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*Research Article*

# Childhood Overweight/Obesity amidst Migration, Socioeconomic Factors, and Obesogenic Behaviors: Insights from the Growing Up in New Zealand Study

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Research on migration as a risk factor for obesity has produced inconsistent findings. Potential influence of migration as a social determinant of obesity has not been previously explored in New Zealand (NZ) as a migrant receiving country. This study aimed to investigate the link between maternal migration status and residential duration and childhood overweight/obesity risk in NZ, considering sociodemographic characteristics and obesogenic behaviors. Data on 5,506 4- to 5-year-old children and their mothers were taken from a large and nationally representative cohort study in NZ (the Growing Up in NZ Study). Multivariable logistic regression analyses were conducted to examine the association between maternal migration status, maternal residential duration, and child's overweight/obesity risk and the risk of adopting obesogenic behaviors independent of socioeconomic influences. A lower proportion of children of foreign-born mothers presented with overweight/obesity (26%) at age 5 years compared with children of NZ-born mothers (29.6%) (adjusted odds ratio (AOR) 0.85, 95% confidence interval (CI) (0.74, 0.98)). Maternal residential duration had no association with children's weight status among migrant families. Regarding obesogenic behaviors, the findings were mixed with children of foreign-born mothers having lower odds of consuming fast food (AOR 0.77, 95% CI (0.65, 0.91)) and soft drinks (AOR 0.87, 95% CI (0.76, 0.99)); however, they had higher odds of having inadequate sleep duration (AOR 2.25, 95% CI (1.85, 2.73)). The lower prevalence of overweight/obesity and lower odds of consuming fast foods and soft drinks among children of foreign-born mothers indicate potential protective factors within migrant families. However, the increased likelihood of inadequate sleep duration highlights an area of concern that warrants further attention and intervention. The findings emphasize the importance of considering diverse social determinants of health and specific risk factors when developing targeted interventions to address childhood overweight/obesity.

## 1. Introduction

The high prevalence of childhood obesity is a global public health concern [1]. Children with overweight and obesity are at risk of maintaining their weight status in adulthood, which, in turn, are associated with an increased risk of morbidity and premature mortality from noncommunicable diseases [2]. Apart from the enduring impacts of carrying excess body weight, children also experience immediate outcomes, including being stigmatized, facing bullying at school, undergoing social isolation, grappling with diminished self-esteem, depression, and feeling dissatisfied with their body image [3].

Migratory flows everywhere are of substantial interest when studying childhood obesity [4, 5], as migration is considered as a social determinant of health, which can positively or negatively impact individuals and their family's health and health behaviors (such as diet and nutritional, screen and sleep habits, and physical activities) [6–9].

Migration and settlement can be a stressful experience, posing an additional path to increased childhood obesity

[10, 11]. Migrants commonly encounter social seclusion and barriers in reaching essential health and social services, including programs aiding access to healthy foods, offering nutritional education, and facilitating physical activity opportunities for children [12]. Moreover, the stress induced by migration can result in notable changes in energy metabolism and increased intake of inexpensive, energy-dense and sugar-laden comfort foods within migrant households and, as a result, an escalated the likelihood of childhood obesity [13]. In line with this argument, an international literature review concerning how migration impacts the likelihood of obesity and diabetes in various ethnic populations has unveiled a greater occurrence of obesity in migrant communities in contrast to those residing in their native countries, confirming the role of environmental aspects such as diet and lifestyle habits, acculturation, and supporting convergence theories [14]. However, previous research on the link between migration and obesity risk is not always in favor of native-born groups with some reporting better weight outcomes for migrant families [15] or even no significant differences between migrant and nonmigrant families [16], highlighting the needs for further research in this field. Moreover, the potential role of the length of stay in the host country in decreased or increased risk of developing health issues such as unhealthy weight outcomes among migrant population is also contested [17].

Among developed nations, New Zealand (NZ) is ranked third highest for childhood obesity rates [18], with around one in three children aged 2–14 years (30.8%) identified with overweight or obesity (OW/OB) in 2022, up from 29.9% in 2019/2020 [19]. NZ's immigrant population is also growing with over a quarter of the population (27.4%) born overseas in 2018, up from 25.2% in 2013 [20].

Previous research in NZ has found significant disparities in overweight/obesity prevalence rates among different ethnic groups, with Pacific and Māori (indigenous people of NZ) children consistently identified as having the highest overweight/obesity rates (61.7% and 39.6%, respectively) relative to their European (26.5%) and Asian (22.1%) counterparts [19]. These differences are often attributed to a complex set of socioeconomic, cultural, behavioral, and environmental factors that can vary across different populations [21].

While there is partial overlap between immigrants and ethnic subgroups (e.g., some ethnic minorities may face similar social exclusion and socioeconomic disadvantages as immigrants), internationally, the health needs of these two groups (ethnic minorities vs. immigrant groups) are often dealt with separately by researchers and policymakers. Recognizing the unique experiences and challenges facing each group, and tailoring interventions, accordingly, can lead to more effective and equitable health outcomes for all subpopulations [22].

Despite the alarming prevalence of overweight/obesity and associated serious health consequences, there is a paucity of evidence in New Zealand, as a migrant receiving country, regarding the impact of migration background and residency duration of parents on children's overweight/obesity risk. The potential contributing factors regarding probable discrepancy such as socioeconomic characteristics or differences in the adoption of unhealthy weight-related or obesogenic behaviors have also not been explored in the NZ context.

We aimed to address these gaps by analyzing data from NZ largest contemporary child cohort study (Growing Up in New Zealand (GUiNZ) study). Our research pursued three primary objectives: (1) to contrast the prevalence of OW/OB among children of NZ-born mothers with those of foreign-born mothers, while controlling for socioeconomic factors, (2) to examine potential impact of maternal length of stay/residence in the country on OW/OB risk among migrant population by exploring differences in OW/OB prevalence rates between children of recent migrants and those of settled migrants, and (3) to investigate the influence of well-known behavioral risk factors (referred as obesogenic behaviors) on potential OW/OB disparities identified in the first part of the study.

## 2. Materials and Methods

*2.1. Participants.* Data on NZ children and their parents were collected as part of the GUiNZ study, a nationally representative longitudinal cohort study of children born in NZ between March 3, 2009 and May 14, 2010. During the recruitment period, 11% of all born children were enrolled, and the research group encompassed a wide range of ethnic backgrounds and indicators of socioeconomic position, making its findings applicable to all families with children in NZ at that time [23]. The GUiNZ methodology and study design details are described elsewhere [23]. We excluded children for whom data on weight and height were missing in the fifth data collection wave (DCW) ($n = 351$). To prevent interrelated observations, we restricted our sample to one child per mother, excluding 75 children where mothers gave birth to twins or triplets. This resulted in a sample size of 5,506 children and their mothers for this study.

## 3. Measures

### 3.1. The Outcomes of Interest

*3.1.1. Childhood Overweight/Obesity.* Trained interviewers objectively measured the weight and height of cohort children at 54 months of age, following a standardized protocol that involved removing shoes, hats, jackets, or jumpers, and taking two measurements for accuracy. Age- and sex-specific body mass index (BMI) was computed as weight divided by the square of height ($kg/m^2$). Childhood overweight/obesity was determined based on the International Obesity Task Force (IOTF) age- and sex-specific criteria (with overweight and obesity defined as BMI values above 25 and 30 $kg/m^2$, respectively, extrapolated from young adults aged 18 years to children) [24].

*3.1.2. Child's Obesogenic Behaviors.* Four key mother-reported obesogenic behaviors were assessed, including excessive screen time, inadequate sleep duration, and frequent fast food and soft drink consumption.

*3.1.3. Screen Time.* Screen time was assessed at the age 54-month time point. The mother responded to the following questions about child's screen time:

Thinking about a usual weekday, approximately how many hours and minutes does your child spend at home:

(1) Watching television programming, including free-to-air, online, and pay TV, or DVDs either on TV or other media?

(2) Using electronic media, e.g., computer or laptop, including children's computer systems such as Leapfrog, iPads, tablets, smartphones, and any electronic gaming devices?

We summed the responses to these two questions to find the child's screen time in total. Following NZ Ministry of Health [25] guidelines for screen viewing limitations at age 2–5 years, total screen time was broken into a dichotomous variable representing children whose screen-viewing time was limited to less than 1 hr per day (met the guideline) versus those who viewed 1 hr or more per day (exceeded the guideline so defined as excessive screen time).

*3.1.4. Night Sleep Duration.* At the age of 45-month time point, mothers were asked, "On average, how much time does your child spend asleep at night in total?" Responses were converted to a dichotomous variable that distinguished children who slept 10 hr or more per night versus those who slept less than 10 hr (defined as inadequate sleep duration). This cut-point follows NZ Ministry of Health [25] guidelines for sleep duration, which recommend preschoolers (3–4-year-old) sleep equal or greater than 10 hr per day.

*3.1.5. Fast Food Consumption.* At the age of 54-month time point, mothers were asked, "Can you tell me how often he/she has eaten takeaways from places like McDonald's, KFC, Burger King, pizza shops, or fast-food outlets over the last 4 weeks?" Responses were converted into two categories: frequent (at least once a month) and none.

*3.1.6. Soft Drink Consumption.* At the age of 54-month time point, mothers were asked, "Can you tell me how often (he/she) has eaten soft drinks and energy drinks over the last 4 weeks?" Responses were converted into two categories: frequent (at least once a month) and none.

*3.2. Main Exposure of Interest: Immigration Status.* All children included in the study cohort were born in NZ. To identify migration status, maternal rather than children's immigration status was used. Recent versus settled migrants were identified based on maternal residential duration. Following the NZ Ministry of Business, Innovation and Employment [26], 5 years' residency was chosen as a benchmark to differentiate between settled and recent migrants with mothers who had resided in the country for more than 5 years at the time of the antenatal DCW classified as settled migrants and those with 5 or less years' residency classified as recent migrants.

*3.3. Other Exposures of Interest (Covariates): Sociodemographic Characteristics.* Potential covariates in multivariable analyses were measured during different DCWs from antenatal to fifth, including child's sex, maternal age at pregnancy, maternal education (categorized into four groups: no secondary school, secondary school, diploma/trade, tertiary), language spoken at home (English, non-English), household annual income groups (four categories: ≤$70k, $70.1–$100k, $100.1–$150k, >$150k), receipt of income-tested benefit (yes/no), area-level deprivation index (NZDep2013), having a partner, having siblings, and high birth weight (no if <4 kg, yes if ≥4 kg [27]).

The NZDep2013 index, derived from the household's geographical location, was used to measure neighborhood area deprivation. This index is measured at the mesh block level (the smallest census tract unit) by combining census data relating to seven domains (including income, homeownership, employment, qualifications, family structure, housing, access to transport and communications) [28]. The score is organized into deciles, where decile 1 represents the least deprived 10% of areas in NZ, and decile 10 indicates the most deprived 10% of areas in NZ. For the purpose of analysis, deprivation scores were categorized into three groups: low deprivation (deciles 1–3), medium (deciles 4–7), and high deprivation areas (deciles 8–10).

## 4. Analytical Procedures

All analyses were conducted using R. Sociodemographic characteristics of the whole sample and stratified by maternal migration status and residential duration are shown in Table 1. Chi-square tests were used to examine whether maternal migration status and residential duration were associated with sociodemographic characteristics (Table 1).

The prevalence rate of overweight/obesity by maternal migration status and residential duration is shown in Table 2. The bivariate associations between maternal migration status and residential duration and children's overweight/obesity at age 5 years were also explored using univariate logistic regression models with results presented as unadjusted odds ratios (ORs) with 95% confidence intervals (CIs) (Table 2).

Then, to determine if the noted differences in the prevalence rates of overweight/obesity between children of migrant and nonmigrant mothers found in the univariate analyses remained significant after controlling for sociodemographic characteristics, the following steps were taken:

(1) First, the bivariate association between each sociodemographic characteristic and children's overweight/obesity status at age 5 years was explored using univariate logistic regression models with results presented as unadjusted ORs with 95% CIs (Table 1).

(2) Second, multivariable logistic regression analyses were conducted, with maternal migration status and sociodemographic characteristics with significant association with overweight/obesity in stage 1 included as the exposures and child overweight/obesity as the outcome variable. The results were presented as adjusted odds ratios (AORs) with 95% CIs (Table 2). The same analyses were repeated with maternal residential duration as the main exposure variable (Table 2). Analyses on maternal residential duration were restricted to foreign-born mothers.

(3) Finally, to explore the potential role of obesogenic behaviors (inadequate night sleep duration, excessive

Table 1: Distribution of sociodemographic characteristics for the whole sample and by maternal migration status and residential duration.

| Sociodemographic characteristics (data collection wave) | Total sample ($n = 5{,}506$) $n$ (%) | Maternal migration status | | | Maternal residential duration | | | Association with OW/OB* for the whole sample OR(95% CI) |
|---|---|---|---|---|---|---|---|---|
| | | NZ-born mothers $n = 3{,}676$ $n$ (%) | Foreign-born mothers $n = 1{,}830$ $n$ (%) | $p$-Value for $\chi^2$ | Recent migrants ($n = 784$) $n$ (%) | Settled migrants ($n = 1{,}035$) $n$ (%) | $p$-Value for $\chi^2$ | |
| Child's sex (DCW1) | 2 | | | | | | | |
| Male | 2,838 (51.5) | 1,880 (51.1) | 958 (52.3) | 0.414 | 406 (51.8) | 546 (52.8) | 0.717 | Ref |
| Female | 668 (48.5) | 1,796 (48.9) | 872 (47.7) | | 378 (48.2) | 489 (47.2) | | 1.13 (1.00, 1.27) |
| Maternal age group (years) at pregnancy(DCW0) | | | | | | | | |
| ≤20 | 328 (6) | 279 (7.6) | 49 (2.7) | | 19 (2.4) | 28 (2.7) | | Ref |
| 21–30 | 2,251 (40.9) | 1,464 (39.8) | 787 (43) | **0.001** | 402 (51.3) | 383 (37) | **0.001** | **0.66 (0.52, 0.84)** |
| 31–40 | 2,784 (50.6) | 1,842 (50.1) | 942 (51.5) | | 348 (44.4) | 588 (56.8) | | **0.50 (0.40, 0.64)** |
| >40 | 143 (2.6) | 91 (2.5) | 52 (2.8) | | 15 (1.9) | 36 (3.5) | | **0.48 (0.31, 0.74)** |
| Maternal education (DCW0) | | | | | | | | |
| No secondary | 317 (5.8) | 274 (7.5) | 43 (2.4) | | 10 (1.3) | 33 (3.2) | | Ref |
| Secondary | 1,209 (22) | 801 (21.8)1 | 408 (22.4) | **0.001** | 199 (25.4) | 206 (19.9) | **0.0030** | **0.75 (0.58, 0.97)** |
| Diploma | 1,675 (30.5) | 149 (31.3)1 | 526 (28.9) | | 219 (28.0) | 306 (29.6) | | **0.62 (0.48, 0.79)** |
| Tertiary | 2,292 (41.7) | 447 (39.4) | 845 (46.4) | | 355 (45.3) | 488 (47.2) | | **0.37 (0.29, 0.47)** |
| Languages spoken at home (DCW0) | | | | | | | | |
| English | 4,573 (83.2) | 3,616 (98.4) | 957 (52.5) | **0.001** | 329 (42) | 622 (60.2) | **0.001** | Ref |
| Non-English | 926 (16.8) | 60 (1.6) | 866 (47.5) | | 454 (58) | 412 (39.8) | | 1.02 (0.87, 1.19) |
| Area deprivation level (DCW5) | | | | | | | | |
| Low (1–3) | 1,721 (31.4) | 1,198 (32.7) | 523 (28.8) | | 214 (27.4) | 309 (30.1) | | Ref |
| Medium (4–7) | 2,005 (36.6) | 1,345 (36.8) | 660 (36.3) | **0.001** | 297 (38) | 359 (35) | 0.321 | **0.48 (0.42, 0.56)** |
| High (8–10) | 1,751 (32) | 1,116 (30.5) | 635 (34.9) | | 270 (34.6) | 358 (34.9) | | **0.38 (0.33, 0.44)** |
| Household income group (NZD) (DCW5) | | | | | | | | |
| ≤$70k | 1,591 (32.4) | 1,052 (31.4) | 539 (34.6) | | 234 (35.9) | 301 (33.6) | | Ref |
| $71k–$100k | 1,078 (22) | 721 (21.5) | 357 (22.9) | **0.024** | 163 (25) | 193 (21.5) | **0.006** | **0.82 (0.62, 0.97)** |
| $101k–$150k | 1,234 (25.2) | 866 (25.9) | 368 (23.6) | | 158 (24.2) | 208 (23.2) | | **0.70 (0.59, 0.83)** |
| >$150k | 1,003 (20.4) | 710 (21.2) | 293 (18.8) | | 97 (14.9) | 195 (21.7) | | **0.58 (0.49, 0.70)** |
| Receipt of income-tested benefit (DCW4) | | | | | | | | |
| Yes | 1,049 (19.1) | 747 (20.4) | 302 (16.6) | **0.001** | 107 (13.7) | 192 (18.6) | **0.007** | Ref |
| No | 4,444 (80.9) | 2,922 (79.6) | 1,522 (83.4) | | 672 (86.3) | 842 (81.4) | | **0.64 (0.56, 0.74)** |
| Having a partner (DCW5) | | | | | | | | |
| Yes | 4,972 (90.4) | 3,272 (89.1) | 1,700 (93) | **0.001** | 748 (95.7) | 943 (91.1) | **0.001** | Ref |
| No | 530 (9.6) | 402 (10.9) | 128 (7) | | 34 (4.3) | 92 (8.9) | | **0.71 (0.59, 0.86)** |
| High birth weight (>4 kg) (DCW1) | | | | | | | | |
| Yes | 969 (17.6) | 669 (18.2) | 300 (16.4) | 0.112 | 106 (13.6) | 192 (18.6) | **0.005** | Ref |
| No | 4,533 (82.4) | 3,007 (81.8) | 1,526 (83.6) | | 675 (86.4) | 842 (81.4) | | **2.1 (1.82, 2.42)** |
| Having siblings (DCW5) | | | | | | | | |
| Yes | 4,847 (88.1) | 3,302 (89.9) | 1,545 (84.5) | **0.001** | 627 (80.2) | 908 (87.7) | **0.001** | Ref |
| No | 655 (11.9) | 372 (10.1) | 283 (15.5) | | 155 (19.8) | 127 (12.3) | | 1.01 (0.85, 1.25) |

*OW/OB, overweight/obesity. Bold values indicate statistical significance, suggesting that the results of the statistical tests show significant differences or associations. Ref, reference groups—these groups are used as benchmarks to assess the associations of other groups with the outcome variable in comparison to them.

Table 2: Association between maternal migration status and residential duration with child's weight status.

| Exposure | | *N* | BMI Mean (SD) | Prevalence of OW/OB* *n* (%) | Association with OW/OB* | |
|---|---|---|---|---|---|---|
| | | | | | OR (95% CI) | AOR** (95% CI) |
| Maternal migration status | NZ-born mothers | 3,676 | 16.81 (1.91) | 1,089 (29.6) | Ref | Ref |
| | Foreign-born mothers | 1,830 | 16.59 (2.23) | 476 (26) | **0.84 (0.74, 0.95)** | **0.85 (0.74, 0.98)** |
| Maternal residential duration | Recent migrants | 784 | 16.42 (2.17) | 192 (24.5) | Ref | Ref |
| | Settled migrants | 1,035 | 16.70 (2.22) | 279 (27) | 1.14 (0.92, 1.41) | 1.05 (0.82, 1.36) |

*OW/OB, overweight/obesity; **AOR, adjusted odds ratio (adjusted for mother's age at pregnancy, maternal education, household deprivation level, household income, receipt of income benefit, having partner, and child's birth weight and sex). Bold values indicate statistical significance, suggesting that the results of the statistical tests show significant associations. Ref, reference groups—these groups are used as benchmarks to assess the associations of other groups with the outcome variable in comparison to them.

screen time, and frequent fastfood and soft drink consumption) in the noted differences in the risk of overweight/obesity among children with migrant and nonmigrant background (if found in previous analyses), differences in obesogenic behaviors between two groups were assessed through the following steps.

(4) Associations between obesogenic behaviors and the risk of overweight/obesity were assessed using univariate logistic regression and the results are shown in Table 3. The included variables have been widely considered as main obesogenic behaviors in the field of obesity research [29].

(5) Characteristics of the whole sample and stratified by maternal migration status regarding obesogenic behavior are shown in Table 3.

(6) Univariate and multivariable logistic regression analyses were conducted, with maternal migration status included as the exposure and obesogenic behaviors as the outcome variable. The results were presented as ORs and AORs after controlling for covariates with 95% CIs (Table 3).

## 5. Results

*5.1. Sociodemographic Characteristics of the Study Sample by Maternal Migration Status and Maternal Residential Duration.* Of the 5,506 mothers, 33.2% ($n = 1830$) were born outside NZ. A higher proportion of foreign-born mothers had tertiary education, spoke a language other than English at home, lived with a partner, lived in highly deprived areas, and in a household with an income of less than $70k than NZ-born mothers, while a higher proportion of NZ-born mothers reported the receipt of income-tested benefits. A lower proportion of foreign-born mothers aged less than 20 years at the time of pregnancy and had more than one child (study child had siblings) compared with the NZ-born group.

No significant differences were found between recent migrants and settled migrants regarding the deprivation index. However, a higher proportion of settled migrants had diploma-level and tertiary educations, received income-tested benefits, had more than one child, and earned more than $150k compared with the recent migrants. A higher proportion of recent migrants spoke a language other than English at home and lived with a partner compared with settled migrants (Table 1).

*5.2. Maternal Migration Status and Residency Duration and Child's Weight Status.* A higher proportion of children of NZ-born mothers were identified with overweight/obesity (29.6%) compared with children of foreign-born mothers (26%, $p < 0.005$) (Table 2). Maternal residential duration had no significant association with children's weight status, and children of both recent and settled migrants experienced a lower rate of overweight/obesity (24.5% and 27%, respectively) compared with children of NZ-born mothers (29.6%) (Table 2).

The results of multivariable logistic regressions indicated that after adjustment for sociodemographic characteristics, children of foreign-born mothers had lower odds of overweight/obesity compared with the children of NZ-born mothers (Table 2). No significant difference was found between settled and recent migrants in terms of their children's risk of overweight/obesity (Table 2).

*5.3. Association between Maternal Migration Status and Obesogenic Behaviors.* The results of multivariable logistic regression modeling indicated that after adjustment for sociodemographic characteristics, children of foreign-born mothers had lower odds of consuming fast food and soft drinks (Table 3) but higher odds of reporting inadequate night sleep duration (<10 hr) (Table 3). No significant difference was found between two groups regarding screen time (Table 3).

## 6. Discussion

This study aimed to investigate the prevalence of overweight/obesity in preschool-aged children (4–5 years old) living in NZ by their mother's migration status and residential duration in the country. Potential roles of obesogenic behaviors as factors contributing to the noted differences in the prevalence rates of overweight/obesity among children of foreign-born mothers versus those of native-born mothers were also explored.

Our findings indicated lower odds of developing overweight/obesity among children of foreign-born mothers compared to their counterparts with NZ-born mothers. The noted differences remained significant after adjustment for socioeconomic differences. This finding is important particularly that children of foreign-born mothers were more likely to live in the most socioeconomically-deprived areas or in a household with an

Table 3: Prevalence of obesogenic behaviors for the whole sample and by maternal migration status and their associations with OW/OB and maternal migration status.

| Child's obesogenic behaviors | Whole sample ($n = 5{,}506$) $n$ (%) | Association with OW/OB* OR (95% CI) | Maternal migration status | | Association between maternal migration status and child's obesogenic behaviors | |
|---|---|---|---|---|---|---|
| | | | NZ-born mothers $n = 3{,}676$ $n$ (%) | Foreign-born mothers $n = 1{,}830$ $n$ (%) | OR (95% CI) | AOR** (95% CI) |
| Fast food | | | | | | |
| None | 829 (15.1) | Ref **1.54 (1.29, 1.85)** | 497 (13.5) | 332 (18.2) | Ref ***0.70 (0.61, 0.82)** | Ref ***0.77 (0.65, 0.91)** |
| ≥1/month | 4,673 (84.9) | | 3,178 (86.5) | 1,495 (81.8) | | |
| Soft drink | | | | | | |
| None | 2,637 (47.9) | Ref **1.61 (1.43, 1.81)** | 1,721 (46.8) | 916 (50.2) | Ref **0.87 (0.78, 0.98)** | Ref **0.87 (0.76, 0.99)** |
| ≥1/month | 2,846 (52.1) | | 1,954 (53.2) | 910 (49.8) | | |
| Screen time | | | | | | |
| <1 hr | 1,045 (19.1) | Ref **1.51 (1.29, 1.79)** | 676 (18.5) | 369 (20.2) | Ref 0.89 (0.78, 1.03) | Ref 0.94 (0.81, 1.10) |
| ≥1 hr | 4,440 (80.9) | | 2,984 (81.5) | 1,456 (79.8) | | |
| Night sleep duration | | | | | | |
| ≥10 hr | 4,864 (88.4) | Ref **1.61 (1.36, 1.91)** | 3,345 (91.1) | 1,519 (83.1) | Ref **2.08 (1.76, 2.46)** | Ref **2.25 (1.85, 2.73)** |
| <10 hr | 636 (11.6) | | 327 (8.9) | 309 (16.9) | | |

*OW/OB, overweight/obesity; **adjusted for mother's age at pregnancy, maternal education, household deprivation level, household income, receipt of income benefit, having partner, and child's birth weight and gender; ***children of NZ-born mothers were considered as the reference group across all obesogenic behaviors. Bold values indicate statistical significance, suggesting that the results of the statistical tests show significant differences or associations. Ref, reference groups—these groups (children of NZ-born mothers in this table) are used as benchmarks to assess the associations of other groups with the outcome variable in comparison to them.

income of less than $70k than children of NZ-born mothers, two factors with established link with OW/OB [30]. Longer residency duration in NZ did not significantly alter the odds of overweight/obesity among children of recent versus those of settled migrants. Further, our findings were mixed regarding differences in obesogenic behaviors, as potential contributors to the noted differences in overweight/obesity rates, with consumption of unhealthy foods (fast foods and soft drinks) to be more common among children of NZ born mothers, while inadequate sleep duration, another risk factor for childhood obesity, was more common among children of foreign-born mothers.

The lower odds of overweight/obesity among children in migrant families found in this research is inconsistent with some previous studies, which found an association between second-generation migration background and the higher odds of obesity [31], but consistent with others that showed better health outcomes for children in migrant families [32]. Our findings on lower risk of OW/OB among children of migrant families despite economic disadvantages are supported by the "healthy migrant" effect, which refers to the similar or better health status among migrants than comparable natives, despite many risk factors for adverse health, such as decreased access to health insurance or socioeconomic challenges [33, 34]. The healthy migrant effect is based on the migrant selectivity assumption: that is, those who choose to migrate tend to differ from their home country population in a significant way. Specifically, they are more likely to have better socioeconomic characteristics (e.g., better human capital such as higher education, better occupational skills, more favorable personality characteristics and personal attitudes) and tend to be healthier, on average, than the general population in their country of origin, all of which are prerequisites for successful integration in the labor market and the host society, which may contribute to adopting healthy lifestyles and habits transferable to their next generation.

Moreover, health selection criteria imposed by NZ's migration policy may further accentuate the positive self-selection of the health of potential immigrants. The immigration policy of NZ encompasses various goals aimed at generating concrete social and economic advantages. As a result, those applicants who meet NZ's selection criteria and have high human capital, including good health and character, language competency, comparable work experiences and skilled employment, and tertiary qualification [35], are more likely to be granted a residency visa.

The healthy migrant effect has been shown in international research to be undermined by the Healthy Immigrant Paradox (HIP), where an immigrant's health deteriorates over time in the host country and gradually aligns with or even worse than that of the native population. This health deterioration can be seen in first-generation migrants over time or sometimes in the next generations [34].

This health deterioration is usually explained through acculturation and lifestyle changes among migrant population—ironically suggesting that successful integration into the host society may produce negative health outcomes. Migrants to Western countries, over time and generations, tend to forsake their customary dietary practices in favor of adopting Westernized eating patterns characterized by elevated levels of fat, sugar, and salt, as well as moving toward sedentary lifestyles and less physical activity [36]. However, our findings showed a different pattern among children of immigrant mothers to NZ where children of settled migrants who resided in the country more than 5 years had similar odds of developing OW/OB as children of recent migrants who resided in the country less than 5 years.

These findings may partially be attributed to the fact that in our sample, settled migrants had higher education and income levels than recent migrants, both of which are associated with lower odds of having a child with overweight/obesity. These characteristics might have protected them against negative aspects of acculturation and moving toward those lifestyles that accelerate the risk of having a child with overweight/obesity, like increased consumption of fast food and soft drink.

Moreover, the finding that children of foreign-born mothers had lower odds of frequent fast food and soft drink consumption than their counterparts of NZ-born mothers is also in contrast to HIP. Given the well-known association between regular fast food and soft drink intake and elevated risk of childhood overweight/obesity found in the current study, as well as in other studies [37–39], it is likely that lower odds of overweight/obesity among children of migrant families is driven by lower consumption of these high-calorie, low-nutrient-dense foods. Thus, it seems that among this cohort of NZ children, weight status and food and drink behaviors of children of migrant mothers were not, at least by age five years, negatively affected by acculturation.

Unhealthy foods are widely promoted, more accessible, and often cheaper than healthier alternatives in NZ [40]. Unhealthy food and drinks outlets target children, population groups on low incomes and those living in deprived neighborhoods in NZ and other high-income countries [41]. Sustainable education, intervention, and prevention strategies and action plans addressing complex relationships between each of these characteristics and obesogenic environment are required to tackle childhood obesity at the population level.

While not explored in the current study, research also found that foreign-born mothers had lower (healthier) pre-pregnancy weight than U.S.-born mothers that might have contributed to their children's lower risk of obesity [42].

Conversely, children of foreign-born mothers had higher odds of inadequate night sleep duration compared with children of NZ-born mothers, which is a well-known obesogenic behavior with significant link with overweight/obesity risk as found in the current study and previous studies [21, 43, 44]. This finding highlights a critical need to promote adherence to recommended sleep guidelines among immigrant families. This may include providing information on the importance of developing healthy sleep practices for themselves and children, creating bedtime routines, recognizing sleep problems, and addressing common sleep challenges faced by children.

## 7. Conclusion

In summary, we found that children of migrant mothers had lower rates of overweight/obesity compared with children of

NZ-born mothers. Lower consumption of fast food and soft drinks among children of foreign-born mothers may partially explain better weight status among their children. However, migrant children, despite the lower odds of overweight/obesity, were worse off in insufficient night sleep duration.

Health education and nutritional support by implementing comprehensive health education programs targeting all families (particularly the native born) to promote healthy eating habits and discourage the consumption of fast food and sugary drinks are recommended. This can include nutritional workshops, culturally-sensitive resources, and partnerships with community organizations to provide access to affordable, nutritious food options, as well as school-based interventions.

Higher odds of insufficient night sleep duration among children of migrant families provides imperative to development of sleep education programs specifically tailored for migrant families. These education programs may contribute to the overall well-being of children and promote equitable health outcomes for all children within the community. Overall, our findings emphasize the importance of considering diverse social determinants of health and specific risk factors when developing targeted interventions to address childhood overweight/obesity.

## Data Availability

The datasets analyzed during the current study are not publicly available, but access request can be submitted to GUiNZ data access committee.

## Additional Points

*Strengths, Limitations, and Future Studies*. This study addressed a gap in research on associations between maternal migration status, maternal residential duration, and the risk of childhood overweight/obesity in New Zealand (NZ). To our knowledge, previous research has focused on ethnicity, and this study was the first to explore the link between maternal migration status and childhood overweight/obesity in NZ. Exploring the potential roles of commonly studied obesogenic behaviors in the noted difference was also a new contribution of our study. The other strengths include the usage of data on a large and nationally representative sample of children, focusing on the preschool-aged children, objective measure of overweight/obesity, and inclusion of a wide range of obesogenic behaviors and covariates. Nevertheless, this study had some limitations. First, all the children of this cohort were born in NZ, which means that we were unable to assess obesity disparity among the first generation of foreign-born versus NZ-born children from migrant families. As a result, we applied maternal place of birth as an indicator for migration status. Second, one of the most critical obesogenic behaviors, physical activity, was not explored as there were no appropriate questions and scoring instructions in GUiNZ dataset for children by 4–5 years of age. This is of particular interest as a previous systematic review has revealed a deficit of sufficient physical activity among migrant children [45]. Third, while we benefited from utilizing a longitudinal dataset to capture a wide range of exposure and outcome variables, our analytical approach was based on a cross-sectional examination. Future research employing a longitudinal approach is recommended to further investigate the dynamics of the variables studied and to provide more robust insights into changes over time. Fourth, an 8-year interval between data collection and analysis means the most current trends and developments in migration, obesity, and obesogenic behaviors may have not been fully captured in this research. Therefore, our findings should be interpreted within the context of the data's original time frame (2009–2015). Finally, the deliberate exclusion of ethnicity as an exposure variable aimed to mitigate the risk of multicollinearity and confounding effects, allowed us to more precisely isolate and analyze the impact of migration background on childhood obesity. However, future research may delve into these intertwined factors to unveil the intricate relationships between migration status and ethnicity and to provide a deeper intersectional understanding of their combined influence on childhood obesity. We also encourage future research to investigate other obesogenic behaviors and contributors to overweight/obesity among children of foreign-born and NZ-born mothers (e.g., sedentary behaviors, mealtime and other household routines, and quality of sleep). Examining intersection of social and environmental factors with migration status is also crucial, given research indicating their significant roles in promoting childhood obesity. Interdisciplinary collaborations between researchers, healthcare professionals, and community organizations are required to identify and address underlying social determinants of childhood obesity, such as cultural factors, socioeconomic influences, and environmental determinants.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Authors' Contributions

MR: conceptualization, methodology, statistical analysis, and writing original draft. AB: conceptualization, review, editing, and supervision. LH: conceptualization, methodology, review, editing, and supervision. All authors contributed to the article and approved the submitted version.

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