Research Article

Effect of Vitamin D3 Supplementation on Levator Ani Muscle Strength in Primipara Pregnancy with Postpartum Vitamin D3 Deficiency

Efek Suplementasi Vitamin D pada Kekuatan Otot Levator Ani pada Kehamilan Primipara dengan Defisiensi Vitamin D3 Pascapersalinan

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Abstract

Objective: To determine the benefits of post-partum vitamin D supplementation on striated muscle strength.

Methods: This is a pre-post quasi-experimental study on postpartum vitamin D3 supplement provision in primiparous women with vitamin D3 deficiency. The effect of vitamin D3 supplement was assessed through the measurement of pelvic floor muscle strength before and after 3 months of vitamin D3 supplementation. Thirty-three primiparous postpartum women with spontaneous vaginal delivery who met inclusion criteria participated in this study. Serum vitamin D3 level, basal tone, and maximum levator ani contraction were measured by perimetry prior to and after vitamin D3 supplementation. This study was conducted in the Obstetric Clinic and Clinical Serology Laboratory of Clinical Pathology Department, Dr. Hasan Sadikin General Hospital/ Faculty of Medicine, Universitas Padjadjaran from March 1 to May 31, 2018.

Results: Data analysis using the Wilcoxon test showed an increase in serum vitamin D3 level and a basal tone strength after vitamin D3 supplementation with a P-value of <0.001. However, the maximum strength of levator ani muscle contraction did not increase (P-value <0.829).

Conclusions: Vitamin D3 supplementation increases basal tone strength.

Keywords: basal tone, maximum levator ani muscle contraction, perimetry, primiparous vitamin D3 deficiency, vitamin D.

Abstrak

Tujuan: *Untuk mengetahui manfaat pemberian suplementasi vitamin D pascasalin terhadap kekuatan otot lurik.*

Metode: *Tipe penelitian ini adalah penelitian eksperimental quasi dengan rancangan sebelum dan sesudah pemberian vitamin D3 pada ibu primipara pascasalin yang mengalami defisiensi vitamin D3, dengan mengukur kekuatan otot dasar panggul sebelum dan sesudah pemberian 3 bulan vitamin D3. Subjek penelitian adalah primipara pasca persalinan spontan yang memenuhi kriteria inklusi penelitian (n=33). Dilakukan pemeriksaan kadar vitamin D serum dan pengukuran tonus basal dan kontraksi maksimal levator ani dengan menggunakan perimetri sebelum dan sesudah pemberian suplementasi vitamin D3. Penelitian dilakukan di Poliklinik obstetri FKUP/RSHS dan Laboratorium serologi Klinik Patologi Klinik FKUP/RSHS pada bulan 1 Maret- 31 Mei 2018.*

Hasil: *Hasil penelitian ini dengan menggunakan uji wilcoxon didapatkan peningkatan kadar serum vitamin D3 dan peningkatan kekuatan tonus basal setelah pemberian suplementasi vitamin D3 dengan nilai P<0,001. Sedangkan kekuatan kontraksi otot maksimal levator ani tidak mengalami peningkatan dengan nilai P<0,829.*

Kesimpulan: *Suplementasi vitamin D3 meningkatkan kekuatan tonus basal*

Kata kunci: *kontraksi maksimal levator ani, perimetri, primipara defisisensi vitamin D3, tonus basal, vitamin D.*

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INTRODUCTION

Vitamin D is one of the vitamins that are very important for human being. In human body, vitamin D is distributed in various different organ systems. The main source of vitamin D (80-90%) comes from the skin that is induced by ultraviolet light and the remaining source comes from diets or vitamin D supplement distributed in some tissues.[1] In recent years various studies have demonstrated the preventive role of Vitamin D in skeletal and non-skeletal physiological functions.[2]

Vitamin D status is still a concern both in Indonesia and in other countries in the world. A study on Vitamin D conducted in Dr. Hasan Sadikin General Hospital Bandung stated that around 38.60% of the subjects were in the severe deficiency groups (<10 ng/mL) while 56.81% and 4.54% were in moderate deficiency (10–19.9 ng/mL) and mild deficiency (20-29.9) groups. This raises a concern because the study also shows that this condition affects uterine prolapse incidence.[3]A study conducted on 74 women in nursing homes in Jakarta has revealed that 35.1% of the residents experienced vitamin D deficiency.[4] In their study stated that the vitamin D status in Southeast Asian countries is lower than in other regions[5] who studied 504 women of reproductive age of 18 to 40 years in Jakarta and Kuala Lumpur discovered that more than 60% percents of the respondents experienced vitamin D deficiency.[6]A study in Australia shows that 31% of subjects of 11,247 adults experience vitamin D deficiency.[7] Meanwhile, a survey by the American National Health and Nutrition Examination 2005-2006 reported that 69% of pregnant women experience vitamin D deficiency.[8]

Several factors that affect pelvic floor muscle strength are age, hormonal, pregnancy, childbirth, neurological disorders, infectious diseases, malignancies, obesity, and chronic diseases. Vaginal delivery is the most common cause of pelvic floor weakness, mainly due to the weakening of the pubococcygeus muscle found that pelvic floor muscle function improved 6 months after vaginal delivery. Furthermore, revealed that almost all women who gave birth to their first child by vaginal delivery experienced partial denervation of the pelvic floor. One of the anatomic damages occur is levator ani muscle avulsion.[9] Suggested that there is no difference in basal tone and maximum levator ani contraction between primiparous women who experience avulsion and without avulsion experience.[10-13]

Vitamin D plays a major role in skeleton mineralization and plasma calcium concentration regulation. Vitamin D receptors (VDR) are present in skeletal muscle cells in orthopaedic patients. Immunohistochemical staining of VDR in skeletal muscle biopsy in women illustrates that the amount of VDR decreases with age. In vitro studies have specifically identified receptors for active vitamin D metabolites.[8]

Delivery process causes damages to levator ani muscle that, in turns, will become a predisposition for pelvic floor dysfunction when regeneration does not properly occur. The availability of sufficient vitamin D level is important for the regeneration of striated muscles. Since vitamin D deficiency incidence among women in Indonesia is still very high, it is necessary to assess the benefit of postpartum vitamin D3 supplementation on levator ani muscle strength. It is expected that the results of this study can be used as a clinical scientific reference to provide vitamin D3 supplementation in preventing pelvic floor muscle damages.

METHODS

Sampling was performed consecutively based on the order of arrival of patients who met the inclusion criteria until the minimum sample size was met. The sample size was determined based on the purpose of the study and the data type in the study. This study aimed to analyze differences in pelvic floor muscle strength in postpartum women with vitamin D3 deficiency after administration of vitamin D3 supplement for 3 months. Since the design of this study is correlative analysis, sample size was calculated statistically using 95% confidence level and a 95%. Power. The following formula for calculating sample size in correlative analytic research was used.

$$N = \left\{ \frac{Z\alpha + Z\beta}{0,5\ln\left[(1+r)/(1-r)\right]} \right\}^2 + 3$$

Where

Z_α = alpha standard deviation
Z_β = beta standard deviation
r = correlation coefficient

In this study, type 1 error of 5% was selected with a one-way hypothesis with Z_α = 1.65 while the type 2 error was established as 20% (Z_β 0.84) while r and S values used were based on the results of a study by Aydogmus et al. where r = 0.5. Hence, the sample size based on the calculation was as calculated below [14]

$$N = \frac{((1.65 + 0.84))^2}{0.5In(1+r)/(1-r)} = 30 + 3$$

Therefore, the minimum sample size for this study was 33 respondents.

RESULTS

Table 1. Subject Characteristics (n = 33)

Characteristics	Number	%
Age (years)		
< 20	9	27
20 – 34	24	73
Mean (SD)		
23.3 (4.7)		
Range		
16 – 31		
BMI (kg/m2)		
< 18.5	1	3
18.5 – 24.9	27	82
≥ 25	5	15
Mean (SD)		
22.3 (2.6)		
Range		
18.3 – 29.6		

Table 1 shows that most subjects in this study were between 20 and 34 years old (73%) with most of them had in normal nutrition status (82%).

Table 2. Comparison of Vitamin D3 Level, Basal Tone, and Maximum Pelvic Floor Muscle Contraction before and after Vitamin D3 Provision

Variable	Measurement		*P-value*
	before	after	
Vitamin D3(ng/mL)	10.7 (1.3)	28.5 (8.5)	<0.001*
Mean (SD)	11.2	25.0	
Median	7.7 – 12.0	17.4 – 55.0	
Range	8	-	
Severe deficiency	25	3	
Moderate deficiency Mild deficiency	-	15	
Normal	-	15	
Levator ani muscle strength (cmH_2O)			
Basal tone			
Mean (SD)	17.43 (4.6)	22.78 (3.9)	
Median	18.2	23.3	<0.001*
Range	10.0 – 25.2	12.1 – 28.1	
Maximum pelvic floor muscle contraction (cmH_2O)			
Mean (SD)	35.4 (10.8)	35.9 (9.2)	
Median	36.7	33.7	0.829**
Range	15.1 – 52.7	21.0 – 59.2	

Notes. **) Wilcoxon test;**) Paired t test. Vitamin D3 deficiency: severe (<10 ng/mL); moderate (10-19.9 ng/mL); Mild (20-29.99ng/mL); normal (≥ 30 ng/mL)*

Table 2 presents the differences in vitamin D3 level and contraction strength in primiparous women with vitamin D3 deficiency before and after vitamin D3 supplementation. It appears that a very significant increase in vitamin D3 levels is seen between before and after vitamin D3 supplementation (p <0.001) when compared to the median vitamin D3 level before supplementation. The level increased from 11.2 ng/mL to 25.0 ng/mL after supplementation. These changes in the level of vitamin D3 deficiency after supplementation had improved the vitamin D3 status of 15 women (45.5%) that had shifted into normal category. A significant difference in basal tone from a median of 18.2 cmH_2O to 23.3 cmH_2O after the administration of vitamin D3 was also seen.

DISCUSSION

This study aimed to determine the differences in levator ani muscle contraction strength in primiparous women with vitamin D3 deficiency before and after administration of vitamin D3 supplementation. Subjects were primiparous women up to 42 days postpartum who met the inclusion criteria and did not meet the exclusion criteria. Prospective subjects who were willing to participate in the study were asked to sign an informed consent and sampling was performed in Dr. Hasan Sadikin General Hospital and Public Health Centers from Cimahi area until the required sample size was reached.

The age of the subjects were between 16-31 years with the mean age of 23.3 years old. Several studies, including epidemiological data, support the hypothesis that age is a risk factor that affects levator muscle weakness and striated muscle regeneration process. A study conducted by Maclennan et al. reveals that the risk for pelvic floor muscle weakness increases with age.

The mean body mass index of the subjects was 22.33 kg/m^2, with the highest body mass index of 29.64 kg/m^2. Obesity is thought to increase the risk for levator ani muscle weakness as reflected that revealed a significant association betwen obesity and pelvic floor muscle strength.

Differences in Serum Vitamin D3 Level before and after Vitamin D3 Supplementation in Postpartum Primiparous Women who Experienced Vitamin D3 Deficiency

Vitamin D deficiency has been widely discussed as a global health problem because it does not only affect the musculoskeletal health but also lead to acute and chronic disease problems with an increased risk of cancer, autoimmune diseases, diabetes, and cardiovascular diseases.[15] Vitamin D deficiency is defined as a serum 25-hydroxyvitamin D concentration (25(OH) D) of <20 ng/mL (50 nmol/ L) while a serum concentration of 21-29 ng/mL (52–72 nmol/L) is defined as vitamin D insufficiency.[16]

Recent recommendation suggests that the lower threshold for adequate vitamin D levels should be a serum 25(OH) D level of 75–80 nmol/L. Although there is no clear safe upper threshold for vitamin D, recent reviews have suggested that the optimum level of 25(OH)D ranges from 75 to 110 nmol/L and this level can be maintained with vitamin D3 supplementation of 1,800 to 4,000 IU per day.[17]

In a study in Indonesia on women aged 45–75 years old, stated that 35.1% of the women experience vitamin D deficiency.[18] Several factors influence the occurrence of vitamin D deficiency in women of reproductive age and in pregnant women in their first trimester, including changes in the function of organs involved in the synthesis of 25(OH)D such as skin, liver, kidneys, and intestines, a lifestyle that tends to avoid sunlight, use of sunscreen; and low intake of foods containing vitamin D. Women of reproductive age and pregnant women during their first trimester need more attention because they are vulnerable to nutritional problems due to the physiological role of menstruation and childbirth. This vitamin deficiency can be overcome by increasing vitamin D synthesis through fortification, vitamin D supplementation, and exposure to sunlight.[19]

In this study primiparas with vitamin D3 deficiency were given vitamin D3 supplementation for 3 months. The median serum vitamin D3 level before D3 supplementation was 11.2 ng/mL (range: 7.7–12.0 ng/mL) which increases to 25 ng/mL (range: 17.4–55 ng/mL) after Vitamin D3 supplementation. This increase is proven to be very significant based on the result of the Wilcoxon test ($p < 0.001$).

Differences of Maximum Levator Ani Muscle Contraction Strength before and after Vitamin D3 Supplementation in Postpartum Primiparous Women with Vitamin D3 Deficiency

The effect of Vitamin D3 on muscle strength and muscle function has been shown in studies regarding striated muscles in animals and human. Pelvic floor muscle weakness can manifest clinically in the form of pelvic floor dysfunction symptoms.

In this study, the average maximum contraction strength of pelvic floor muscle before the provision of vitaminD3 supplement was 35.36 (SD 10.84) cmH2O, which increases to 35.86 (SD 9,18) cmH2O after supplementation. Analysis using paired t-test presents a p-value of 0.829 ($p>0.05$). This result is different from the results of several previous studies, which may be due to, among others, racial differences, time of measurements, and postpartum nutrition. Several studies have stated that the elasticity of levator ani muscle is influenced by race. A study on 25 primiparas and 20 multiparas with spontaneous

vaginal delivery at 36–42 week gestational age, 3–8 das postpartum, 6–10 weeks postpartum, and 9–15 months postpartum shows different results even for the same subject. According to Lien et al., perimetry examination can be affected by intraabdominal pressure during examination and pain during contraction can also create bias during examination.[20, 21]

Differences in Basal Tone Strength before and after Vitamin D3 Supplementation in Postpartum Primiparous Women with Vitamin D3 Deficiency

Vitamin D3 affects the strength and function of skeletal muscles. Vitamin D3 deficiency has been linked to muscle weakness. Levator ani and coccygeus muscles are important components of the pelvic floor and can be affected by the vitamin D3 status. In this study, an analysis was performed using the Wilcoxon test and a p-value of <0.001 was obtained. The median basal tone value before vitamin D3 supplementation in this study was 18.2 (range: 10-25.2 cmH2O) which increases to 23.3 after vitamin D3 supplementation (range: 12.1–28.1 cmH_2O). This is a very significant increase. A study in Turkey on 156 pregnant women revealed that there is a relationship between antepartum vitamin D level and pelvic floor muscle strength. Women with normal vitamin D level have a significantly higher postpartum pelvic floor muscle strength. Low vitamin D level in the third trimester is associated with a decrease in postpartum pelvic floor muscle strength. This brings to a conclusion that a low vitamin D level in the third trimester correlates with decreased pelvic floor muscle strength. Vitamin D3 affects skeletal muscle strength and function through various mechanisms. Strength and/or functional dysfunction of the pelvic floor muscles may be related to the distortion of pelvic floor function.[14]

CONCLUSION

A significant increase is seen in serum vitamin D level before and after vitamin D supplementation for 3 months in postpartum primiparas with vitamin D deficiency. Provision of vitamin D3 supplementation does not increase the maximum contraction strength of levator ani muscle. Provision of Vitamin D3 supplementation increases the basal tone.

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