Growing Up in New Zealand

Now We Are Twelve

Life in early adolescence

Now We Are 12:

Young People's Experiences of Puberty at Aged 12

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1. Introduction

A summary of the *Growing Up in New Zealand* study and the 12-year data collection wave (DCW), including data collection, methodology, and cohort description, can be found in the Introduction & Methodology reports.

2. What do we know about puberty?

Puberty is a dynamic period of hormonal and physical development whereby a child's body transitions to an adult body capable of reproduction. During puberty, increased production of gonadal hormones, such as androgens, oestrogens, and progesterone, drives the development of secondary sex characteristics (1-4). This typically includes growth spurts (increased height), skin changes (e.g., pimples, acne, oily skin), changes to body odour, growth of axillary (armpit) and pubic hair, and the darkening of genitals (3-7). Most males will also develop deeper voices, become more muscular, begin growing facial hair, and their genitalia will become enlarged (3-4, 7-8). Meanwhile, most females will develop breasts, their hips will broaden, and they will start menstruating (3-4, 7, 9). Consequently, *Growing Up in New Zealand* investigated young people's experiences of puberty according to sex assigned at birth.

The age at which puberty occurs depends on complex interactions between factors such as sex, genetics, endocrine regulation, nutrition, and physical activity (6). Most females and males begin puberty between the ages of 8-13 and 9-14, respectively (10), and nearly 50% of females in Aotearoa, New Zealand start menstruating before attending high school (11). Puberty is a significant transitional period for many young people and can impact numerous psychosocial outcomes (1, 12-14). In particular, early puberty can sometimes create a gap between biological and social maturity, potentially resulting in unrealistic expectations of young people and related mental health issues, regardless of sex at birth (1, 12). Early-maturing females are typically at increased risk of these outcomes (15), and early puberty may also exacerbate the effects of discriminatory ethnic stereotypes experienced by some Māori and Pacific young people (1). However, early puberty does not always have negative consequences and may result in young people being perceived with higher regard in some contexts (1). Attitudes towards puberty are, therefore, contextually dependent and can impact young people's feelings about the changes their bodies are undergoing. Thus, young people must be supported to navigate puberty in a positive and healthy way.

In addition to sex assigned at birth, *Growing Up in New Zealand* also investigated how young people's experiences of puberty differed according to self-reported ethnicity. Previous research has suggested that Māori and Pacific young people reach puberty earlier than Europeans (2). Several studies have also demonstrated that puberty typically begins earlier and progresses faster among

females who experience greater early-life adversity (16). In particular, recent evidence has suggested that females born in neighbourhoods of concentrated ethnic and economic privilege are less likely to experience early puberty than females born in neighbourhoods of concentrated disadvantage (17). Therefore, a young person's ethnicity may affect pubertal timing, justifying why it was important for *Growing Up in New Zealand* to investigate the topic in relation to ethnicity.

Puberty and poor access to period products are associated with lower school attendance, engagement, and participation in extracurricular activities (13). Accordingly, the Ministry of Education has introduced a new programme called *Ikura/Manaakitia te whare tangata,* providing free period products in schools[1] (13, 18). The programme currently serves 2130 schools and kura nationwide, representing approximately 96% of estimated menstruating students (13). Phase 1 of the programme was rolled out in June 2021, with Phase 2 beginning in early 2022. The *Growing Up in New Zealand* 12-year DCW coincided with the end of Phase 1 and the beginning of Phase 2, when access to and the availability of period products in schools may have been less extensive, limiting our results' applicability to the programme's current state.

Asking the *Growing Up in New Zealand* cohort about puberty allowed us to estimate puberty stages among 12-year-olds in Aotearoa, New Zealand and examine early and late development trends. We also captured young people's feelings about the processes their bodies are undergoing, providing insights that can inform a more inclusive Relationships and Sexuality Education (RSE) curriculum. Females were also asked about their access to free period products at school, giving insight into the success of *Ikura/Manaakitia te whare tangata*.

3. What can *Growing Up in New Zealand* add?

This report will examine young people's experiences of puberty using data from the 12-year DCW of the *Growing Up in New Zealand* longitudinal study. We investigated the cohort's pubertal development at aged 12 to determine whether this differed by sex assigned at birth or self-reported ethnicity. We also explored how young people felt about the changes happening to their bodies, highlighting the diverse experiences of young people according to their sex and ethnicity. This report also describes the average age of first menstruation and use of free period products in schools among females who reported they had begun menstruating by aged 12.

[1] *Ikura/Manaakitia te whare tangata* is currently offered to all levels of state and state-integrated schools and kura in New Zealand (13). Most young people in the *Growing Up in New Zealand* cohort were in Year 7 and 8 during the 12-year DCW.

4. Research questions

Two main questions were addressed in this report.

- Research Question 1: What proportion of 12-year-olds have begun puberty, and does this differ by sex or ethnicity?
- Research Question 2: How are 12-year-olds feeling about the changes to their bodies with the onset of puberty, and does this differ by sex or ethnicity?

5. Key findings on puberty from the 12-year interviews

- Puberty questions were answered by 97.2% of young people in the *Growing Up in New Zealand* study, with a total of *n*=2231 males and *n*=2145 females responding to at least one of the pubertal development questions.
- The mean age of the cohort when these questions were asked was 12 years and four months, with approximately 30-40% of the cohort reporting that some aspects of puberty were underway.
- Almost half (45.6%) of all 12-year-old females had begun menstruating, and the mean age of first menstruation was 11.1 years (median 11 years).
- Over 41% of females who had started menstruating at aged 12 reported using free period products from school at least once (*n*=406/979), and 8% had used them often or during every period (*n*=79/979). However, 58.5% of females (*n*=573/979) who had begun menstruating had never used free period products from school.
- The mean puberty score for males was 1.77 (SD±0.54) and 2.48 (SD±0.68) for females, indicating that females were typically further along in their pubertal development than males at aged 12.
- More female participants were in the mid-, late-, and post-pubertal stages of pubertal development than male participants at aged 12, indicating that females in Aotearoa, New Zealand, typically progress through puberty earlier than males, as expected.
- The proportion of male young people in the pre-pubertal category was lower for Māori (18.9%, *n*=78/412), Pacific (13.7%, *n*=56/408) and Asian (19.8%, *n*=71/359) young people compared to European (23.1%, *n*=284/1229).

- For female participants, over 30% of Māori (31.6%, *n*=197/624) and Pacific (32.0%, *n*=155/485) young people were in the late-pubertal category compared to 21.6% of European (*n*=309/1431).
- The most common feelings reported to describe changes due to puberty were 'not interested' (42.1%), 'positive' (35.3%), and 'nervous' (22.0%), while the least common feelings reported were 'angry' (3.4%), 'upset' (4.2%), and 'scared' (5.5%).
- The two most frequently reported feelings by both sexes were 'not interested' and 'positive'. This was followed by 'excited' for males (17.5%) and 'nervous' for females (23.7%).
- Nearly three times as many females (20.5%) reported feeling 'embarrassed' about puberty compared to males (7.0%).
- The least frequently reported feelings were the same for all sexes. However, feelings with a negative tone tended to be reported more frequently by females than males. These included 'scared', 'upset', and 'angry'.
- The overall patterns of most and least frequently reported feelings were consistent across all ethnic groups. However, Pacific young people also frequently reported feeling 'proud' about puberty (21.0%).
- Feelings such as 'proud', 'annoyed', and 'embarrassed' in both sexes tended to increase in proportion as puberty progressed. However, feelings such as 'nervous' decreased in proportion among male participants as puberty progressed.

6. Measuring puberty

As a child-centric study, *Growing Up in New Zealand* asked young people themselves about pubertal development using questions from Petersen *et al.*'s study of pubertal status (4). The cohort was asked about growth spurts, skin changes, and body hair development in the armpit and/or pubic areas, regardless of their sex at birth. Females (sex assigned at birth) were also asked about breast development and menstruation, whilst males (sex assigned at birth) were asked about voice changes and facial hair growth. Additionally, females who indicated that they had begun menstruating by aged 12 were asked how regularly they accessed free period products at school through the Ministry of Education's new programme, *Ikura/Manaakitia te whare tangata* (13, 18).

Responses to these questions informed the development of a mean puberty score and a Puberty Category Score (PCS) based on that described by Pompéia *et al.* (19), whereby each young person was assigned to one of the five Tanner stages of pubertal development (see Appendix 1 section 2.3 for score derivation) (7). PCSs are described according to sex assigned at birth and self-reported total response ethnicity (see the Ethnic and Gender Identity report for details on ethnic group derivation).

The cohort was also asked to select how they felt about the changes to their bodies from a randomised list of twelve options: proud, excited, worried, scared, embarrassed, positive, nervous, annoyed, not interested, upset, angry, and confused. They were allowed to select up to three response options. Differences in feelings are described according to sex assigned at birth, ethnicity and PCS.

7. Puberty findings

7.1. Research question 1: What proportion of 12-year-olds have begun puberty, and does this differ by sex or ethnicity?

7.1.1. Individual puberty items

Puberty questions were answered by *n*=4376/4500 (97.2%) young people, with a total of *n*=2231 males and *n*=2145 females responding to the pubertal development questions.

Figure 1 shows the age distribution of the cohort when these questions were asked. The mean age of the cohort was 12.30 years (SD±0.27 years) or 147.6 months, and there was no difference in mean age between male and female young people (male – 148 SD±3.2 months, female - 148 SD±3.3 months).

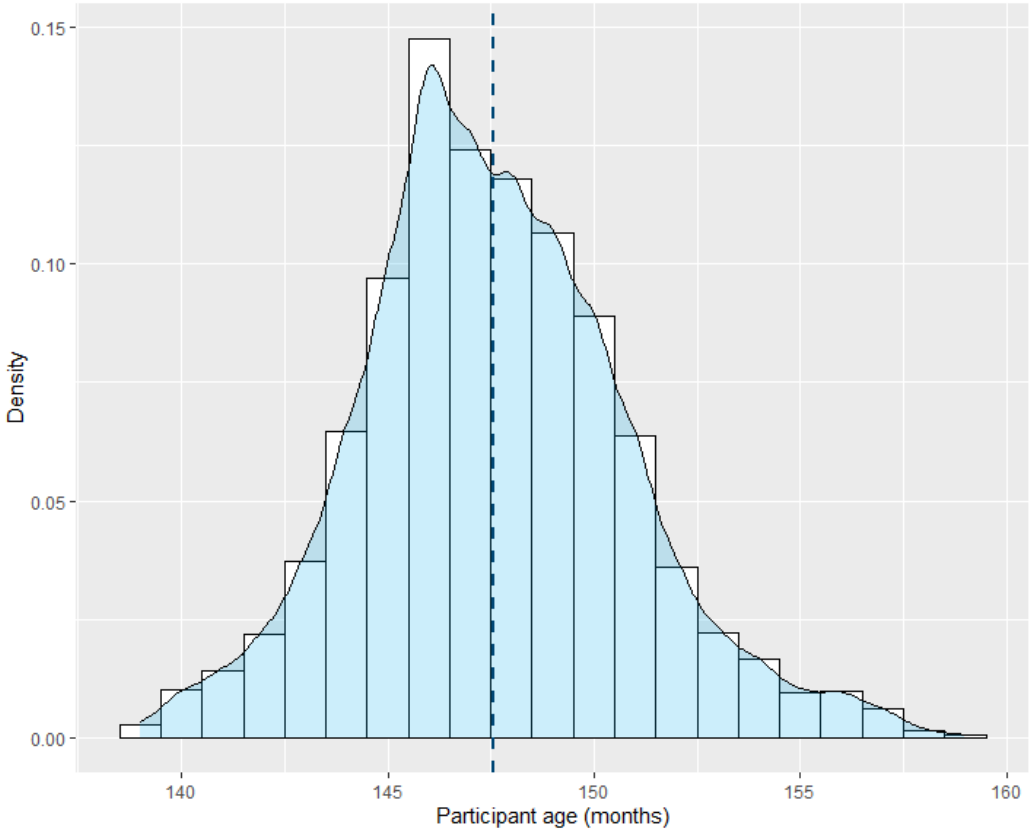


Figure 1. Age distribution of the cohort during the 12Y DCW (N=4500).

Both male and female participants answered questions about growth spurts, skin changes, and body hair development in the armpit and/or pubic areas. Nearly 40% (39.9%, *n*=1745/4376) of the cohort stated that their growth spurt was 'definitely underway', over 30% (30.7%, *n*=1344/4376) said they had 'started' to grow body hair, and approximately one-third reported they had 'started' to observe changes to their skin (32.9%, *n*=1439/4376). As expected, some differences were observed between male and female participants, with more females reporting having growth spurts underway (male – 35.8%, *n*= 799/2231; female 44.1%, *n*=946/2145). For body hair growth, the greatest proportion of males was in the 'just started' category (34.4%, *n*=768/2231), whilst the greatest proportion of females was in the 'definitely underway' category (32.5%, *n*=698/2145). More males also stated that changes to their skin had 'not started' (42.0%, *n*=938/2231), compared to over a third of females who reported they had 'just started' (34.2%, *n*=733/2145).

Males were asked an additional two questions about the deepening of their voice and whether they had begun to grow facial hair. Over half of all males reported that they had 'not yet' observed any voice changes (57.1%, *n*=1277/2231), and almost 70% (69.7%, *n*=1555/2231) reported their facial hair had 'not yet' started growing.

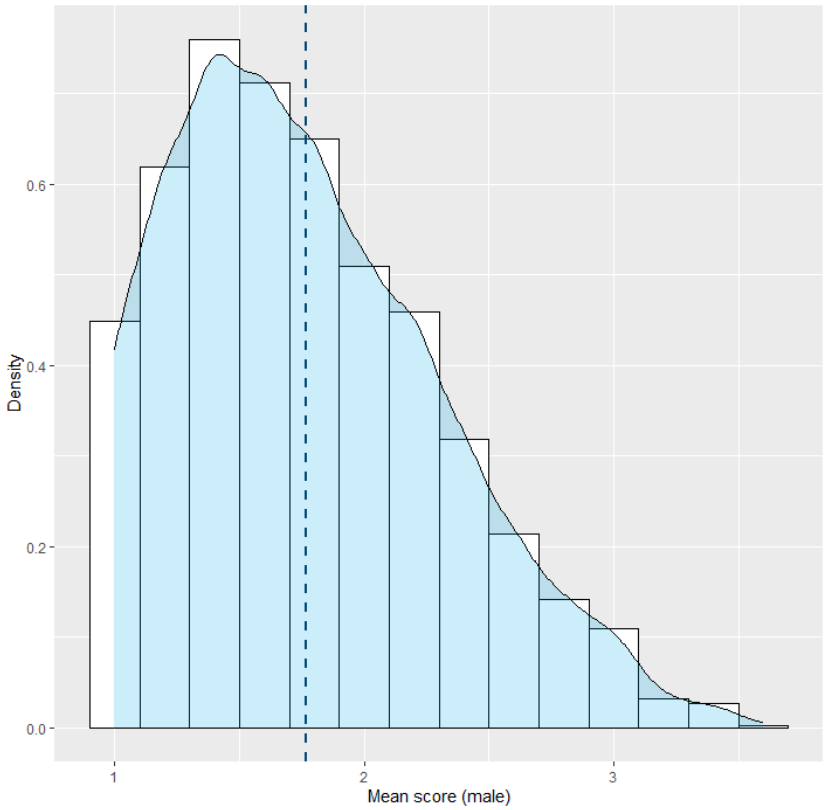
Females were asked additional questions about breast development and menstruation, with approximately 40% of all females stating that breast development was 'definitely underway' (40.2%, *n*=862/2145) and 45.6% reporting they have had at least one period (*n*=979/2145). They were then asked, 'How old were you when you first menstruated, or had your first period?' and the mean age of first menstruation was 11.1 years (median 11 years).

Note that the proportions calculated in this section include those who did want to answer one or more of the questions. There was less than 10% refusal for all of these questions, except for the body hair question, where 13.6% of young people refused (*n*=597/4376), and the breast development question, where 16.7% of females (*n*=359/2145) refused (see Appendix 1, section 2.4 for a breakdown of refusal rates for this topic and whether they differed by sex, ethnicity, or area level deprivation).

Females were also asked, 'How often have you used free period products (pads or tampons) from school?'. Over 41% of females who had started menstruating at aged 12 reported using free period products from school at least once (41.5%, *n*=406/979), and 8% had used them often or during every period (8.1%, *n*=79/979). However, 58.5% of females (*n*=573/979) who had begun menstruating had never used free period products from school, despite being offered universally.

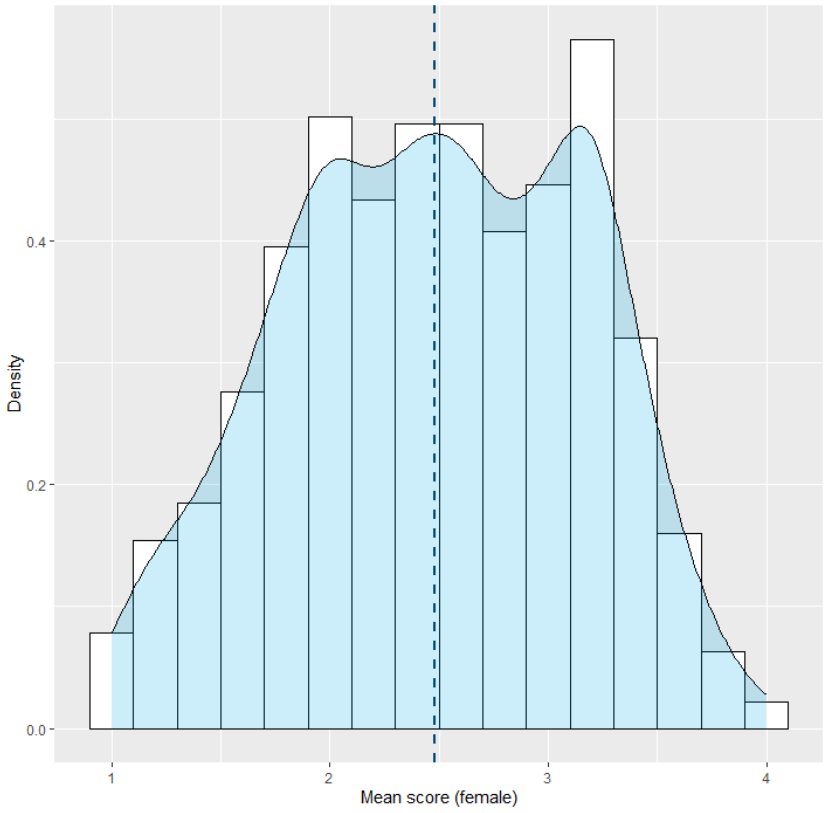
7.1.2. Mean Puberty Score + Puberty Category Score

To assess pubertal development, a mean puberty score and Puberty Category Score (PCS) were derived for males and females (see Appendix 1 Section 2.3 for score derivation). The male mean puberty score was 1.77 (SD±0.54), with the greatest proportion of males scoring 1.4 (15.2%; Figure 2). In contrast, the female mean puberty score was 2.48 (SD±0.68), with the greatest proportion of females scoring 3.2 (11.3%; Figure 3).



--- *Dotted line indicates the overall mean puberty score for all males.*

Figure 2. Distribution of male mean puberty scores at aged 12 (*n*=1916).



--- *Dotted line indicates the overall mean puberty score for all females.*

Figure 3. Distribution of female mean puberty scores at aged 12 (*n*=1593).

The PCS and corresponding Tanner stages demonstrated a similar pattern, with more female participants in the mid-, late-, and post-pubertal stages of development than male participants at aged 12 (Figure 4 & Figure 5). In particular, no males were in the post-pubertal group, compared to *n*=45 female participants. These results suggest that females in Aotearoa, New Zealand, typically progress through puberty earlier than males, as expected (2).

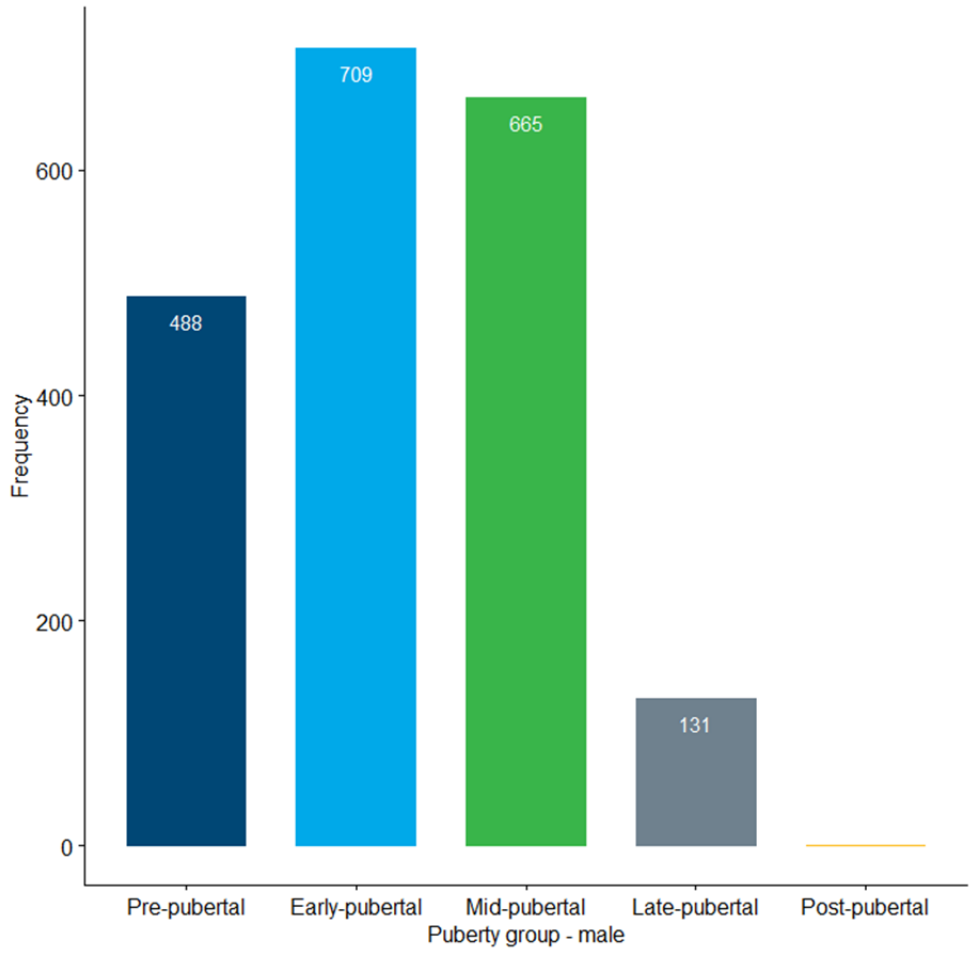


Figure 4. Frequency of male participants in each Tanner stage of pubertal development at aged 12 (n=1993).

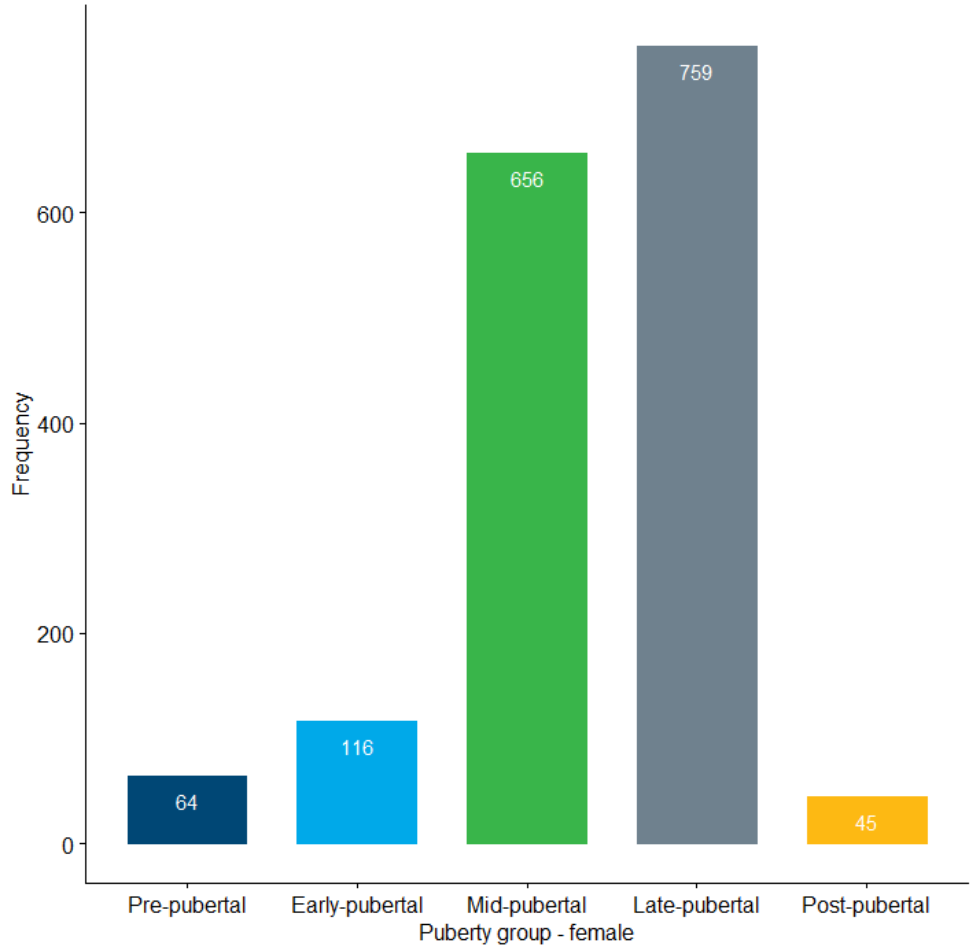
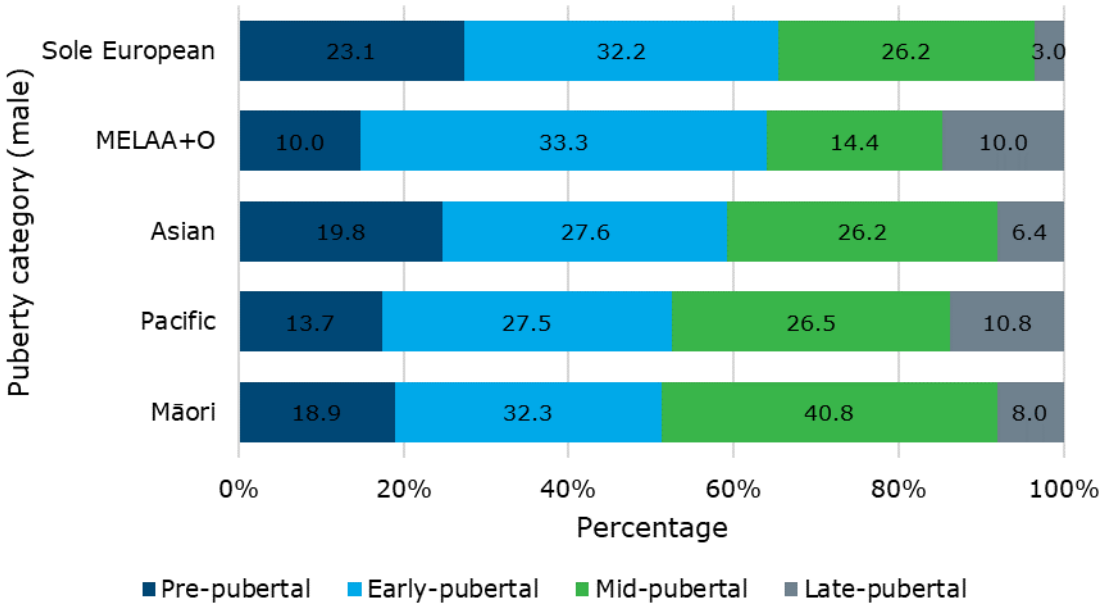


Figure 5. Frequency of female participants in each Tanner stage of pubertal development at aged 12 (*n*=1640).

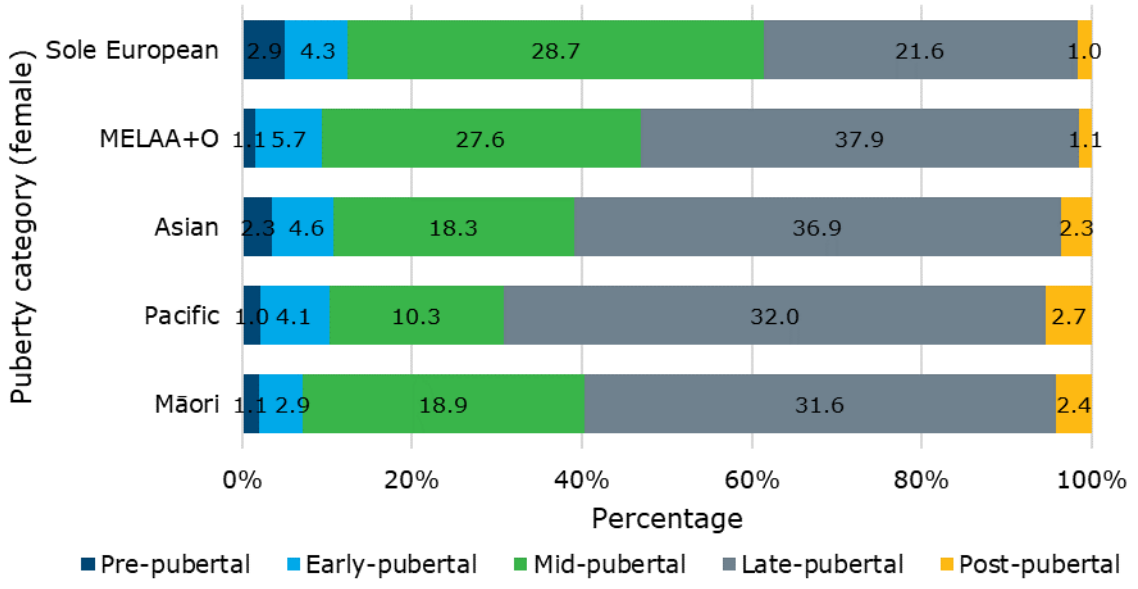
7.1.3. Puberty Category Score by ethnicity

When we compared PCSs by self-reported ethnicity, differences were observed according to sex assigned at birth (Figure 6 & Figure 7). The proportion of male young people in the pre-pubertal category was lower for Māori (18.9%, *n*=78/412), Pacific (13.7%, *n*=56/408) and Asian (19.8%, *n*=71/359) young people compared to European (23.1%, *n*=284/1229). Despite the numbers being small, a greater proportion of Pacific young people were in the late-pubertal category (10.8%, *n*=44/408) compared to European (3.0%, *n*=37/1229). For female participants, the biggest differences were observed in the mid- and late-pubertal categories. In the mid-pubertal category, there was a greater proportion of European young people (28.7%, *n*=410/1431) compared to both Māori (18.9%, *n*=118/624) and Pacific (10.3%, *n*=50/485) participants. There were also over 30% of Māori (31.6%, *n*=197/624) and Pacific (32.0%, *n*=155/485) female young people in the late-pubertal category compared to European (21.6%, *n*=309/1431). Asian female participants had similar proportions for both mid- and late pubertal categories to Māori and Pacific ethnic groups. Note there were no differences in the proportion of male and female young people within each of the self-reported ethnic groups. There was also no difference in mean age for each of the ethnic groups.



* The 'total response' classification system allows individuals to be counted in all the ethnic groups they identify with. This means that row percentages presented in this graph may be greater than 100%. The Sole European variable was derived and used in these analyses due to the high number of young people who identified as European and the significant overlap between European and other ethnicities. MELAA + Other were also combined as there were small numbers of young people in these two ethnic groups who answered these questions.

Figure 6. Proportion of male participants in each Tanner stage of pubertal development by self-reported ethnicity* (*n*=1993).



* The 'total response' classification system allows individuals to be counted in all the ethnic groups they identify with. This means that row percentages presented in this graph may be greater than 100%. The Sole European variable was derived and used in these analyses due to the high number of young people who identified as European and the significant overlap between European and other ethnicities. MELAA + Other were also combined as there were small numbers of young people in these two ethnic groups who answered these questions.

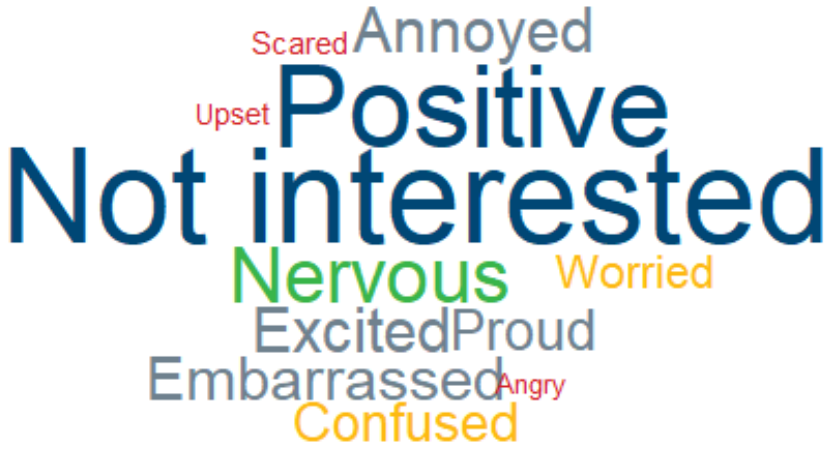
Figure 7. Proportion of female participants in each Tanner stage of pubertal development by self-reported ethnicity* (*n*=1640).

7.2. Research question 2: How are 12-year-olds feeling about the changes to their bodies with the onset of puberty, and does this differ by sex or ethnicity?

7.2.1. Overall feelings

Young people were asked to 'Click on one to three words that best describe how you feel about changes that might be happening in your body?'. Approximately 98.7% (*n*=4440/4500) of the cohort responded to this question, with only *n*=60 missing responses for this section. A further 11.3% (*n*=503/4440) of participants did not want to name a feeling. As a result, a total of *n*=3937 responses were included in these analyses.

The most common feelings reported were 'not interested' (42.1%, *n*=1657/3937), 'positive' (35.3%, *n*=1390/3937), and 'nervous' (22.0%, *n*=867/3937), while the least common feelings reported were 'angry' (3.4%, *n*=134/3937), 'upset' (4.2%, *n*=166/3937), and 'scared' (5.5%, *n*=215/3937). These feelings are represented in Figure 8, where the size of each word is proportional to the frequency at which the feeling was reported.



* Font size is proportional to the frequency of report.

Figure 8. Feelings about puberty at 12 years of age* (*n*=3937).

7.2.2. Feelings by sex

The proportions of those who did not want to name their feelings were similar for both sexes (male - 12.0%, *n*=274/2286; female - 10.3%, *n*=229/2214). The two most frequently reported feelings by both sexes were 'not interested' (male – 40.9%, *n*=934/2286; female – 32.7%, *n*=723/2214) and 'positive' (male – 32.2%, *n*=737/2286; female – 29.5%, *n*=653/2214). This was followed by 'excited' for males (17.5%, *n*=399/2286) and 'nervous' for females (23.7%, *n*=525/2214). More than twice as many females reported feeling 'annoyed' than males (male – 8.1%, *n*=186/2286; female – 20.8%, *n*=461/2214). Additionally, nearly three times as many females reported feeling 'embarrassed' about puberty compared to males (male- 7.0%, *n*=161/2286; female – 20.5%, *n*=453/2214).

The least frequently reported feelings were the same for both sexes. However, feelings with a negative tone tended to be reported more frequently by females than males. These included 'scared', 'upset' and 'angry', as illustrated in Figures 9A and B.

* Font size is proportional to the frequency of report.

Sex was determined by the young person's sex assigned at birth.

Figure 9. Feelings about puberty at 12 years of age*, by sex# (*n*=3937). A) Male B) Female.

7.2.3. Feelings by self-reported ethnicity

Like the above findings, 'not interested', 'positive', and 'nervous' were the most frequently reported feelings about puberty across all ethnic groups (Table 1). However, Pacific young people reported feeling 'proud' about puberty (21.0%, *n*=134/639) more than other ethnic groups. There were no major differences in the words used to describe the three least frequently reported feelings. However, a greater proportion of Pacific young people reported both 'scared' and 'angry' feelings compared to sole European (Table 1).

Table 1. Feelings about puberty at 12 years of age, by total response ethnicity* (*n*=3937).

Words that best describe feelings about puberty *n* (%)					
	Māori *n*=866	Pacific *n*=639	Asian *n*=578	MELAA+Other *n*=130	Sole European *n*=1988
Not interested	342 (39.5)	198 (31.0)	244 (42.2)	52 (40.0)	905 (45.5)
Positive	296 (34.2)	270 (42.3)	203 (35.1)	42 (32.3)	701 (35.3)
Nervous	179 (20.7)	150 (23.5)	127 (22.0)	30 (23.1)	440 (22.1)
Excited	149 (17.2)	118 (18.5)	94 (16.3)	21 (16.2)	325 (16.3)
Annoyed	176 (20.3)	134 (21.0)	111 (19.2)	23 (17.7)	255 (12.8)
Embarrassed	126 (14.5)	92 (14.4)	91 (15.7)	24 (18.5)	321 (16.1)
Proud	158 (18.2)	134 (21.0)	92 (15.9)	18 (13.8)	217 (10.9)
Confused	130 (15.0)	120 (18.8)	91 (15.7)	17 (13.1)	229 (11.5)
Worried	90 (10.4)	73 (11.4)	67 (11.6)	19 (14.6)	210 (10.6)
Scared	48 (5.5)	45 (7.0)	28 (4.8)	*n*<10 (3.1)	99 (5.0)
Upset	39 (4.5)	30 (4.7)	27 (4.7)	*n*<10 (3.8)	81 (4.1)
Angry	36 (4.2)	39 (6.1)	15 (2.6)	*n*<10 (1.5)	50 (2.5)
Refused	102 (11.8)	79 (12.4)	60 (10.4)	20 (15.4)	259 (13.0)

* The 'total response' classification system allows individuals to be counted in all the ethnic groups they identify with. This means that column counts and percentages presented in this table may be greater than the total number of participants or 100%. The Sole European variable was derived and used in these analyses due to the high number of young people who identified as European and the significant overlap between European and other ethnicities. MELAA + Other were also combined as there were small numbers of young people in these two ethnic groups who answered these questions.

Note: Colours indicate proportions increasing in increments of 5% until over 20%, which is represented by the darkest green. Feelings are ordered from most to least frequently reported (except for the 'Refused' category).

7.2.4. Feelings by Puberty Category Score (PCS)

Feelings such as 'proud', 'annoyed' and 'embarrassed' tended to increase in proportion for both sexes as puberty progressed (Table 2 & Table 3). However, feelings such as 'nervous' decreased in proportion among male participants as puberty progressed. Feelings such as 'not interested' and 'positive' did not appear to change for either sex as puberty progressed.

Table 2. Feelings about puberty in male participants at 12 years of age, by PCS (*n*=1819).

Words that best describe feelings about puberty *n* (%)					
Male	Pre-pubertal *n*=438	Early-pubertal *n*=653	Mid-pubertal *n*=608	Late-pubertal *n*=120	Post-pubertal *n*=0
Not interested	222 (50.7)	305 (46.7)	213 (43.2)	55 (45.8)	-
Positive	155 (35.4)	244 (37.4)	247 (40.6)	43 (35.8)	-
Excited	76 (17.4)	135 (20.7)	148 (24.3)	24 (20.0)	-
Proud	51 (11.6)	117 (17.9)	128 (21.1)	30 (25.0)	-
Nervous	89 (20.3)	122 (18.7)	101 (16.6)	14 (11.7)	-
Confused	58 (13.2)	86 (13.2)	88 (14.5)	13 (10.8)	-
Annoyed	30 (6.8)	55 (8.4)	65 (10.7)	19 (15.8)	-
Embarrassed	24 (5.5)	43 (6.6)	68 (11.2)	15 (12.5)	-
Worried	35 (8.0)	38 (5.8)	40 (6.6)	13 (10.8)	-
Scared	19 (4.3)	28 (4.3)	20 (3.3)	n<10 (1.7)	-
Angry	n<10 (1.8)	12 (1.8)	28 (4.6)	n<10 (3.3)	-
Upset	n<10 (1.8)	11 (1.7)	14 (2.3)	n<10 (3.3)	-

Note: Colours indicate proportions increasing in increments of 5% until over 20%, which is represented by the darkest green. Feelings are ordered from most to least frequently reported.

Table 3. Feelings about puberty in female participants at 12 years of age, by PCS (*n*=1560).

Words that best describe feelings about puberty n (%)					
Female	Pre-pubertal *n*=61	Early-pubertal *n*=110	Mid-pubertal *n*=622	Late-pubertal *n*=724	Post-pubertal *n*=43
Positive	24 (39.3)	32 (29.1)	243 (39.1)	249 (34.4)	14 (32.6)
Not interested	26 (42.6)	36 (32.7)	184 (29.6)	272 (37.6)	12 (27.9)
Nervous	12 (19.7)	36 (32.7)	226 (36.3)	156 (21.5)	12 (27.9)
Embarrassed	n<10 (11.5)	10 (9.1)	144 (23.2)	182 (25.1)	14 (32.6)
Annoyed	n<10 (6.6)	10 (9.1)	120 (19.3)	211 (29.1)	12 (27.9)
Worried	n<10 (14.8)	19 (17.3)	111 (17.8)	90 (12.4)	n<10 (18.6)
Excited	n<10 (8.2)	18 (16.4)	104 (16.7)	105 (14.5)	n<10 (4.7)
Confused	n<10 (13.1)	17 (15.5)	69 (11.1)	119 (16.4)	n<10 (11.6)
Proud	n<10 (4.9)	11 (10.0)	51 (8.2)	97 (13.4)	n<10 (16.3)
Scared	n<10 (4.9)	n<10 (6.4)	44 (7.1)	45 (6.2)	n<10 (14.0)
Upset	n<10 (1.6)	0 (0.0)	27 (4.3)	57 (7.9)	n<10 (14.0)
Angry	0 (0.0)	0 (0.0)	18 (2.9)	35 (4.8)	n<10 (4.7)

Note: Colours indicate proportions increasing in increments of 5% until over 20%, which is represented by the darkest green. Feelings are ordered from most to least frequently reported.

8. Relevance for policy and practice

This report has explored young people's experiences of puberty at aged 12 in Aotearoa, New Zealand.

Puberty is beginning earlier than it did previously

In line with previous research (20-22), our findings indicated that young people in Aotearoa, New Zealand are reaching puberty earlier than previous generations. Our study found that 45.6% of females had begun menstruating at the time of data collection (mean age 12.30 years), and the mean age of first menstruation was 11.1 years. This is younger than previous estimates from the 2014/15 New Zealand Health Survey (13.2 years) (11) and the Dunedin Multidisciplinary Health and Development Study (12.9 years) (23). Our findings indicate that a significant proportion of females enter puberty before attending high school, which has important implications for the timing of puberty education, resourcing, and the availability of support services. This becomes even more important given that earlier puberty has been associated with mental health issues such as depression, anxiety, eating disorders, and antisocial behaviours, as well as participation in risky behaviours such as earlier onset of sexual activity, greater number of sexual partners, alcohol consumption, smoking, and drug experimentation (2, 24).

Age of pubertal onset differed by ethnicity

Our findings have also provided important insight into the diverse experiences of puberty between different ethnic groups, whereby Māori, Pacific, and Asian young people were more likely to be in later stages of puberty than young people who identified as European only. This is similar to findings from the United States suggesting that African American and Latino young people typically begin puberty at the youngest ages (1, 3). It also aligns with research conducted in New Zealand, suggesting that approximately 80% of Māori and Pacific females begin menstruating by the age of 13, compared to only 62% of Europeans (2). However, in both the United States and the United Kingdom, Asian young people typically begin puberty at similar ages to Europeans (1, 3). We cannot discern why our results differ from this, but it may have been due to varying demographic representations of Asian young people between the countries.

Environmental factors such as nutrition and stress at least partially contribute towards the age of pubertal onset. As previously mentioned, young people who experience greater adversity often begin and progress through puberty earlier than young people who experience less adversity. As early puberty is associated with an increased risk of mental health issues and participation in risky behaviours, it was important that *Growing Up in New Zealand* investigate whether there were any ethnic differences in pubertal development within the cohort. This becomes even more important

considering that ethnic differences in pubertal development have critical implications for access to support systems, health equity and school engagement. Ethnic differences in pubertal onset are, therefore, important to keep in mind when developing new policies and programmes. They must be delivered meaningfully to meet the diverse needs of all young people and their families.

Some young people reported negative feelings about puberty

A small yet important proportion of young people reported feeling negatively about puberty. These findings support the Ministry of Education's revised Relationships and Sexuality Education (RSE) guidelines (25-26), underscoring the need for comprehensive RSE that is appropriately timetabled and resourced at all year levels. This applies to puberty as well as other RSE topics across the curriculum. Schools typically teach RSE as part of Health and Physical Education, but the Ministry of Education also encourages schools to take a whole-of-school approach to RSE that creates a safe and inclusive environment for all students (27). Teaching young people about puberty from traditional biological perspectives (e.g., menstruation status indicating the ability to reproduce) can harm how young people view themselves (28-30). Accordingly, we recommend that in addition to traditional RSE, schools approach puberty in other subjects, such as English, that may encourage young people to think critically about diverse experiences of puberty and consider what puberty means to them (29).

Free period products in schools were underutilised

Our results showed that only 8% of females who had started menstruating at aged 12 frequently accessed free period products at school, and 58.5% had never accessed them, despite the Ministry of Education suggesting that schools should encourage students to take enough products to manage their entire menstrual cycle (18). Our data collection coincided with the end of Phase 1 and the beginning of Phase 2 in the rollout of free period products in schools, which likely meant access to and the availability of period products in schools was more limited. If these questions had been asked of the cohort when Phase 2 was further underway, we may have found different use patterns.

The Youth19 Survey found that 12% of menstruating students had experienced financial difficulty purchasing period products, and this was particularly pronounced for Māori and Pacific students and those attending lower decile schools (31). Therefore, *Ikura/Manaakitia te whare tangata* is clearly an essential programme. Further research is required to determine the programme's current utilisation and whether any persistent barriers prevent young people from utilising the programme. For example, use may be hampered if some schools are not ordering enough supplies, products are not being promoted adequately, or are stored in inconvenient locations that reduce discretion. There may also be a stigma towards using unbranded products. For example, previous research has suggested that branded products may be incorrectly perceived as 'healthier' options than unbranded products (32). RSE is well-positioned to debunk this myth and teach young people about the benefits and risks of

using different types of period products. Some students have requested more disposable products become available in schools, such as applicator tampons and panty liners, as well as sustainable options, such as period cups and reusable underwear (18). The programme's funding is currently only secured until June 2024, so action is required to explore ways of further enhancing programme uptake to ensure it can continue providing free period products to those who need them. In particular, our findings indicated that a significant proportion of females in Aotearoa, New Zealand begin menstruating before entering year nine at school. As a result, we highly recommend that these schools prioritise making period products readily accessible to students, as this will also help normalise puberty.

9. Relevant quotes from participants

As part of the 12-year DCW, we asked the *Growing Up in New Zealand* cohort what they were looking forward to and whether they were particularly worried about anything in the next few years. These quotes typify their responses regarding puberty.

"I guess I am a bit worried about starting puberty, and growing apart from my friends"

"Puberty getting in the way"

"Being left behind from puberty."

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References

1. Deardorff J, Hoyt LT, Carter R, Shirtcliff EA. Next Steps in Puberty Research: Broadening the Lens Toward Understudied Populations. J Res Adolesc. 2019;29(1):133-54.

2. Gluckman P, Low F, Franko K. Puberty and adolescence: transitions in the life course. Improving the Transition: Reducing Social and Psychological Morbidity During Adolescence. Auckland, New Zealand: Office of the Prime Minister's Science Advisory Committee; 2011. p. 19-34.

3. Mendle J, Beltz AM, Carter R, Dorn LD. Understanding Puberty and Its Measurement: Ideas for Research in a New Generation. J Res Adolesc. 2019;29(1):82-95.

4. Petersen AC, Crockett L, Richards M, Boxer A. A self-report measure of pubertal status: Reliability, validity, and initial norms. J Youth Adolesc. 1988;17(2):117-33.

5. Rush E, Tautolo el S, Paterson J, Obolonkin V. Pacific Islands Families Study: Signs of puberty are associated with physical growth at ages 9 and 11 years. N Z Med J. 2015;128(1425):24-33.

6. Soliman A, De Sanctis V, Elalaily R, Bedair S. Advances in pubertal growth and factors influencing it: Can we increase pubertal growth? Indian J Endocrinol Metab. 2014;18(Suppl 1):S53-62.

7. Tanner JM. Growth at adolescence. 1962.

8. Marshall WA, Tanner JM. Variations in the pattern of pubertal changes in boys. Arch Dis Child. 1970;45(239):13-23.

9. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. Arch Dis Child. 1969;44(235):291-303.

10. National Health Service (NHS). Early or delayed puberty UK: Crown; 2022 [Available from: https://www.nhs.uk/conditions/early-or-delayed-puberty/].

11. Donovan S, Telfar-Barnard L. Age of first menstruation in New Zealand: findings from first ever national-level data and implications for age-appropriate education and support. N Z Med J. 2019;132(1500):100-2.

12. Boden JM, Fergusson DM, Horwood LJ. Age of menarche and psychosocial outcomes in a New Zealand birth cohort. J Am Acad Child Adolesc Psychiatry. 2011;50(2):132-40.e5.

13. Ministry of Education. Ikura|Manaakitia te whare tangata Period products in schools Wellington, New Zealand: New Zealand Government; 2023 [Available from: https://www.education.govt.nz/our-work/overall-strategies-and-policies/wellbeing-in-education/ikura-manaakitia-te-whare-tangata-period-products-in-schools/].

14. Paterson J, Lusitini L, Taylor S. Pacific Islands Families Study: depressive symptoms in 9-year-old Pacific children living in New Zealand. N Z Med J. 2014;127(1390):13-22.

15. Graber JA. Pubertal timing and the development of psychopathology in adolescence and beyond. Horm Behav. 2013;64(2):262-9.

16. Bleil ME, Booth-LaForce C, Benner AD. Race disparities in pubertal timing: Implications for cardiovascular disease risk among African American women. Popul Res Policy Rev. 2017;36(5):717-38.

17. Acker J, Mujahid M, Aghaee S, Gomez S, Shariff-Marco S, Chu B, et al. Neighborhood Racial and Economic Privilege and Timing of Pubertal Onset in Girls. J Adolesc Health. 2023;72(3):419-27.

18. Ministry of Education. Ikura|Manaakitia te whare tangata Period products in schools: information for schools and kura Wellington, New Zealand: New Zealand Government; 2023 [Available from: https://www.education.govt.nz/our-work/overall-strategies-and-policies/wellbeing-in-education/ikura-manaakitia-te-whare-tangata-period-products-in-schools/ikurainfo/].

19. Pompéia S, Zanini GAV, Freitas RS, Inacio LMC, Silva FCD, Souza GR, et al. Adapted version of the Pubertal Development Scale for use in Brazil. Rev Saude Publica. 2019;53:56.

20. Herman-Giddens ME, Steffes J, Harris D, Slora E, Hussey M, Dowshen SA, et al. Secondary sexual characteristics in boys: data from the Pediatric Research in Office Settings Network. Pediatrics. 2012;130(5):e1058-68.

21. Herman-Giddens ME, Slora EJ, Wasserman RC, Bourdony CJ, Bhapkar MV, Koch GG, et al. Secondary sexual characteristics and menses in young girls seen in office practice: a study from the Pediatric Research in Office Settings network. Pediatrics. 1997;99(4):505-12.

22. Eckert-Lind C, Busch AS, Petersen JH, Biro FM, Butler G, Bräuner EV, et al. Worldwide Secular Trends in Age at Pubertal Onset Assessed by Breast Development Among Girls: A Systematic Review and Meta-analysis. JAMA Pediatr. 2020;174(4):e195881.

23. St George IM, Williams S, Silva PA. Body size and the menarche: the Dunedin Study. J Adolesc Health. 1994;15(7):573-6.

24. Cheng TS, Ong KK, Biro FM. Adverse Effects of Early Puberty Timing in Girls and Potential Solutions. J Pediatr Adolesc Gynecol. 2022;35(5):532-5.

25. Ministry of Education. Relationships and Sexuality Education: A guide for teachers, leaders, and boards of trustees. Years 9-13. Wellington, New Zealand: New Zealand Government; 2020.

26. Ministry of Education. Relationships and Sexuality Education: A guide for teachers, leaders, and boards of trustees. Years 1-8. Wellington, New Zealand: New Zealand Government; 2020.

27. Ministry of Education. Relationships and sexuality education Wellington, New Zealand: New Zealand Government; 2022 [Available from: https://parents.education.govt.nz/primary-school/learning-at-school/sexuality-education/].

28. Joy E, Lundberg T, Roen K. Experiencing the Wrong Kind of Puberty: Navigating Teenage Years with a Variation in Sex Characteristics. Youth. 2023;3(1):465-76.

29. Diorio JA, Munro J. What Does Puberty Mean to Adolescents? Teaching and learning about bodily development. Sex Education. 2003;3(2):119-31.

30. Agnew C. The discursive construction of menstruation within puberty education. Dunedin, New Zealand: University of Otago; 2012.

31. Fleming T, Archer D, Sutcliffe K, Donovan S, Clark T. Youth19: Period Poverty Fact Sheet. Wellington and Auckland, New Zealand: Victoria University of Wellington, University of Otago, The University of Auckland, Youth19 Research Group, and Adolescent Health Research Group; 2020.

32. Medina-Perucha L, López-Jiménez T, Holst AS, Jacques-Aviñó C, Munrós-Feliu J, Martínez-Bueno C, et al. Use and perceptions on reusable and non-reusable menstrual products in Spain: A mixed-methods study. PLoS One. 2022;17(3):e0265646.

33. Baird J, Walker I, Smith CA, Inskip H. Review of methods for determining pubertal status and age of onset of puberty in cohort and longitudinal studies. London, UK: CLOSER; 2017.

34. Taylor SJ, Whincup PH, Hindmarsh PC, Lampe F, Odoki K, Cook DG. Performance of a new pubertal self-assessment questionnaire: a preliminary study. Paediatr Perinat Epidemiol. 2001;15(1):88-94.

10. Appendix 1

10.1. Questionnaire Items

Table 4. Puberty-related questions from the 12-year-old child questionnaire.

Question	Variable code	Answer options
Click on one to three words that best describe how you feel about changes that might be happening in your body?	*PUB10_1_y12C to PUB10_98_y12C*	1. Proud 2. Excited 3. Worried 4. Scared 5. Embarrassed 6. Positive 7. Nervous 8. Annoyed 9. Not interested 10. Upset 11. Angry 12. Confused 98. I don't want to answer this question
Would you say that your growth in height...?	*PUB1_y12C*	0. Has not yet begun to spurt ('Spurt' means more growth than usual) 1. Has just started 2. Is definitely underway 3. Seems completed 98. I don't want to answer this question
And how about the growth of body hair ("Body hair" means under your armpits and pubic hair)? Would you say that your body hair has...?	*PUB2_y12C*	0. Not yet started growing 1. Has just started growing 2. Is definitely underway 3. Seems completed 98. I don't want to answer this question
Have you noticed any skin changes, especially pimples?	*PUB3_y12C*	0. Not yet started showing changes 1. Has just started showing changes 2. Skin changes are definitely underway 3. Skin changes seem completed 98. I don't want to answer this question
[FOR FEMALES ONLY] Have your breasts begun to grow?	*PUB4_y12C*	0. Not yet started growing 1. Have just started growing 2. Breast growth is definitely underway 3. Breast growth seems completed 98. I don't want to answer this question
[FOR FEMALES ONLY] Have you begun to menstruate? ("Menstruate" means you have had at least one period)	*PUB5_y12C*	1. Yes 0. No 98. I don't want to answer this question
[For FEMALES if PUB5_y12C = 1] How old were you when you first menstruated, or had your first period?	*PUB6_y12C*	Please enter your age in years _____ [6 to 14 as options]

Question	Variable code	Answer options
[For FEMALES if PUB5_y12C = 1] How often have you used free period products (pads or tampons) from school?	*PUB7_y12C*	0. Never 1. Once 2. A few times 3. Often 4. Every period
[FOR MALES ONLY] Have you noticed a deepening of your voice?	*PUB8_y12C*	1. Not yet started changing 2. Has just started changing 3. Voice change is definitely underway 4. Voice change seems completed 98. I don't want to answer this question
[FOR MALES ONLY] Have you begun to grow hair on your face?	*PUB9_y12C*	1. Not yet started growing hair 2. Has just started growing hair 3. Facial hair growth is definitely underway 4. Facial hair growth seems completed 98. I don't want to answer this question

10.2. Skip Logic

BOTH GENDERS ANSWER PUB1_y12C to PUB3_y12C then [IF GENDER_PDL (sex at birth) = MALE SKIP to PUB8_y12C], [IF GENDER_PDL (sex at birth) = FEMALE CONTINUE to PUB4_y12C].

Where the skip logic did not work correctly, and participants potentially answered the incorrect puberty questions according to their sex assigned at birth (n=19), their data was removed from analyses of *PUB1_y12C* to *PUB9_y12C*, mean puberty scores, and subsequent Puberty Category Score (PCS) derivation.

10.3. Scoring

Clinical assessment using the Tanner stages (7) is the gold standard for measuring pubertal status, but this can be challenging in large cohort studies (33). We considered incorporating the Tanner stages in our child-proxy questionnaire; however, this was decided against as numerous studies have suggested it may be unreliable when utilising self-reports (8, 33-34). Accordingly, we asked the *Growing Up in New Zealand* young people to report on their pubertal status using questions from Petersen *et al.*'s (4) validated study of pubertal status, as outlined in Table 2. All young people were asked about growth spurts, the development of body hair, and skin changes (*PUB1-3_y12C*), whilst males were asked about voice changes and facial hair development (*PUB8_y12C* and *PUB9_y12C*), and females were asked about breast development and menstruation (*PUB4_y12C* and *PUB5_y12C*).

The Petersen *et al.* (4) questions were scored from one to four, where 1='Not yet started', 2='Has just started', 3='Is definitely underway', and 4='Seems completed' (except for the menstruation question (*PUB5_y12C*) where a score of 1=no menstruation and 4=menstruation). Responses to these

questions were then summed and divided by five to give a mean puberty score ranging from 1-4 for both males and females.

The data was also used to create a PCS based on that described by Pompéia *et al.* (19), whereby each young person was assigned to one of the five Tanner stages of pubertal development (7). Female PCSs were developed based on the sum of body hair (*PUB2_y12C*) and breast development (*PUB4_y12C*) scores (minimum PCS=2, maximum PCS=8), whilst male PCSs were developed based on the sum of body hair (*PUB2_y12C*), voice changes (*PUB8_y12C*), and facial hair (*PUB9_y12C*) scores (minimum PCS=3, maximum PCS=12). These PCSs were used to assign young people to one of the five Tanner stages (7) of pubertal development, as outlined in Table 5.

Table 5. Tanner staging of Petersen *et al.*'s (4) pubertal development questions based on the scoring conducted by Pompéia *et al.* (7).

Tanner Stage	Female PCS	Male PCS
1. Pre-Pubertal	2 (with no menstruation)	3
2. Early-Pubertal	3 (with no menstruation)	4-5 (with no 3-point answers)
3. Mid-Pubertal	4-8 (with no menstruation)	6-8 (with no 4-point answers)
4. Late-Pubertal	1-7 (with menstruation)	9-11
5. Post-Pubertal	8 (with menstruation)	12

10.4. Missing data and refusal rates

In the 12-year DCW, young people were asked about their feelings towards puberty (*PUB10_y12C*), which included 98.7% of the cohort (*n*=4440/4500). Of these individuals, 11.3% (*n*=503/4440) refused to name one or more feelings. As a result, a total of *n*=3937 responses were included in these analyses. When we assessed refusal by sex, ethnic group, and area level deprivation (NZDEP18) quintiles to see if some participants were more likely to have refused to answer this question, we found no statistical difference in probability of refusal by sex or ethnic group. We did, however, find that young people living in higher area level deprivation were more likely to refuse to answer this question compared to those living in lower deprivation areas (Group 1, REFERENCE; Group 2, *t*=2.02, ***p*=.04**; Group 3, *t*=1.64, *p*=.10; Group 4, *t*=2.21, ***p*=.03**; Group 5, *t*=1.89, *p*=.06).

In the 12-year DCW, young people were also asked nine questions about the pubertal changes happening to their bodies (*PUB1-9_y12C*), which included 97.2% of the cohort (*n*=4376/4500). There were three questions answered by both male and female participants (*PUB1-3_y12C*), two questions by male participants only (*PUB8-9_y12C*) and four by female participants only (*PUB4-7_y12C*). A total of *n*=2231 males and *n*=2145 females responded to at least one of the puberty questions. Table 6 demonstrates the refusal rates for each of these questions. Note that *PUB6_y12C* and *PUB7_y12C* were

only answered by those who responded 'yes' to *PUB5_y12C*; there was no option to refuse to answer these questions.

Table 6. Refusal rates for the pubertal development questions.

Puberty Question	Refused (%)	Total
PUB1_y12C (growth spurt)	275 (6.3)	4376
PUB2_y12C (body hair)	597 (13.6)	4376
PUB3_y12C (skin changes)	208 (4.8)	4376
PUB4_y12C (breast development)	359 (16.7)	2145
PUB5_y12C (menarche)	161 (7.5)	2145
PUB6_y12C (age at menarche)	-	979
PUB7_y12C (period product use)	-	979
PUB8_y12C (deepening voice)	63 (2.8)	2231
PUB9_y12C (face hair)	66 (3.0)	2231

Mean puberty scores were only calculated for participants where we had complete data from all five puberty questions (see Appendix 1 section 2.3 for details on score derivation). As a result, we calculated mean puberty scores for 85.9% of males (n=1916/2231) and 74.3% of females (n=1593/2145). Additionally, we looked at refusal rates for male and female young people by ethnic group and area level deprivation (NZDEP18). Male participants were less likely to have refused to answer the questions if they were Asian, MELAA or European (Māori, t=-0.21, p=.83; Pacific, t=-0.51, p=.61; Asian, t=-2.04, ***p*=.04**; MELAA, t=-2.70, ***p*=.01**; Other, t=1.27, p=.20; Sole European, t=-2.40, ***p*=.02**). However, male young people were more likely to have refused to answer if they were living in high deprivation areas (Group 1, REFERENCE; Group 2, t=1.08, p=.28; Group 3, t=-0.09, p=.93; Group 4, t=1.11, p=.27; Group 5, t=3.65, ***p*<.001**). Female participants were also more likely to have refused to answer the puberty questions if living in higher deprivation areas (Group 1, REFERENCE; Group 2, t=1.69, p=.09; Group 3, t=0.09, p=.93; Group 4, t=2.44, ***p*=.01**; Group 5, t=1.65, p=.10). There were no significant differences in refusal rates by ethnic group.

A PCS was also only calculated for participants where we had complete data from all relevant puberty questions (see Appendix 1 section 2.3 for details on score derivation). As a result, we calculated a PCS for 89.3% of males (n=1993/2231) and 76.5% of females (n=1640/2145). We then assessed the probability of refusal to answer the sex-specific PCS questions by ethnic group and area level deprivation (NZDEP18). Male participants were less likely to have refused the PCS questions if they were MELAA or European (Māori, t=-0.43, p=.67; Pacific, t=-1.41, p=.16; Asian, t=-1.62, p=.11; MELAA, t=-2.31, ***p*=.02**; Other, t=1.65, p=.10; Sole European, t=-1.94, ***p*=.05**). However, male

participants were more likely to have refused to answer if they were living in high deprivation areas (Group 1, REFERENCE; Group 2, t=1.23, *p*=.22; Group 3, *t*=-0.02, *p*=.98; Group 4, *t*=0.95, *p*=.34; Group 5, *t*=2.07, ***p*=.04**). Likewise, female young people were more likely to have refused to answer the PCS questions if living in higher deprivation areas (Group 1, REFERENCE; Group 2, *t*=1.66, *p*=.10; Group 3, *t*=-0.92, *p*=.36; Group 4, *t*=1.97, ***p*=.05**; Group 5, *t*=1.34, *p*=.18). There were no significant differences in refusal rates by ethnic group.

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