SUPPLEMENTARY MATERIAL

Running on empty: A longitudinal global study of psychological well-being among runners during the COVID-19 pandemic

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Supplementary Methods

Specification of square root-, natural logarithmic- and quadratic models:

The square root and natural log models were based on the following equation:

$$WHO5_{it} = \beta_0 + \beta_1 Deaths_{it} + \beta_2 RunningActicity_{it} + \beta_3 Injury_{it} + a_i + u_t + \epsilon_{it}$$

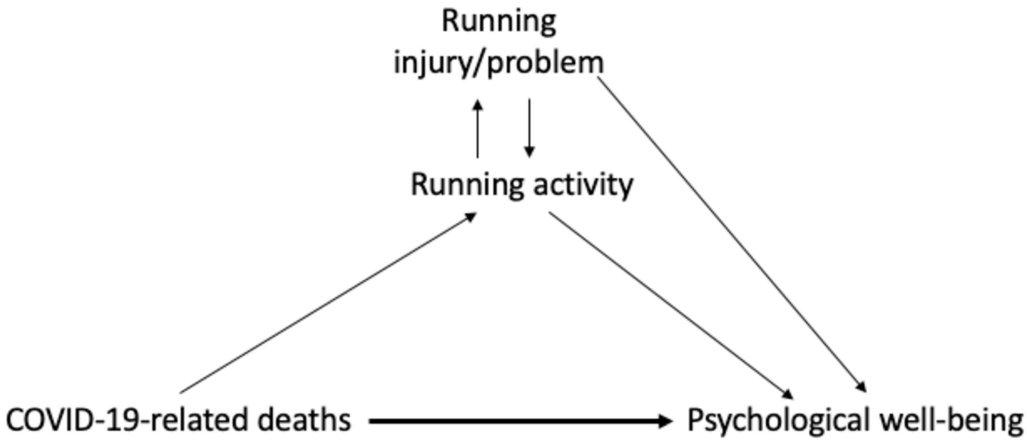
In the square root model, *Deaths* is replaced by $\sqrt{\text{deaths}/10{,}000}$. In the natural log model, *Deaths* is replaced by Ln((deaths/10,000)+0.01). Due to zero-values, 0.01 is added to the number of deaths per 10,000 before log-transformation.

The quadratic model was defined as follows:

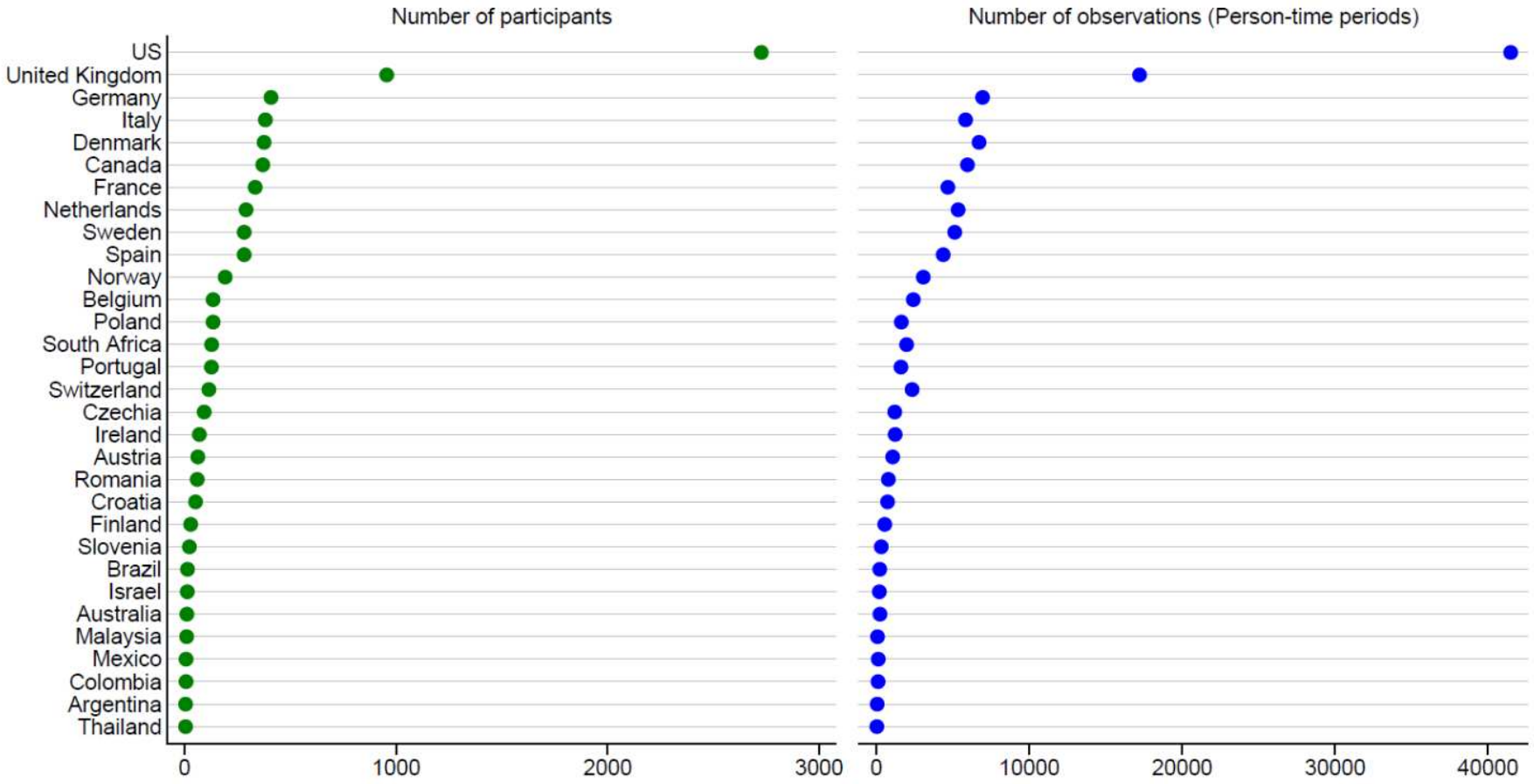
$$WHO5_{it} = \beta_0 + \beta_{1a} Deaths_{it} + \beta_{1b} deaths_{it}^2 + \beta_2 RunningActicity_{it} + \beta_3 Injury_{it} + a_i + u_t + \epsilon_{it}$$

In all three models, *Deaths* is a numerical discrete variable measuring the number of deaths per 10,000 inhabitants in *i*'s country of residence at time period *t* (*t* represents periods of 14 days), $RunningActivity_{it}$ is a continuous variable measuring *i*'s running activity (total meters) at time period *t*, $Injury_{it}$ measures the number of days where activity was affected by a running injury or problem at time period *t*. The three remaining terms represent unobserved factors affecting $WHO5_{it}$: a_i is time-invariant and individual-specific; u_t is unit-invariant and time-specific; and ϵ_{it} represents unobserved determinants of $WHO5_{it}$ that vary across both individual and time. To remove a, we included a full set of individual-level fixed effects, and to remove u_t we included time-fixed effects.

***Supplementary Figure 1*.**

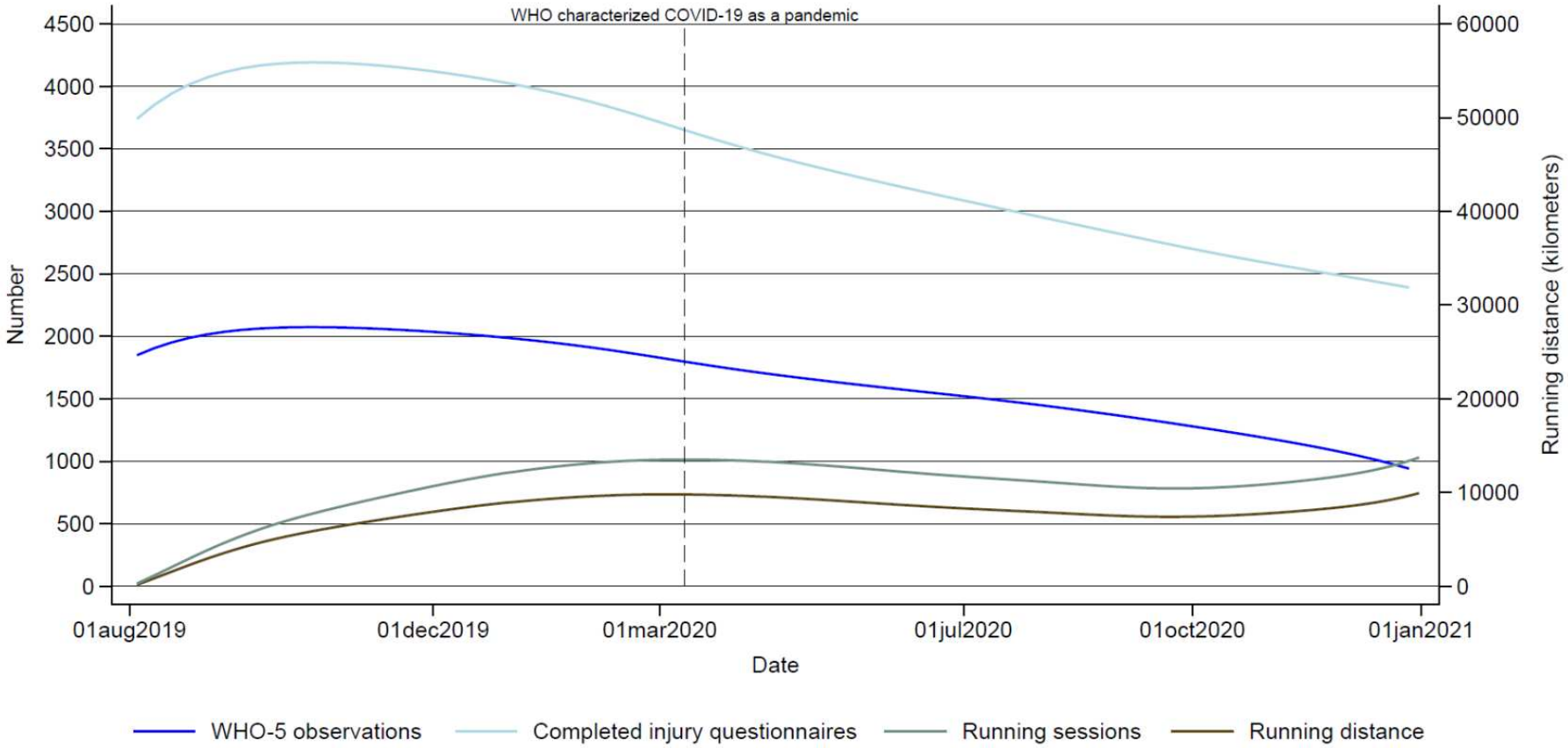


***Supplementary Figure 2*. Number of participants and WHO-5 observations per country**



Note: Countries with less than five participants are not included in the graph. A total of 55 countries have less than five participants, and together they account for 105 participants and 1400 WHO-5 records.

***Supplementary Figure 3*. Number of WHO-5 observations, completed injury-questionnaires, running sessions, and total running distance over the course of the study period**



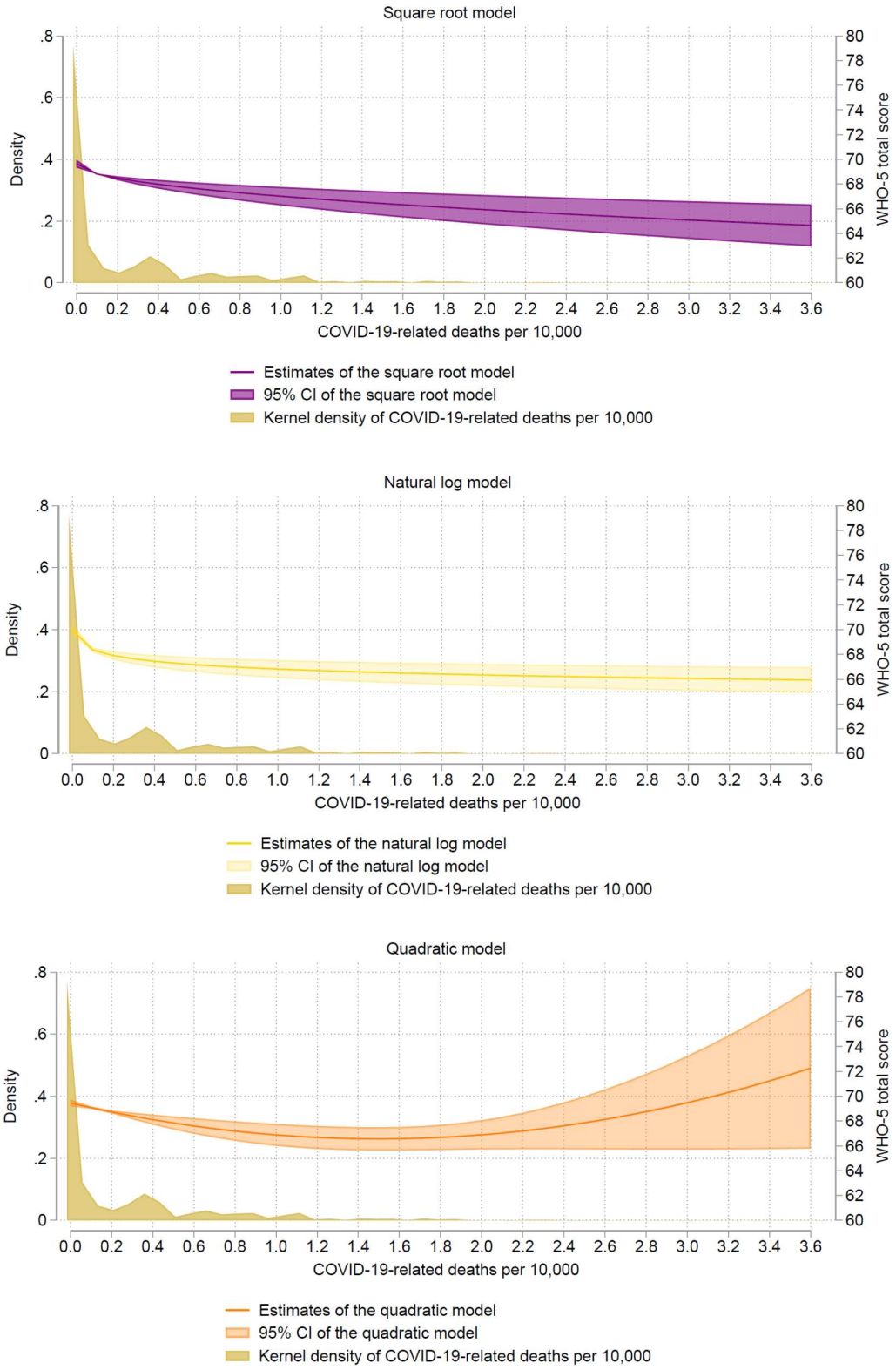
Note: The number of WHO-5 observations, injury questionnaires, running sessions and running distance are generated using a lowess smoother.

***Supplementary Table 1*. Individual fixed-effects linear-regression analyses with time fixed effects and excluding one country at the time (linear specification*). US and Belgium are reported separately, as they account for the highest proportion of participants and the highest number of COVID-19 related deaths per 10,000, respectively.**

	Regression coefficient ($\beta_1 Deaths_{it}$) (95% CI)	p-value
Leave-one-out (min/max of regression coefficient excl. the 95% CI)	-1.67 / -1.12	All ≤0.001
Excluding US	-1.12 (-1.62; -0.62)	<0,001
Excluding Belgium	-1.62 (-2.49; -0.76)	<0,001

*Model: $WHO5_{it} = \beta_0 + \beta_1 Deaths_{it} + \beta_2 RunningActicity_{it} + \beta_3 Injury_{it} + a_i + u_t + \epsilon_{it}$
where *Death* is a continuous variable measuring the number of deaths per 10,000 inhabitants (cf. Table 1) in *i*'s country of residence at time period *t* (*t* represents periods of 14 days), $RunningActivity_{it}$ is a continuous variable measuring *i*'s running activity (total meters) at time period *t*, *Injury* measures the number of days where activity was affected by a running injury or problem at time period *t*. The three remaining terms represent unobserved factors affecting $WHO5_{it}$: a_i is time-invariant and individual-specific; u_t is unit-invariant and time-specific; and ϵ_{it} represents unobserved determinants of $WHO5_{it}$ that vary across both individual and time. To remove a, we included a full set of individual-level fixed effects, and to remove u_t we included time-fixed effects.

***Supplementary Figure 4*. Non-linear association between COVID-19-related deaths per 10,000 and psychological well-being (WHO-5 total score), based on a square root model (top figure), a natural log model (middle figure), and a quadratic model (bottom figure).**



***Supplementary Table 2*. Individual fixed-effects linear-regression analyses with time-fixed effects exploring non-linear associations.**

Model	Regression coefficient ($\beta_1 Deaths_{it}$) (95% CI)	p-value
Square root*:		
DEATHS = $\sqrt{\text{deaths}/10{,}000}$	-2.72 (-3.84; -1.61)	<0.001
Natural log*:		
DEATHS = Ln((deaths/10,000)+0.01)**	-0.70 (-0.95; -0.44)	<0.001
Quadratic***:		
DEATHS = deaths/10.000	-3.86 (-5.96; -1.77)	<0,001
DEATHS = (deaths/10,000)^2	1.29 (0.27; 2.31)	0.013

Observations: 84,679. Individuals: 6,222.

*Model: $WHO5_{it} = \beta_0 + \beta_1 DEATHS_{it} + \beta_2 RunningActicity_{it} + \beta_3 Injury_{it} + a_i + u_t + \epsilon_{it}$

** Due to zero-values, 0.1 is added to the number of deaths per 10,000 before log-transformation

*** Model: $WHO5_{it} = \beta_0 + \beta_{1a} DEATHS_{it} + \beta_{1b} DEATHS_{it}^2 + \beta_2 RunningActicity_{it} + \beta_3 Injury_{it} + a_i + u_t + \epsilon_{it}$ where *Death* is a numerical discrete variable measuring the number of deaths per 10,000 inhabitants (cf. Table 1) in *i*'s country of residence at time period *t* (*t* represents periods of 14 days), *RunningActivity* is a continuous variable measuring *i*'s running activity (total meters) at time period *t*, Injury measures the number of days where activity was affected by a running injury or problem at time period *t*. The three remaining terms represent unobserved factors affecting *WHO5*: a_i is time-invariant and individual-specific; u_t is unit-invariant and time-specific; and ϵ_{it} represents unobserved determinants of *WHO5* that vary across both individual and time. To remove a, we included a full set of individual-level fixed effects, and to remove u_t we included time-fixed effects.