

Distributional Lognormal Model Specifications

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1 MODELS FOR FOOT TRAITS REGRESSED ON AVERAGE DAILY STEP COUNT

1.1 Arch height index

$$\begin{aligned}\text{Arch height index}_i &\sim \text{Lognormal}(\mu_i, \sigma_i) \\ \mu_i &= \beta_0 + \beta_1(\text{Average daily step count}_i) + \beta_2(\text{Age}_i) + \beta_3(\text{Male}_i) \\ \log \sigma_i &= \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i) \\ \beta_0 &\sim \text{Student}(3, -1.1, 2.5) \\ \beta_{1-3} &\sim \text{Student}(3, 0, 2.5) \\ \gamma_{1-2} &\sim \text{Student}(3, 0, 2.5)\end{aligned}$$

1.2 Static arch stiffness index

$$\begin{aligned}\text{Static arch stiffness index}_i &\sim \text{Lognormal}(\mu_i, \sigma_i) \\ \mu_i &= \beta_0 + \beta_1(\text{Average daily step count}_i) + \beta_2(\text{Age}_i) + \beta_3(\text{Male}_i) \\ \log \sigma_i &= \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i) \\ \beta_0 &\sim \text{Student}(3, 0.4, 2.5) \\ \beta_{1-3} &\sim \text{Student}(3, 0, 2.5) \\ \gamma_{1-2} &\sim \text{Student}(3, 0, 2.5)\end{aligned}$$

1.3 Dynamic arch stiffness index

$$\begin{aligned}\text{Dynamic arch stiffness index}_i &\sim \text{Lognormal}(\mu_i, \sigma_i) \\ \mu_i &= \beta_0 + \beta_1(\text{Average daily step count}_i) + \beta_2(\text{Age}_i) \\ &\quad + \beta_3(\text{Male}_i) + \beta_4(\text{Walking speed}_i) \\ \log \sigma_i &= \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i) \\ \beta_0 &\sim \text{Student}(3, -0.3, 2.5) \\ \beta_{1-4} &\sim \text{Student}(3, 0, 2.5) \\ \gamma_{1-2} &\sim \text{Student}(3, 0, 2.5)\end{aligned}$$

1.4 Abductor hallucis cross-sectional area

$$\begin{aligned}\text{Abductor hallucis cross-sectional area}_i &\sim \text{Lognormal}(\mu_i, \sigma_i) \\ \mu_i &= \beta_0 + \beta_1(\text{Average daily step count}_i) + \beta_2(\text{Age}_i) \\ &\quad + \beta_3(\text{Male}_i) + \beta_4(\text{Truncated foot length}_i) \\ \log \sigma_i &= \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i) \\ \beta_0 &\sim \text{Student}(3, -1.5, 2.5) \\ \beta_{1-4} &\sim \text{Student}(3, 0, 2.5) \\ \gamma_{1-2} &\sim \text{Student}(3, 0, 2.5)\end{aligned}$$

1.5 *Flexor digitorum brevis cross-sectional area*

Flexor digitorum brevis cross-sectional area_{*i*} \sim Lognormal(μ_i, σ_i)

$$\begin{aligned}\mu_i = & \beta_0 + \beta_1(\text{Average daily step count}_i) + \beta_2(\text{Age}_i) \\ & + \beta_3(\text{Male}_i) + \beta_4(\text{Truncated foot length}_i)\end{aligned}$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -1.4, 2.5)$$

$$\beta_{1-4} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

1.6 *Abductor digiti minimi cross-sectional area*

Abductor digiti minimi cross-sectional area_{*i*} \sim Lognormal(μ_i, σ_i)

$$\begin{aligned}\mu_i = & \beta_0 + \beta_1(\text{Average daily step count}_i) + \beta_2(\text{Age}_i) \\ & + \beta_3(\text{Male}_i) + \beta_4(\text{Truncated foot length}_i)\end{aligned}$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -2.1, 2.5)$$

$$\beta_{1-4} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

2 MODELS FOR FOOT TRAITS REGRESSED ON AVERAGE DAILY TIME SPENT IN MODERATE-TO-VIGOROUS PHYSICAL ACTIVITY

2.1 Arch height index

Arch height index_{*i*} \sim Lognormal(μ_i, σ_i)

$$\mu_i = \beta_0 + \beta_1(\text{Average MVPA time per day}_i) + \beta_2(\text{Age}_i) + \beta_3(\text{Male}_i)$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -1.1, 2.5)$$

$$\beta_{1-3} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

2.2 Static arch stiffness index

Static arch stiffness index_{*i*} \sim Lognormal(μ_i, σ_i)

$$\mu_i = \beta_0 + \beta_1(\text{Average MVPA time per day}_i) + \beta_2(\text{Age}_i) + \beta_3(\text{Male}_i)$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, 0.4, 2.5)$$

$$\beta_{1-3} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

2.3 Dynamic arch stiffness index

Dynamic arch stiffness index_{*i*} \sim Lognormal(μ_i, σ_i)

$$\begin{aligned} \mu_i = & \beta_0 + \beta_1(\text{Average MVPA time per day}_i) + \beta_2(\text{Age}_i) \\ & + \beta_3(\text{Male}_i) + \beta_4(\text{Walking speed}_i) \end{aligned}$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -0.3, 2.5)$$

$$\beta_{1-4} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

2.4 Abductor hallucis cross-sectional area

Abductor hallucis cross-sectional area_{*i*} \sim Lognormal(μ_i, σ_i)

$$\begin{aligned} \mu_i = & \beta_0 + \beta_1(\text{Average MVPA time per day}_i) + \beta_2(\text{Age}_i) \\ & + \beta_3(\text{Male}_i) + \beta_4(\text{Truncated foot length}_i) \end{aligned}$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -1.5, 2.5)$$

$$\beta_{1-4} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

2.5 *Flexor digitorum brevis cross-sectional area*

Flexor digitorum brevis cross-sectional area_{*i*} \sim Lognormal(μ_i, σ_i)

$$\begin{aligned}\mu_i = & \beta_0 + \beta_1(\text{Average MVPA time per day}_i) + \beta_2(\text{Age}_i) \\ & + \beta_3(\text{Male}_i) + \beta_4(\text{Truncated foot length}_i)\end{aligned}$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -1.4, 2.5)$$

$$\beta_{1-4} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$

2.6 *Abductor digiti minimi cross-sectional area*

Abductor digiti minimi cross-sectional area_{*i*} \sim Lognormal(μ_i, σ_i)

$$\begin{aligned}\mu_i = & \beta_0 + \beta_1(\text{Average MVPA time per day}_i) + \beta_2(\text{Age}_i) \\ & + \beta_3(\text{Male}_i) + \beta_4(\text{Truncated foot length}_i)\end{aligned}$$

$$\log \sigma_i = \gamma_1(\text{Female}_i) + \gamma_2(\text{Male}_i)$$

$$\beta_0 \sim \text{Student}(3, -2.1, 2.5)$$

$$\beta_{1-4} \sim \text{Student}(3, 0, 2.5)$$

$$\gamma_{1-2} \sim \text{Student}(3, 0, 2.5)$$