

Original Research

Knowledge of Osteoporosis and Lifestyle Behaviours Impacting Peak Bone Mass among Young Adults

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Abstract

Osteoporosis is a major public health problem through its association with fragility fracture. Low peak bone mass (PBM) is a major contributor to later osteoporosis risk. Despite this, most studies concentrate on older people when the window of opportunity to impact PBM has passed. This study aimed to understand what adolescents and young adults understand about PBM, the risk of osteoporotic fracture and how lifestyle factors impact PBM. Such information may inform educational interventions to reduce future risk of fracture, and provide important public health benefits. New Zealand university students were approached to participate in this study. Nine focus groups of a total of 44 adolescents and young adults, mean age 22.9 (\pm 4.02) years of different ethnicities (29 female 15 male), were conducted using a semi-structured approach with open-ended questions and prompts. Transcripts were thematically coded using an inductive content analysis approach. Participants reported poor knowledge of PBM and factors impacting risk of osteoporotic fracture. There was a general awareness of the positive



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and negative impacts of many lifestyle behaviours such as physical activity, diet, tobacco smoking and alcohol consumption on health in general, but not specifically how these impact PBM and good bone health in later life. We conclude that in a cohort of New Zealand University students, current knowledge of osteoporosis and lifestyle factors that impact PBM is limited. Educational interventions in young adults are now warranted to improve PBM and prevent osteoporosis in late adulthood.

Keywords

Knowledge; bone; qualitative; lifestyle; peak bone mass (PBM); osteoporosis

1. Introduction

Osteoporosis is a major public health problem through its association with fragility fracture [1]. Preventative methods often focus on older people [2]. However, a critical period of bone development occurs during childhood and adolescence, with bone development reaching a peak in an individual's twenties and thirties. The greater the peak bone mass (PBM) attained, the greater the protection against developing osteoporosis and osteoporotic fracture. Whilst genetic factors are an important contributor to PBM, environmental factors such as exercise, nutrition and disease (such as eating disorders, RED-S (relative energy deficient-syndrome), endocrine and other childhood diseases) also play a role [3]. The impact of cigarette smoking and excessive alcohol consumption on bone health has been less extensively studied in young adults, but is also considered detrimental to PBM acquisition [4, 5].

Unlike genetic factors, lifestyle behaviours may be modified to improve bone health and reduce fracture risk later in life [3, 6, 7]. For example, a previous systematic review reported that enhanced levels of weight bearing physical activity, acting together with dietary calcium intake, is the most beneficial to PBM acquisition [3]. However, engagement of adolescents and young adults with such lifestyles depends upon their knowledge of factors associated with good bone health and a motivation to lead healthy lives [8]. A recent study by our group examined factors that impact participation in sporting activity among young people, finding that a number of barriers and enablers exist [9].

Young people may perceive osteoporosis as an older person's disease; as a 'silent disease' bone loss may occur without obvious external indications until later in life [10]. Furthermore, most osteoporosis prevention programmes provide information that are targeted towards older adult lifestyles. A systematic literature review in 2018 identified 34 studies that used self-designed or validated questionnaires to assess bone health and concluded that most adolescents and young adults had poor knowledge of bone health and osteoporosis [11]. That review suggested both this lack of knowledge and misconceptions about osteoporosis lead to behaviours that might result in suboptimal PBM acquisition. The study concluded that personal susceptibility and acknowledging the importance of osteoporosis would encourage changes in behaviour to lessen the burden of osteoporosis [11].

Far less qualitative work has considered understanding of PBM and the factors that affect it. Given the utility of qualitative research to gain an understanding of ideas, thoughts and meanings,

the aim of this study was to examine what adolescents and young adults understand about PBM, and the lifestyle factors that impact it in focus groups set in the university environment in Wellington. There is a need to recognise what adolescents and young adults understand about bone health because, if they understand the implications of their lifestyle behaviours, they may be able to make informed choices of the risks and benefits of those behaviours and hence act to reduce their risk of fracture later in life. This novel preventative approach may lead to significant public health benefits through reduced risk of fragility fracture in older age.

2. Methods

Ethical approval was obtained from the New Zealand Health and Disability Ethics Committee (reference #HDEC 18/CEN/18).

2.1 Participants

Study recruitment was undertaken from July 2018 to October 2018 in the Wellington region in New Zealand. Students from Victoria University of Wellington, and other adolescents and young adults aged 16 to 35 years associated with the university, were approached to participate in the study. There were no exclusions criteria except the participants' age bracket being 16 to 35 years inclusively and ability to give verbal and written consent. The participants who had previously been involved in a larger quantitative bone health study [12] had consented to being contacted by email for further research. Others were recruited through word of mouth, recruitment flyers and emails posted through the university media service. Participants were provided with participant information sheets and informed consent forms. Written informed consent was provided by willing participants. The focus groups were semi-structured with open-ended questions (Table 1). The participants were encouraged to discuss with each other what they understood about PBM and the risk of osteoporotic fracture affecting their bone health. Participants were prompted to discuss what they understood about bone health (for example: "What factors do you think have negative or positive impact on your bone health? What food do you think affects bone health? What about the effects of smoking and alcohol?) and discuss their behaviours (for example: What are the lifestyle factors you would choose to keep your bones strong and healthy? What changes have you made to your lifestyle with the knowledge you have about bone health? Participants were encouraged to direct the discussion with minimum intervention by the study facilitators.

Table 1 Interview Guide Questions.

Questions about knowledge
What do you understand about Bone health?
1. What factors do you think have negative or positive impact on your bone health?
2. What food do you think effects bone health?
3. What about smoking?
4. What about alcohol?

Questions about behaviour
1. What are the lifestyle factors you would choose to keep your bones strong and healthy?

2. What changes did you bring in your lifestyle with the knowledge you have about bone health?
 3. What prompts you to stay physically active?
 4. How important are physical activities to you in a day to day life?
 5. How do you think food affects your bone? What changes did you bring in your diet to have strong bones?
 6. How about dairy products consumption?
 7. What made you start smoking? What kept you going?
 8. Was there anything that stopped you from smoking for any reasons?
 9. How happy are you with how much you drink?
 10. Would alcohol affect bone health?
 11. Have you ever sought any medical care for bone pain/ fracture?
 12. Final questions (may relate to knowledge or behavior but should come at the end of the focus groups because asking them may lead to providing knowledge to participants):
 13. Have you ever heard about Osteoporosis/PBM?
 14. How do you think your bone health relates to risk of fracture later in life?
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The discussions were recorded with two or more recording devices and an assistant recorded non-verbal communication (to record information about the level of consensus and dissension to the topic under discussion). At the end of each discussion, the lead interviewer summarised the ideas that had been discussed and asked for any final feedback to ensure all ideas or opinions and experiences were recorded. After each focus group, a debriefing session was held with the study facilitators. Subsequent focus group interviews used an iterative process whereby any previous emergent themes were followed up to obtain further insights until all themes were fully explored to achieve theoretical data saturation.

2.2 Data Analysis

The recordings of the focus group discussions were transcribed verbatim and then verified by listening to the voice recordings several times to ensure all data was recorded correctly. All participants' data were de-identified. The transcription and any tabulated data, including any notes obtained from the focus groups, were thematically analysed. We used an iterative process of qualitative analysis whereby inductive patterns emerge into themes from the data itself by constant comparative analysis [13]. Sections of data were then assigned codes and compared for consistency. The assigned codes were categorised into themes. NVivo (qualitative data analysis software; QSR International Pty Ltd. Version 12, 2018) was used to organise the data.

3. Results

Nine focus groups discussions were held in total between August and October 2018, with 3 to 11 participants attending each group. The sample size was 44 individuals in total, with a mean age of

22.9 (± 4.02) and an age range of 17 to 33 years (Table 2). The majority of participants were of European descent, 10 were of mixed ethnicity including Māori, Pacific people, Asian and Indian, and approximately two thirds were female, with one third male (29:15).

Table 2 Participant’s characteristics.

Participant’s characteristics	
Age range	17 to 35 years
Average age	22.9 (± 4.02) years
Ethnicity	34 European, 10 mixed Māori, Pacific people, Asian and Indian origin
Gender	Female 29: Male 15
Education level	Minimum university entrance

Three main themes emerged from the focus groups (Table 3): there is a limited understanding of PBM and the risk of osteoporotic fracture; seeking bone health advice is uncommon; and although participants had a good understanding of lifestyle factors that contributed to good health, they had little knowledge of how these could lead to improved PBM acquisition.

Table 3 Themes.

Themes	Sources of knowledge	Knowledge
Limited understanding of PBM and the risk of osteoporotic fracture	Understand nutrition & exercise important for overall health	Improved knowledge of PBM & bone health awareness early in young people
Seeking bone health advice is uncommon	Online and GP health information Education Media Family and social circles	Understand nutrition & exercise important for overall health
Little knowledge of how lifestyles lead to improved PBM acquisition.	Recreational sporting activity, fitness, & physical activity Alcohol & smoking Nutrition and diet	Desire to know more about modifiable osteogenic lifestyles behaviours to incorporate into daily life & to reduce detrimental behaviours to improve PBM acquisition & reduce risk of osteoporotic fracture later in life

3.1 Participants had a Limited Understanding of PBM and the Risk of Osteoporotic Fracture

Generally, participants had a good understanding of lifestyle factors that contributed to good health, but little knowledge of how these related to PBM, that is, they were aware of the overall health and well-being benefits of exercise and good nutrition, but not specifically in relation to bone health. Participants’ knowledge of specific bone health issues and PBM was limited.

“More common in older people and it’s to do you know with bone strength and that you should drink milk. Yeah I don’t have a very good understanding of like causes or preventative measures or anything like that.”

“[I] think of bones as [a] skeleton structure where the meat just hangs off...think more about exercise and diet and organs being affected.”

Participants did not always have a clear understanding of the supplements or medication taken.

“I started taking Vitamin D because it’s supposed to help with asthma. But I feel like on the bottle it says something about bone health (laughing). I have actually read the bottle. I went to my GP and said I was having problems controlling my asthma and he suggested Vitamin D and I just take Vitamin D now.”

Participants did not feel susceptible to acquiring osteoporosis and many considered osteoporosis to be specific to women, and a problem in later life.

“I thought osteoporosis was just old people, just getting old (agreement)... and breaking their bones, but it makes more sense to encourage it from a younger age rather than waiting till you’ re old type thing, to think about it.”

“Is it the older women get, the more brittle our bones get?”

“Not many worry about what’s going to happen when they are 90 years old.”

Participants found the descriptive terminology and “*medical jargon*” difficult to understand, confused osteoporosis with other conditions such as “*osteoarthritis*” and confused the use of supplements such vitamin D with vitamin C.

“I’ve heard of osteoarthritis. Is that a different thing?”

“Oh, is that, you get scurvy, is that it?”

“That’s vitamin C.”

3.2 Seeking Bone Health Advice is Uncommon

Participants used various methods to obtain information about general health but did not actively seek information on osteoporosis or bone health unless a fracture had occurred. Seeking medical advice for bone health was uncommon. Further, participants felt there is a lack of readily available information about osteoporosis prevention, and were unaware that there are fracture risk assessments currently available in New Zealand in both hard copy and online versions.

3.2.1 Bone Health Information Available Online

Generally, participants spoke more about the internet as their first source of information for many topics, as it is readily accessible and used it to gather information for most health related matters, including nutrition. However, unless a fracture had occurred, few participants had searched the internet for information specifically related to bone health.

“Heaps of information on their website, my dad likes it so...there’s information you have to find it and look for it, but like again you have to do it yourself.”

3.2.2 Bone Health Information from General Practitioners

Participants found that health professionals do not typically advise them about bone health, and do not advise specifically about attaining PBM aside from preventative measures to avoid fracture (such as by taking care when participating in sport and avoiding excessive alcohol consumption).

"I really don't know much about it at all, and I can't even think of a doctor visit where it was brought up in conversation other than me stubbing my toe, fracturing it, yeah."

3.2.3 Education

Participants reported learning much of what they knew about health, and lifestyles favourably associated with health, from school or from studying biology and science at university. When talking about osteoporosis awareness, a participant recalled learning about osteoporosis at school.

"I think for myself I heard about it in high school and in nutrition papers they did in high school and that was it. I did one year of that. That was all the information I had about it."

Another participant became aware of the availability of vitamin D testing while studying a health topic at school although was informed by their doctor that the test was not routinely available.

"People don't know what to ask for like I, I read about this because I am studying biology, because I happen to have like a huge interest in like all of this kind of stuff like personally. But most people don't have that. And she said that it used to be part of standard (...) but it's not anymore. Because I am studying biology, because I happen to have like a huge interest."

3.2.4 Media

Participants spoke at length about media, internet and television sources and historical healthy living and physical activity campaigns that they remembered. In terms of nutritional and healthy lifestyle factors, many participants vividly recalled previously advertised physical activity campaigns. A participant recalled media marketing directed at women and older people.

"They tend not to be marketed towards, like, 18 to 35 year olds. It's more like a, sort of, 60 year old, around women, is sort of there, seems to be bone health marketing, around sort of different supplements you can take. Sort of, general bone health for young people isn't something that I've ever seen."

Another participant remembered having heard or read about astronauts breaking bones after going into space; they recalled having a very visual reaction to this information.

"I just remember hearing one story – like I just have no idea who or the details of it, but someone, like an astronaut, coming back to earth and then like stepping onto ground, and the bone just like breaking. And that stuck with me 'cause it, I remember having a very visceral reaction to it. Just being like, "ahh"."

3.2.5 Family and Social Circles

Participants had a limited understanding of their own personal family health history but acknowledged there may be heredity factors impacting their future health status.

"...my grandma broke her hip and I don't know, I mean I think it was age-related, but I don't know."

Some participants were aware of older family members with fragility fractures. Although they may believe that they are at a potential risk of eventual osteoporosis, those participants did not think there is anything they can do at their current age to prevent osteoporosis and considered that osteoporosis may be an inevitable part of getting old.

"I thought osteoporosis was just old people, just getting old."

"It's not something that you really think much about when you're young."

3.3 Participants Had a Good Understanding of Lifestyle Factors that Contributed to Good Health, But Little Knowledge of How These Applied to PBM

Participants' knowledge and understanding of how their lifestyles, including alcohol consumption, smoking, drugs and nutrition, affect bone health and PBM was limited. These individual lifestyle factors are discussed below.

3.3.1 Recreational Sporting Activity

Participants understood the need to be active for better health. Many of the participants enjoyed participating in recreational sporting activity for "fun". Their chosen activities did not specifically arise from an intention to improve bone health but rather from the enjoyment of the sport or for muscle strength.

"I am thinking of making things stronger, I am thinking like muscles and like this or that. But, I never think about, I could do something that could change my bone structure."

3.3.2 Alcohol Consumption and Smoking

Participants were aware that the alcohol and smoking had long-term negative effect on their health but not that long-term alcohol consumption was detrimental to bone health.

"It's just generally bad for you and it might hinder your ability to I guess process nutrients and grow, but I'm not sure. I don't think it would have a detrimental effect would it, if you're just drinking as an adult?"

3.3.3 Nutrition, Diet and Bone Health

Participants did not know about the possible impact of different diets on bone health. However, participants understood the importance of including calcium in diets mainly sourced through dairy products and the benefits of taking supplements for vegetarian or vegan diets. Parents and family members were commonly cited as reasons for drinking milk.

"My mum always used to make me drink milk, but I didn't know too much."

Another participant compared their own high milk consumption and sporting abilities with a sibling's low milk consumption and frequent fractures.

"I really like my milk, my blue top. Um, so that sort of became a joke, starting with like my sister. I do it for yeah, I have strong bones and teeth, 'cause she's like fragile and breaks everything."

Participants believed food types with high calcium content such as milk also increases cholesterol levels.

Although the majority of participants previously consumed milk daily during childhood, several participants held ethical concerns regarding milk, dairy and meat consumption, based on information obtained through social media and the internet.

"It's mostly an environmentally conscious decision, um just to you know, help improve the environment and not contribute to pollution in that way with dairy farming and farming."

Ethical and environmental concerns may influence lifestyles changes. Reasons given for changing their lifestyles, including becoming vegan or otherwise changing their diet, often showed that participants did not always consider the impact of such lifestyle changes on their bone health.

"I definitely change and then read later. Yeah I think I yeah based on my experiences, I pretty much decided to go vegan sort of with a snap of the fingers and then read up afterwards what I needed to do. It sure was healthy."

Some participants did not always trust the motives of health campaigns and preferred independent research-based campaigns.

"The only ads for bone health tend to be, like, supplement and pharmaceutical companies, or, little companies that are trying to milk [profits]. And they like know – whereas like, I wouldn't exactly trust."

Some participants were well-informed about supplementation information from the doctor as students may be recommended vitamin D supplementation due to spending significant periods of time indoors studying.

"I haven't heard of vitamin D in relation to bones. Like sunshine in general, but not like [for bones]."

Females were more aware of their personal health and more likely to seek regular medical help for other health issues, such as contraceptive advice. Easy access to the contraception at an early age of around 15 was common in females. They were not aware of the potential detrimental effects of the oral contraceptives on bone health and do not remember being told of such effects by their doctor.

"[Doctors] don't talk about the medication, they just take your blood pressure."

4. Discussion

Osteoporosis is a condition associated with huge personal and societal burden in later life, with a high proportion of older adults affected. However, this qualitative study suggests that adolescents' and young adults' knowledge of bone health and PBM was limited despite being highly educated; some had never heard of PBM or osteoporosis before.

Many participants were confused by medical terminology and mostly perceived osteoporosis to be a disease that occurred in elderly females. This view was consistent with a recent study that highlighted a lack of awareness that osteoporosis affects males as well [14]. Participants in this study were all University students – even in this group knowledge was poor, in keeping with previous research that found, in a study using a quantitative osteoporosis assessment tool, that even amongst highly educated female medical school entrants knowledge of osteoporosis was poor [15]. Although it might be expected that such deficiency in knowledge was worse in young people, even in studies of older people there was often confusion between osteoporosis and other bone and joint conditions, with poor knowledge of what the condition actually was. Study respondents did understand the importance of exercise and nutrition, reporting that medical practitioners were be their preferred source of information [16].

Some adolescents and young adults in this study underestimated their vulnerability to health risks in general but more so for osteoporosis. This is partly due to the misconception that bone growth occurs only in the very young, bones are not visible and often are unnoticed and there was little to do to prevent osteoporosis as it was an inevitable part of getting old. This misconception leads to a belief that lifestyle choices in early adulthood do not affect bone health, for example, that bones are mostly unaffected by alcohol consumption. The participants recognised themselves to be adults over the age of 18 years and did not perceive themselves as being in the growth phase. Adolescents and young adults were not aware of recreational sporting activity as a method of improving bone health, as they did not appreciate that bone health could be improved with increased high impact weight-bearing activity. Participants recognised that muscular strength and appearance improved with regular exercise and good nutrition. Further, they understood that a reduction in detrimental lifestyle behaviours (for example, alcohol consumption, smoking or drugs) may improve general health and mental well-being, but not specifically affect bone health. The findings of this study highlight the need to intervene earlier in the life course to promote behavioural change that will result in reduced risk of osteoporotic fracture in late adulthood, with all its attendant health consequences.

In our study, overall, females were more aware of factors affecting their health: this finding is consistent with that of other studies that reported that young people often do not feel susceptible to developing osteoporosis, which may hinder the adoption of measures to reduce risk of developing osteoporosis later in life [17]. Female participants were generally more aware of their personal health and often obtained contraception at an early age of around 15, although were less aware of potential detrimental effects of oral contraceptives on bone health. Hormonal contraceptives potentially negatively impact PBM accrual depending on the extent of use and age at which it was taken [18]. In particular, early use of OCP during teenage years may impact PBM development [19]. As such a greater understanding and education of the use of OCP and the alternative options is warranted especially as young people may use contraceptives for their non-contraceptive effects such as menstrual suppression or dysmenorrhea and acne) [20].

Conventional sources of health information came from family and friends, health professionals and the education and sport sectors. Similar to other studies, adolescents and young adults vividly recalled past public health campaigns for recreational sporting activity and milk consumption from childhood [21]. Adolescents and young adults triangulated information-seeking using online sources, their immediate social circles and education or health resources. They were aware that the information available may be biased and untrustworthy. Many participants did not recall the past experiences and bone health complications of friends and family members' bone health clearly: as such, communicating and recording of pertinent family health history may be warranted.

The strengths of the qualitative focus study include the participants' wide ethnic diversity and age range. Although the generalisability of this study may be considered limited to the university environment, the data was sourced from a range of participants from the university campus who came from different backgrounds, and a range of locations within New Zealand and internationally, reflecting the population of the Wellington region [22]. However, the study did not include address those with mobility disabilities and those identifying as gender diverse: health research is typically inadequate in these areas [23, 24, 25].

Trustworthiness in a qualitative study may be judged by its credibility, transferability, dependability and confirmability [26]. The data presented here were sourced from a range of

participants from the university campus who came from different backgrounds, affirming credibility. Ideas were summarised after each discussion group. The reflexive diary (preliminary analysis) after each focus group meeting with the study facilitators permitted continuous comparisons and consensus, and the data were interpreted independently. The study protocol and reflexive diary of the iterative research process permitted transferability of the methods used to other contexts. An appraisal of the research protocol by an external party and other qualified researchers in the field ensured dependability of the research process. The emergent themes were auditable in NVivo the software program used for managing the data, and continuously compared to develop the emerging themes. Debriefing sessions held with the study facilitators were used to highlight any discussion issues to be addressed, including any keywords, themes or patterns and relationships identified from the focus groups and recorded in the reflexive diary to objectively confirm that findings and interpretations were true to the participants' views. The data obtained from the nine focus group interviews held, field notes and responses to the open-end probe questions, and the objective independent observations from the different facilitators were triangulated and synthesised to provide confirmation of the findings and different perspectives true to the views of the participants in the qualitative study [27].

This study has some limitations. No formal data were collected on the participants' socioeconomic status and data relating to the field of study for participants was not collected although all participants had a minimum of university entrance level of education and many had completed an undergraduate degree. It would have been interesting to consider the balance of science and humanities students. An inclusion of a small sociodemographic questionnaire to the study to include background information such as level of education, diet preferences, additional occupation or any relevant factors affecting bone health (for example, veil wearing) would have been helpful. Finally, participants in this study were recruited as part of a larger study considering relationships between sporting activity and bone health. It is possible therefore that participation in other parts of the study may have led to increased awareness of bone health, and produced a selection bias towards the recruitment of individuals more interested in bone health – our findings are perhaps even more striking for this reason, as they highlight a lack of awareness of factors among highly educated, and possibly motivated towards an interest in bone health.

Due to low group numbers our study was not able to perform sub-group analysis based on ethnicity though studies indicate lack of osteoporosis knowledge may result in racial disparities in bone health particularly in females [28]. Additionally, some of the views of the participants may reflect a more an international perspective, due to spending differing amounts of time in and out of New Zealand. Finally, we acknowledge the modest sample size of the study population and the need to conduct similar studies in other populations; reassuringly data saturation was reached despite this.

Adolescents and young adults in our study reported a desire for access to online unbiased information about PBM supported by well-conducted health research. Information about the role of supplements or calcium rich food in the general diet to aid bone health in adolescents and young adults would be beneficial [29]. Although the lack of safe levels of sunlight exposure in those with darker pigmentation is a risk factor for bone health, some participants of Asian and Indian origin revealed a lack of knowledge of the benefits of sun exposure as a source of vitamin D [17, 30]. This is particularly important as in darker skinned individuals vitamin D absorption through the skin

through sun exposure is less efficient particularly if clothing such as veils or veils and full-body-coverage clothing is used [31].

5. Conclusions

Adolescents and young adults enrolled at a University in New Zealand demonstrated a lack of knowledge of osteoporosis and the lifestyles behaviours that can improve PBM acquisition to reduce their risk of osteoporotic fracture later in life. A greater understanding of these factors has the potential to help reduce risk of osteoporotic fracture later in life, with significant public health benefits.

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Author Contributions

Elaine Dennison and Hayley Denison designed the study, with Hansa Patel. Hansa Patel and Sana Zafar performed data collection. Hansa Patel performed data analysis, supervised by Hayley Denison. All authors oversaw data collection and manuscript production.

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Competing Interests

The authors have declared that no competing interests exist.

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