 1020 1-value 1-15.187 1-5.98 4.480 1.162 df 1018 20 - 60 1-4010e 40.739 61 1032 1-value 1.178 1032 1-value 1.178 1033 1-value 1.178 1033 1-value 4.739 4.731 1033 1-value 4.731 1033	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.246 adjR2 0.0345 0.000 0.046 0.000 0.046 0.000 0.040 0.000 0.040 0.000 0.032 0.032 0.032 0.032 0.032 0.030 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.952 -0.042 N 612	0.108 0.062 0.526 0.546 0.546 0.625 0.165 0.066 0.067 0.003 SEE er Adu sid.err, 0.144 0.001 0.025 0.002 SEE 0.057 0.033 SEE 0.154 0.001 0.259 sid.err, 0.212 0.240 0.340 0.340 0.090	-0.685 df 609 t-value 0.355 4.088 -0.151 1.181 -7.852 df 607 t-value 15.348 -0.239 2.298 -4.142 df 617 t-value 5.736 df 618 t-value 5.447 1.814 -2.405	0.00 0.499 adjR 0.11 p 0.72 0.00 0.88 0.02 0.00 adjR 0.00 0.81 0.02 0.00 adjR 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.

**Table S3.** Adjusted total expenditure (TEE), Adjusted basal expenditure (BEE), and Adjusted BEE<sub>TEE</sub>. \*Infant data from the literature, males and females pooled. N values for infant BEE (0 to 2 years) indicate number of entries and (number of individuals).

	Adjusted TEE - Female & Male Cohorts										Adjus	ted BE	E and A	Adjuste	d BE	ETEE				
						Adjus	ted TEE						Adjuste	ed BEE			Adj	justed	BEETE	E
Age		N	mear	n Age	F		ı	M	N		mean	Age		F	М		F		М	
Cohort	F	М	F	M	mean	sd	mean	sd	F	М	F	М	mean	sd	mean	sd	mean	sd	mean	sd
(0,0.5]	103	93	0.2	0.2	120.0	23.2	118.4	23.2	22 (1:	11)*	0.2	2		100.47	33.89		8	36.03	28.9	
(0.5,1]	18	23	0.7	0.7	139.8	17.0	145.5	25.7	20 (8	8)*	0.	9		142.89	11.62		1:	15.47	9.2	
(1,2]	33	35	1.7	1.6	147.4	23.9	148.2	21.6	18 (8	86)*	1.	6		142.02	13.52		1:	11.94	9.6	
(2,4]	54	48	3.8	3.8	147.0	13.4	150.3	19.6	3	1	3.8	4.0	150.2	6.0	144.3	NA	108.6	7.4	100.7	NA
(4,6]	99	121	5.3	5.3	142.5	14.0	148.2	18.5	9	5	5.7	5.4	156.4	26.3	158.8	30.9	110.1	19.9	108.1	19.9
(6,8]	42	42	7.0	7.2	139.2	16.7	143.2	13.6	18	12	7.2	7.4	136.9	25.8	141.9	21.8	94.6	17.7	94.6	15.1
(8,10]	79	75	9.1	9.1	132.8	19.2	140.2	18.7	22	16	9.2	9.5	130.0	23.4	137.3	21.8	87.2	15.2	88.8	14.2
(10,12]	68	34	11.1	11.0	122.0	23.4	133.4	16.3	5	5	11.1	11.1	128.3	19.9	126.3	21.2	82.6	12.3	81.8	15.0
(12,16]	229	128	14.4	14.5	113.1	22.9	118.9	21.4	18	16	14.4	13.9	103.1	18.6	130.0	23.3	64.9	12.2	82.4	15.7
(16,20]	209	103	18.3	18.4	107.1	14.4	113.3	17.1	155	148	18.5	18.9	97.5	12.9	109.3	7.5	60.2	8.1	62.9	5.3
(20,25]	252	123	23.2	23.5	100.6	15.5	106.7	21.9	135	116	23.4	23.8	98.3	10.5	99.6	8.1	60.6	7.1	57.0	5.2
(25,30]	280	182	27.8	28.0	100.5	15.3	102.0	21.2	115	104	27.9	27.9	100.8	11.5	104.0	13.4	62.5	7.8	59.6	8.3
(30,35]	235	146	33.0	32.8	100.0	11.9	100.7	16.5	96	94	33.2	33.1	98.7	9.7	103.3	10.4	60.9	6.3	59.7	7.0
(35,40]	231	165	38.0	38.0	100.0	11.9	102.3	16.3	112	110	38.1	38.2	99.7	10.2	101.6	11.7	61.4	6.9	59.1	7.2
(40,45]	301	165	42.8	42.9	101.3	12.6	100.8	13.2	100	96	42.9	42.6	99.8	10.4	102.9	9.1	61.6	6.9	59.7	6.1
(45,50]	171	144	47.4	47.8	102.0	12.4	100.5	14.3	42	41	47.3	48.1	99.0	14.7	108.1	14.6	61.4	9.6	62.7	8.9
(50,55]	105	93	52.8	52.6	100.5	11.4	100.8	13.2	33	33	53.1	53.4	96.1	9.1	103.1	9.2	59.8	5.5	60.3	5.9
(55,60]	111	76	58.2	57.8	102.2	11.7	102.9	20.0	23	23	58.1	57.5	100.3	9.5	100.0	7.1	62.5	6.1	57.9	4.5
(60,65]	252	90	63.2	63.2	98.8	12.4	99.8	15.3	23	21	62.4	63.1	99.5	12.8	99.2	8.5	62.6	8.3	58.3	5.2
(65,70]	387	90	68.0	68.0	97.6	10.9	94.4	11.1	40	40	68.0	68.7	91.0	8.6	95.2	7.6	56.9	5.9	56.4	4.8
(70,80]	681	232	75.1	75.4	93.9	12.1	90.6	14.6	188	173	75.2	75.4	86.8	9.9	86.4	12.9	55.2	6.6	51.5	8.0
(80,90]	149	66	83.6	84.2	87.6	12.2	82.8	13.0	47	38	84.1	84.0	86.5	16.0	78.6	10.8	55.3	10.8	47.6	6.8
(90,100]	22	8	94.4	94.0	73.2	12.4	76.0	9.6	14	5	94.9	94.0	91.2	19.1	94.8	14.6	57.1	12.9	57.3	8.6

 Table S4. Segmented Regression Analyses

adjTEE	Segme	nts			Break Poir	nts	
	beta	SE	CI_lower	Cl_upper	Estimate	CI_lower	CI_upper
	84.70	7.15	70.69	98.71	0.69	0.61	0.76
	-2.77	0.07	-2.91	-2.63	20.46	19.77	21.15
	-0.02	0.02	-0.07	0.03	62.99	60.13	65.85
	-0.68	0.06	-0.79	-0.57			
adjBEE	Segme	nts			Break Poir	nts	
	beta	SE	CI_lower	Cl_upper	Estimate	CI_lower	CI_upper
	75.51	5.59	64.55	86.46	1.04	0.94	1.14
	-3.75	0.22	-4.17	-3.33	18.00	16.82	19.18
	0.02	0.05	-0.07	0.12	46.46	40.57	52.35
	-0.45	0.04	-0.53	-0.37			