**Supplementary Material to “Impact of the COVID-19 pandemic and related lockdown measures on lifestyle behaviors and wellbeing in children and adolescents with severe obesity”**

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Supplementary Fig. 1. Study flow diagram.

**Supplementary Methods**

**Qualitative analysis**

*Regular semi-structured interviews*
All interviews were independently coded by two physicians (OA, MW) according to the Grounded Theory [1], using a deductive, theory-driven approach followed by an inductive, data-driven approach. The two physicians commenced by open coding of the interviews independently. Afterwards, the coded segments were compared; differences were solved through discussion. Following this, the study team developed a code tree using axial coding based on interviews from a subset of 24 patients (8 patients per interviewing physician). After all remaining interviews were coded using the final code tree, selective coding was performed to identify the code categories most relevant to the research aims. These code categories were finally summarized into four themes: changes in eating styles and behaviors, changes in physical activities, changes in emotional wellbeing of child and family dynamics and impact on daily structure of children. The axial and selective coding steps were also performed independently by both physicians; differences were solved through discussion. To further ensure rigor, a study log was kept during this entire process and memos were used to carefully note emerging ideas about the data analysis which were discussed during weekly meetings of the study team. Importantly, the qualitative data analyses were performed after all interviews were conducted.

*In-depth semi-structured interviews*

Because most regular semi-structured interviews were either conducted with parents alone or together with their children, we performed additional in-depth semi-structured interviews with a subset of eight of our included children within a two-week timeframe after the regular telephone interview. For these interviews we approached children aged 10-14 years We did not approach children with syndromic obesity, mental disorders, developmental delay or severe behavioral problems, as we expected their experiences during the lockdown would not be representative for our patient population and we expected difficulties for them to participate in an interview by video-call. The interviews focused on environmental factors influencing the lifestyle behaviors of children and adolescents before and during COVID-19 lockdown. Three girls and 5 boys consented to participate. At one interview, a mother was present and at two interviews, a father. Deductive exploratory analyses, based on the code tree that we had developed for the qualitative analyses of the regular telephone interviews, were performed on the full transcripts of the in-depth interviews. Our aim for these analyses was to collect insightful quotes related to the qualitative analyses of the regular telephone interviews.

**Quantitative analysis**

The following definitions were used for the assessed baseline characteristics presented in this study and previous studies of Obesity Center CGG [2].

*Ethnicity* was defined according to the definition of the Dutch Central Agency for statistics as Dutch if patient and both parents were born in The Netherlands; otherwise, patients were classified as having a migration background [3].
*Socioeconomic status z-scores* were retrieved from the Netherlands Institute for Social Research. These z-scores summarizing average income, education and unemployment in postal code areas to provide an estimate of the socioeconomic status of patients [4].

*Whether subjects lived in urban or rural areas* was determined using the 2020 data on urbanization from the Dutch Central Bureau for Statistics (CBS). According to CBS definitions, Dutch living areas are classified into five categories of urbanization based on postal code area: ‘no’, ‘small’, ‘moderate’, ‘strong’ or ‘very strong’ degrees of urbanization.[5] Accordingly, we dichotomized patients into living in rural (CBS: ‘no’ or ‘small’ degree of urbanization) or urban (CBS: ‘moderate’, ‘strong’ or ‘very strong’ degree of urbanization) areas.
Presence of *insatiable behavior* was determined by the physician, based on the child’s or parents’ answers regarding hunger, e.g., satiation and satiety, preoccupation with food, night eating, secret eating, food-seeking behavior, and the distress that accompanies the child’s hunger or obsession with food [6].

*Intellectual disability/developmental delay* was determined by the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders 5) definition of intellectual disability or an IQ score ≤70 [2].
*Psychosocial problems* was defined as the presence of an established DSM-5 diagnosis (with the exception of intellectual disability) such as major depressive disorder, or social problems for which official authorities were involved, such as child protective services [2].

**Supplementary methods references:**

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**Supplementary Tables**

Table S1. Characteristics of the study population vs. patients who were excluded at their most recent visit to the hospital pre-pandemic.

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| --- | --- | --- | --- |
| **Characteristic** | **All excluded patients** **(n=33)** | **All included patients (n=83)** | **P-value** |
| Age in years, mean (SD) | 12.2 (3.9) | 11.2 (4.6) | 0.24 |
| Sex, female (%) | 20 (61) | 43 (52) | 0.39 |
| Ethnicity, Dutch (%) | 22 (67) | 56 (68) | 0.80 |
| Socioeconomic status z-score, mean (SD) | -0.1 (1.3) | -0.1 (1.2) | 1.00 |
| Living conditions, urban, n (%) | 28 (85) | 65 (78) | 0.43 |
| BMI SDS, mean (SD) | +3.8 (1.0) | +3.8 (1.0) | 0.65 |
| Signs of insatiable behavior, n (%) | 13 (39) | 38 (46) | 0.53 |
| Intellectual disability/developmental delay, n (%) | 9 (27) | 26 (31) | 0.67 |
| Autism, n (%) | 4 (12) | 14 (17) | 0.52 |
| Psychosocial problems, n (%) | 15 (46) | 46 (55) | 0.33 |
| *Abbreviations: BMI, body mass index; SD, standard deviation; SDS, standard deviation score; COVID-19, coronavirus disease 2019*  |

Table S2. Characteristics of the patients who participated in the telephone interviews vs. those that did not at their most recent visit to the hospital pre-pandemic.

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| **Characteristic** | **Patients who participated in the telephone interviews** **(n=75)** | **Patients who did not participate in the telephone interviews** **(n=8)** | **P-value** |
| Age in years, median (IQR) | 10.5 (7.6 – 15.2) | 11.0 (6.5 – 15.7) | 0.99 |
| Sex, female (%) | 39 (52) | 4 (50) | 1.00 |
| Ethnicity, Dutch (%) | 50 (69) | 6 (75) | 1.00 |
| Socioeconomic status z-score, median (IQR) | +0.0 (-0.7 – +0.7) | +0.4 (-0.1 – +1.1) | 0.17 |
| Living conditions, urban, n (%) | 59 (79) | 6 (75) | 1.00 |
| BMI SDS, median (IQR) | +4.0 (+3.2 – +4.4) | +3.6 (+3.0 – +3.9) | 0.40 |
| Signs of insatiable behavior, n (%) | 34 (45) | 4 (50) | 1.00 |
| Intellectual disability/developmental delay, n (%) | 23 (31) | 3 (38) | 0.70 |
| Autism, n (%) | 13 (17) | 1 (13) | 1.00 |
| Psychosocial problems, n (%) | 40 (53) | 6 (75) | 0.29 |
| *Abbreviations: BMI, body mass index; SD, standard deviation; SDS, standard deviation score; COVID-19, coronavirus disease 2019*  |

Table S3. Characteristics at their most recent visit to the hospital pre-pandemic of the patients who filled out the Dutch Eating Behavior-Child version (DEBQ-C) questionnaire vs. those that did not.

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| **Characteristic** | **Patients who filled out the DEBQ-C** **(n=59)** | **Patients who did not fill out the DEBQ-C** **(n=24)** | **P-value** |
| Age in years, median (IQR) | 10.2 (7.6 – 15.5) | 11.5 (7.1 – 15.0) | 0.80 |
| Sex, female (%) | 32 (54) | 11 (46) | 0.49 |
| Ethnicity, Dutch (%) | 43 (75) | 13 (54) | 0.06 |
| Socioeconomic status z-score, median (IQR) | +0.1 (-0.5 – +0.8) | +0.0 (-1.1 – +0.4) | 0.20 |
| Living conditions, urban, n (%) | 47 (80) | 18 (75) | 0.64 |
| BMI SDS, median (IQR) | +3.8 (+3.0 – +4.4) | +3.9 (+3.3 – +4.5) | 0.42 |
| Signs of insatiable behavior, n (%) | 31 (53) | 7 (29) | 0.053 |
| Intellectual disability/developmental delay, n (%) | 20 (34) | 6 (25) | 0.43 |
| Autism, n (%) | 12 (20) | 2 (8) | 0.33 |
| Psychosocial problems, n (%) | 36 (61) | 10 (42) | 0.11 |
| *Abbreviations: BMI, body mass index; SD, standard deviation; SDS, standard deviation score; COVID-19, coronavirus disease 2019*  |

Table S4. Characteristics at their most recent visit to the hospital pre-pandemic of the patients who filled out the Dutch Physical Activity (PA) questionnaire vs. those that did not.

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| **Characteristic** | **Patients who filled out the Dutch PA questionnaire** **(n=55)** | **Patients who did not fill out the Dutch PA questionnaire** **(n=28)** | **P-value** |
| Age in years, median (IQR) | 10.2 (7.6 – 15.5) | 11.5 (7.1 – 15.0) | 0.88 |
| Sex, female (%) | 29 (53) | 14 (50) | 1.00 |
| Ethnicity, Dutch (%) | 40 (76) | 16 (57) | 0.09 |
| Socioeconomic status z-score, median (IQR) | +0.0 (-0.6 – +0.8) | +0.1 (-1.0 – +0.6) | 0.52 |
| Living conditions, urban, n (%) | 44 (80) | 21 (75) | 0.60 |
| BMI SDS, median (IQR) | +3.9 (+3.0 – +4.4) | +3.8 (+3.3 – +4.4) | 0.84 |
| Signs of insatiable behavior, n (%) | 28 (51) | 10 (36) | 0.19 |
| Intellectual disability/developmental delay, n (%) | 19 (35) | 7 (25) | 0.38 |
| Autism, n (%) | 12 (22) | 2 (7) | 0.13 |
| Psychosocial problems, n (%) | 34 (62) | 12 (43) | 0.10 |
| *Abbreviations: BMI, body mass index; SD, standard deviation; SDS, standard deviation score; COVID-19, coronavirus disease 2019*  |

Table S5. Characteristics at their most recent visit to the hospital pre-pandemic of the patients who filled out the Pediatric Quality of Life Inventory (PedsQL) vs. those that did not.

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| **Characteristic** | **Patients who filled out the PedsQL****(n=49)** | **Patients who did not fill out the PedsQL****(n=34)** | **P-value** |
| Age in years, median (IQR) | 11.2 (8.1 – 16.1) | 10.3 (4.9 – 15.0) | 0.06 |
| Sex, female (%) | 24 (49) | 19 (54) | 1.00 |
| Ethnicity, Dutch (%) | 36 (77) | 20 (59) | 0.09 |
| Socioeconomic status z-score, median (IQR) | -0.0 (-0.6 – +0.7) | +0.1 (-1.0 – +0.7) | 0.73 |
| Living conditions, urban, n (%) | 38 (78) | 27 (79) | 0.84 |
| BMI SDS, median (IQR) | +4.0 (+3.2 – +4.4) | +3.6 (+2.7 – +4.2) | 0.11 |
| Signs of insatiable behavior, n (%) | 28 (51) | 10 (36) | 0.80 |
| Intellectual disability/developmental delay, n (%) | 19 (39) | 7 (21) | 0.08 |
| Autism, n (%) | 12 (24) | 2 (6) | 0.03 |
| Psychosocial problems, n (%) | 33 (67) | 13 (28) | 0.009 |
| *Abbreviations: BMI, body mass index; SD, standard deviation; SDS, standard deviation score; COVID-19, coronavirus disease 2019*  |