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From Adolescence to Adulthood: A Time-Series Analysis of Changes in Beliefs Related to Osteoporosis Across Women's Life Course

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Abstract
This multi-stage study analyzed the changing health beliefs about osteoporosis related to the various stages of a woman's life. A sample size of 50 women was collected at 6 stages: early adolescence (T1) and middle adulthood (T6). Results showed health beliefs supported a gradually and non-linearly positive trend over the years.
The average total score of health beliefs increased from T1 (M = 58.4) to T2 (M = 64.7) with a large positive increase to be seen in T3 and T4 (M = 78.9 and M = 92.3 respectively). The T5 score (M = 108.6) showed an even larger positive increase and the T6 score (M = 112.4) remained about the same.
The health beliefs component perceived self-efficacy provided an increased positive trend, perceived barriers showed a decrease, and perceived susceptibility showed positive growth. perceived severity and perceived benefits of preventive behavior were positive and both internal/external cues to action showed positive trends, with positive growth internal cues dominating.
It can be overall concluded that the output of the study shows womens cognitive and behavioral development health beliefs related to osteoporosis and their stages of life to be positive and progressive.

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Introduction

Osteoporosis is a chronic skeletal disorder with a major skeletal impact. It is characterized by low bone mass and heavily impacts skeletal fragility. It is affected by and contributes to a decline in quality of life, high disability, and increased later life healthcare expenditures [1]. Most bones are affected throughout life, with mass continuously lost. Osteoporosis is the most frequent metabolic bone disease and a disabling condition as skeletal mass continuously declines throughout life [2]. Osteoporosis is often asymptomatic until a skeletal fracture occurs. Osteoporosis is often referred to as the fourth leading cause of death and a threatening hidden public health concern [3, 4].

There is a marked increase in fracture prevalence globally. This has increased interest in osteoporosis amongst the public and healthcare providers, prompting early preventative healthcare [5]. Most peak bone mass is developed in the adolescent and early adult age ranges. It is critical to raise awareness of preventive behaviors in this age range to mitigate future osteoporosis. In order to take the necessary steps to effect long term positive health behaviors aimed at skeletal health, we must understand the health beliefs of each age group.

Health-supported beliefs bar none her own (concerning susceptibility, consequences of illness, prevention, and significance of diet and exercise) affect behaviors in prevention. Different behaviors in prevention regarding an area of concern (i.e., intake of calcium and vitamin D, continuous exercise, reduction of prolonged inactivity, vigilance of risk factors) relate directly to an individual's extent of awareness and beliefs regarding health [6]. Nevertheless, beliefs regarding health and osteoporosis are context-based, and evolve and change through time.

They are influenced by one's own individual factors, and are affected by factors from the environment and by the culture. Changes in beliefs can be observed during the life period in the transition to adulthood, secondary education, marriage, and during family responsibility [7].

The transition to high school marks an important time health-related attitude [8]. Both formal and informal forms of education (i.e., from family, from the media, and from school) influence adolescents [9]. In fact, as most adolescent students consider themselves healthy, the consequences associated with osteoporosis become one of those diseases that are often older, and chronic. This may lead to a lack of desire to become active in prevention.

By contrast, in adulthood, life stages such as marriage bring increased responsibility, changes in lifestyle, and changes in dietary and physical activity patterns. The impact of these changes weighs in either direction, and the accompanying belief and attitude changes about bone health can be quantified. Therefore, understanding the changes in beliefs about osteoporosis at different stages in life can identify the most relevant considerations for the establishment of health-protecting behaviors.

Most studies dealing with knowledge, attitudes and health beliefs about osteoporosis have been cross-sectional in nature and have been able to capture participants at the most one time in their life [10–13]. The tendency of single-snapshot studies is the inability to record the subtle but inevitable changes of beliefs and behaviors. Unlike beliefs about health, which can also be changed, these beliefs can alter gradually and in a stepwise manner. They can change as a result of one's own or a close family member's sickness, changes in social roles, the family and economic status. There is a research gap in the precise estimation of these changes, their nature as well as the health-related beliefs rotating around the disease.

On the positive side, theories relating to the different stages of life require the appropriate analytical frameworks to study the changes in beliefs. Data relating to health beliefs, in most cases, are collected in a series of measurements at different time intervals, and therefore, are time dependent. For that reason, time series analysis and study designs of a longitudinal nature are most suitable to analyze trends, changes and the different stages regarding belief changes that occur over a certain time period. The presence of these types of studies would be able to inform changes in the beliefs surrounding Osteoporosis as people move through the different stages of their life; from teenage years through adult years and married years, and tell which types of beliefs changed the most within that stage of life.

Because the prevention of Osteoporosis has to begin at a young age [14] and because people's beliefs significantly shape health behaviors [15, 16], this study attempts to analyze and describe the time-series evolution of women's beliefs about Osteoporosis over the different stages of their life. The objective of the present study was to determine the time series changes in women's beliefs over the different stages of their lives, including highschool, post graduate and post married years. The goal of this was to identify the life stages most in need of health promotion and education programs.

With this study, health planners and educational policymakers may determine the best timing for educational interventions and misunderstandings. Should incorrect beliefs or low perceived risk continue throughout adolescence and well into adulthood, developing those specific preventive programs to be offered in school and/or educational settings becomes necessary. If, theoretically, the neglect to practice preventive behaviors decreases after marriage or early adulthood, then educational interventions may also be designed for those specific time frames.

In the end, learning how beliefs about osteoporosis change over time plays a significant role in managing and controlling the disease, thereby improving the overall health of the population.

Methods

Study Design

This research utilized a time-series retrospective observational approach to assess the perceived movement of osteoporosis-related health beliefs from adolescence to adulthood. Participants were asked to recall their beliefs regarding osteoporosis for each of the six listed age brackets. Given the design of this study, it was not a longitudinal follow-up study, but rather a time-series retrospective self-report.

Participants

Women from Mosul made up the study population. Mosul women were chosen via convenience and purposive sampling which aids in obtaining samples in different age cohorts. A total of 120 respondents were requested. The final respondents were those who had successfully answered all the retrospective questions in the given time frames. The retrospective parameters were set to periods of time in early adolescence (10-13 years), late adolescence (14-17 years), early adulthood (18-22), young middle adulthood (23-30), early middle adulthood (31-40), and middle adulthood (41-50).

Those who were aged above 18, able to both read and follow the instructions on the survey, and able to answer the questions without the survey being facilitated were included in the study. Respondents who suffered from chronic illnesses that inhibited the completion of the survey were medically diagnosed with cognitive disabilities were diagnosed with the brittle bone disease were excluded from the study. Other exclusion criteria were surveyed at the time of the survey and were found to be involuntary participants failing to answer all questions in the timeframe prescribed.

Instruments

Gathering data began with a two-part osteoporosis health beliefs questionnaire. The first part of the questionnaire gathered information on the respondents' demographic and lifestyle characteristics, such as their age, educational achievement, socioeconomic status, and whether they had a family history of osteoporosis. The first part also gathered information on their physical activity and dietary habits, such as their consumption of dairy and supplements. The second part of the questionnaire focused on the respondents' health beliefs regarding osteoporosis and included the following: perceived susceptibility, perceived severity, perceived benefits of preventive behavior, perceived barriers, self-efficacy, and internal and external cues to action. The instrument's reliability was measured by Cronbach's alpha. It was validated through an expert review as well as content validation [17].

Procedure

Participants filled out an in-person questionnaire at the health care center in Mosul. The aim of the study and the necessity of informed consent were explained. This required the first author's attendance at the health care center. Participants were asked to think back and document their health beliefs for the six designated age brackets.

To decrease biased memory of their health beliefs, respondents were presented with memory guidelines. Respondents were asked to think back for each age bracket and relate their answer to significant life events such as starting elementary school, starting and finishing high school, starting university, beginning their first job, and getting married and starting their own family. To predetermine some possible events, respondents were able to think back to their health beliefs more accurately for various intervals despite the bias.

Ethical Considerations

Northern Technical University of Mosul Medical Technical Institute's Ethics Committee approved this study. Before enrollment, all participant's written consent was collected. Data was stored in coded form, and confidentiality was preserved. Participants were informed of their right to withdraw from the study, deidentified, and had no consequence.

Statistical Analysis

A repeated-measures ANOVA was performed for data comparison of retrospectively assigned belief scores in six different adult timeframes. Averages were taken for each of the six time periods of one's adult life. A one-way ANOVA was used to assess identity belief scores for each time averaged. The Greenhouse-Geisser correction was performed where sphericity was violated. A polynomial trend analysis was used to examine score averages over the six time periods. A post hoc analysis was performed, adjusting for the Bonferroni correction, for comparison between each averaged time period.

Results

This study involved 50 women and the final demographic analysis of participants can be found in Table 1. This study has analyzed data across six time intervals; early adolescence (T1), late adolescence (T2), early adulthood (T3), young adulthood (T4), middle adulthood (T5) and later adulthood (T6) to describe and categorize the data in relation to the development of osteoporosis over one's lifetime.

On average, the total health belief score began low in T1 (M = 58.4) and brought only slight changes to T2 (M = 64.7). T3 (M = 78.9) and T4 (M = 92.3) noted bigger gains. By T5 (M = 108.6), the last recorded total health belief score that demonstrated the study's linear trajectory had a total belief score that was the highest in the trajectory thus far, and in T6, was the highest of all the recorded total health belief scores thus far (M = 112.4).

Outside of total health belief scores, the only noted change was in health and perceived barriers. Perceived self-efficacy notably increased and began low in T1 (M = 49.2) and finished notably high in T6 (M = 121.7). T1 recorded the most barriers to health with a summary score of (M = 97.5) and T6 recorded the least to zero perceived health barriers with a low summary score of (M = 55.8). These perceived health barriers denote a gradual decrease in perceived health barriers.

The perception of susceptibility to osteoporosis has been gradually increasing from M=62.1 at T1 to M=89.4 at T6. Perceived severity M=65.7 at T1 to M=84.6 at T6. M=60.3 at T1 to M=118.9 at T6. Rising M=60.3 at T1 to M=118.9 at T6 fell within one of the more extreme cases of growth over the phase.

Personal concern, internal awareness, and perceived risk, or, internal cues to action, gradually increased from M=57.8 at T1 to M=95.6 at T6, as did the externally influenced action cues from physician advice, family, and more from M=60.9 at T1 to M=88.3 at T6.

Throughout the six phase process, the changes in beliefs of health related behaviors associated with the condition of osteoporosis are shown in Table 2, and the trends are outlined with time intervals in Fig. 1.

Table 1: Demographic and Background Characteristics of the Study Participants (n = 50)

Variable	Categories	Frequency (%)
Age	Mean ± SD	41.6 ± 6.4
Education level	Primary	6 (12%)
	Secondary	10 (20%)
	Diploma	18 (36%)
	University	16 (32%)
Socioeconomic status	Low	9 (18%)
	Moderate	28 (56%)
	High	13 (26%)
Family history of osteoporosis	Yes	17 (34%)
	No	33 (66%)
Physical activity	Low	14 (28%)
	Moderate	22 (44%)
	High	14 (28%)
Dairy consumption	Low	12 (24%)
	Moderate	24 (48%)
	High	14 (28%)
Calcium & vitamin D supplementation	Yes	21 (42%)
	No	29 (58%)

Table 2: Changes in Osteoporosis Health Beliefs Across Six Developmental Stages

Construct	T1 (10–13 y)	T2 (14–17 y)	T3 (18–22 y)	T4 (23–30 y)	T5 (31–40 y)	T6 (41–50 y)
Total health beliefs	58.4	64.7	78.9	92.3	108.6	112.4
Perceived self-efficacy	49.2	62.0	74.5	88.1	103.4	121.7
Perceived barriers	97.5	90.2	82.6	74.3	65.1	55.8
Perceived susceptibility	62.1	66.8	72.5	78.9	84.6	89.4
Perceived severity	65.7	69.4	73.8	77.5	81.2	84.6
Perceived benefits	60.3	70.1	82.4	95.6	107.8	118.9
Internal cues to action	57.8	66.5	75.9	83.7	90.4	95.6
External cues to action	60.9	66.2	72.1	78.4	83.5	88.3

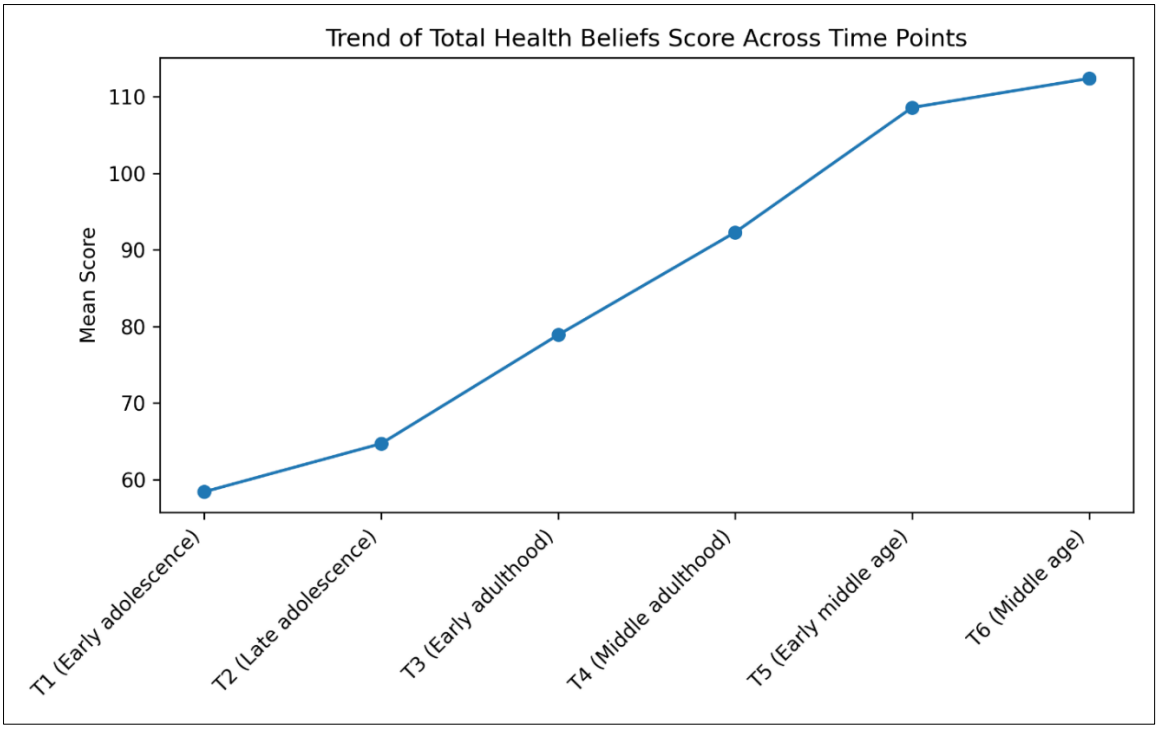

Fig 1: Trend of Total Health Belies related to osteoporosis Across Time points

Discussion

Findings of the present study indicated that osteoporosis-related health beliefs changed significantly over time (T1 to T6). These changes in the total score and in several components of the Health Belief Model suggest the influence of time and potentially educational or behavioral interventions on improving individuals' attitudes and perceptions regarding osteoporosis prevention. This result is consistent with previous studies showing that interventions based on the Health Belief Model can lead to significant improvements in constructs such as perceived susceptibility, perceived benefits, and health motivation [18, 19].

In another study that examined the effect of an educational program based on the Health Belief Model, repeated-measures analysis of variance revealed that health belief scores significantly increased in post-intervention and follow-up phases compared to baseline [20]. These findings are in line with the present study and confirm that changes in health beliefs are a gradual and time-dependent process.

On the other hand, cross-sectional studies have indicated that health beliefs may be associated with demographic factors such as age, educational level, and socioeconomic status; however, these studies do not capture temporal changes [21, 22]. It is noteworthy that perceived susceptibility and health motivation differ across age groups, but these differences are inherently static and do not reflect longitudinal changes over time. Therefore, the present study, with its longitudinal approach, provides a more precise understanding of the developmental trajectory of these changes.

Furthermore, studies on the validation of the Osteoporosis Health Belief Scale have emphasized that this instrument is capable of capturing subtle changes in individuals' cognitive and behavioral constructs over time and is therefore highly suitable for evaluating the effectiveness of educational interventions [19, 21]. This supports the validity of the findings obtained in the present study.

Overall, consistent with the literature, the findings from this study suggest that there are malleable osteoporosis-related health beliefs, and the transformation within these health beliefs, particularly after educational interventions, is observable over an extended duration of time. These findings underscore the need for the implementation of sustained interventions and longitudinal follow-up to maintain and strengthen cognitive and behavioral changes.

Limitations of the Study

There are plenty of limitations with this study. First, it is important to note that the data collected were from a retrospective study. Participants were asked to talk about their beliefs during other parts of their adult lives during one interview. This can be called the retrospective interview. Results can be prone to bias. Memory distortion is a big risk in the accuracy of the perceived changes of beliefs.

Second, the study structured the design such that participants

compared their beliefs over time. This study lacked a true, repeated, longitudinal design. Because of this, the developmental changes cannot truly be identified and be proven.

Third, this can be positive or negative, but participants were asked to give their data in an honest manner, This can cause an extreme bias depending on the result. Some participants have positive intentions and want to think of their beliefs from the past.

Finally, a retrospective design is a box and may lack a true image of a longitudinal design in the relativity of the adult beliefs.

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